SECTION EM
ENGINE MECHANICAL

CONTENTS

CR

HR

K9K

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

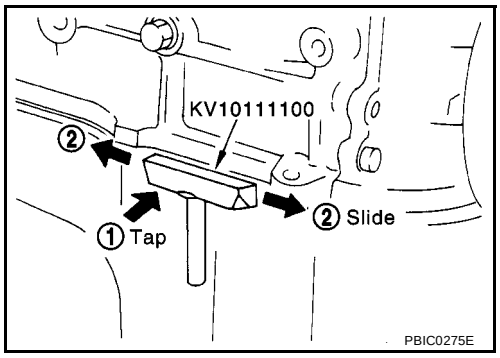
EBS00OEH

REMOVAL OF LIQUID GASKET SEALING

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

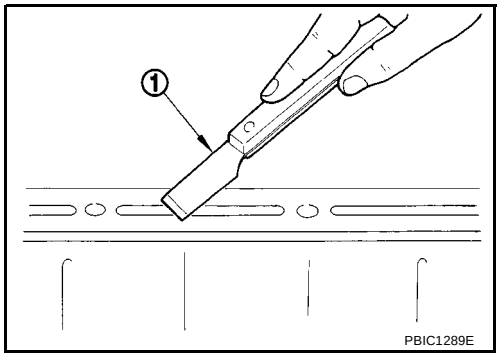
  CAUTION:
  Be careful not to damage the mating surfaces.
- In positions where a seal cutter is difficult to use, lightly tap with a plastic hammer and remove.

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

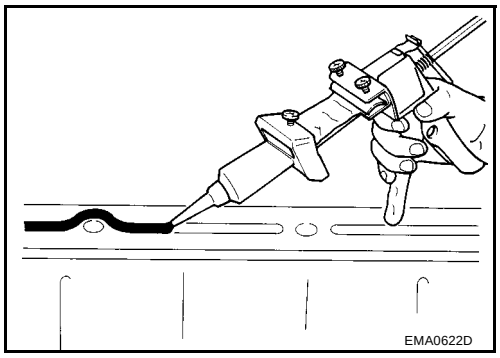


LIQUID GASKET APPLICATION PROCEDURE

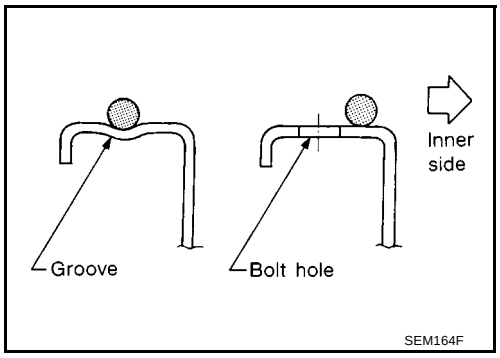
1. Using a scraper (1), remove any old liquid gasket remaining on the gasket application surface and its mating surface.
   - Remove any old liquid gasket remaining in the gasket application groove and on the threads of bolts and bolt holes.
2. Using white gasoline, wipe the gasket application surface 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.



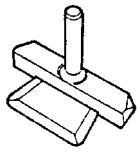
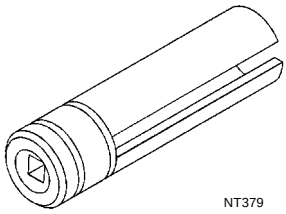
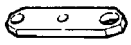
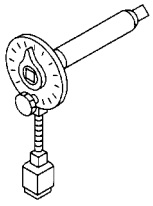
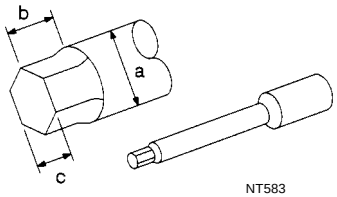
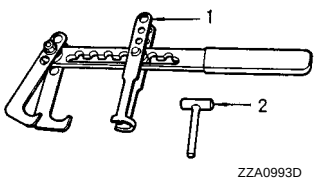
CAUTION:
Follow all specific instructions in this manual.

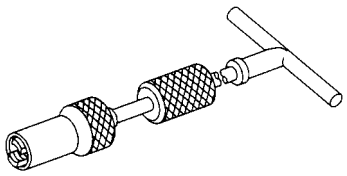
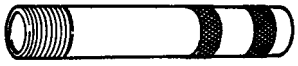
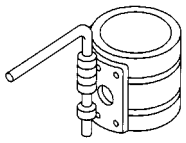
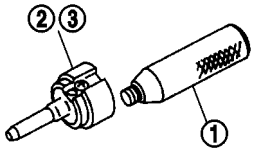
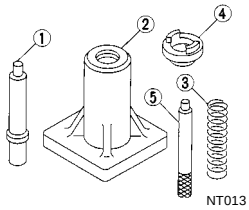
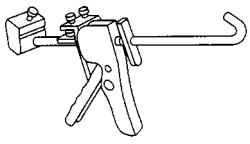
PREPARATION

PFP:00002

Special Service Tools

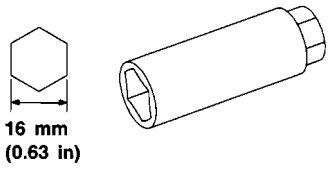
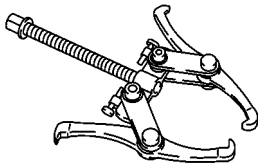
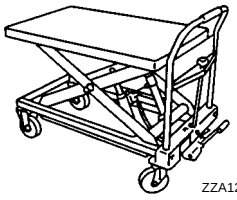
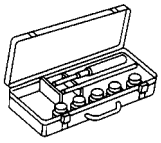
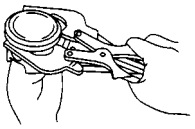
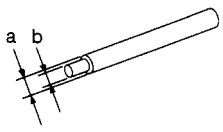
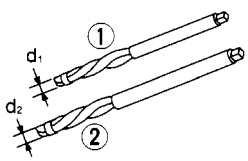
EBS00OEI

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

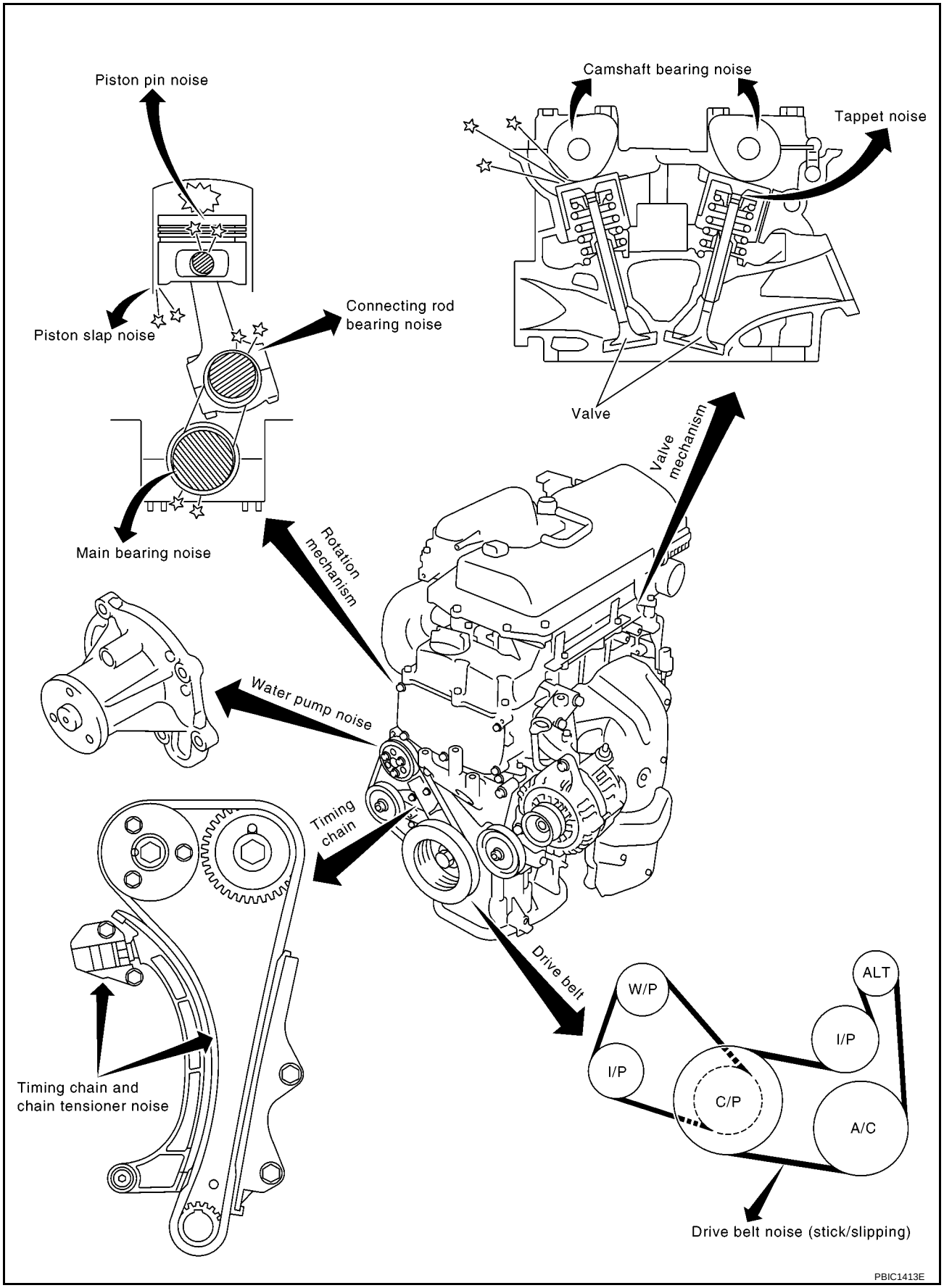
Tool name	Description
Spark plug wrench  NT047	Removing and installing spark plug
Crankshaft pulley puller  PBIC0887E	Removing crankshaft pulley
Manual lift table caddy  ZZA1210D	Removing and installing engine
Valve seat cutter set  NT048	Finishing valve seat dimensions
Piston ring expander  NT030	Removing 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-47
	Rattle	C	A	—	A	B	C	Camshaft bearing noise	Camshaft journal clearance Camshaft runout	EM-45 EM-44
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-86 EM-88
	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-89 EM-86 EM-87 EM-87
	Knock	A	B	C	B	B	B	Connecting rod bearing noise	Connecting rod bushing clearance (Small end) Connecting rod bearing clearance (Big end)	EM-88 EM-88
	Knock	A	B	—	A	B	C	Main bearing noise	Main bearing oil clearance Crankshaft runout	EM-92 EM-91
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-53 EM-51
Front of engine	Squeaking or fizzing	A	B	—	B	—	C	Drive belts (Sticking or slipping)	Drive belts deflection	EM-14
	Creaking	A	B	A	B	A	B	Drive belts (Slipping)	Idler pulley bearing operation	
	Squall Creak	A	B	—	B	A	B	Water pump noise	Water pump operation	CO-23, "WATER PUMP"

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

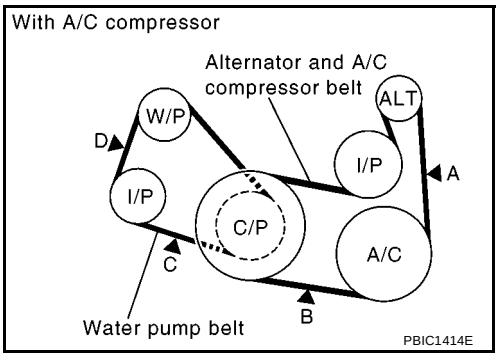
DRIVE BELTS

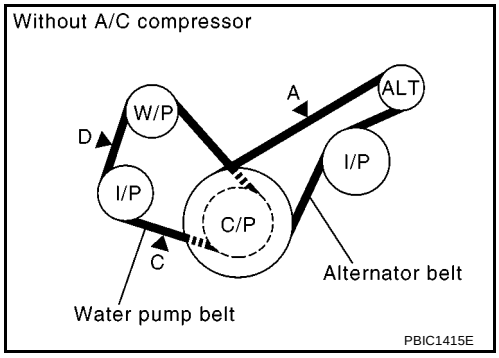
PFP:02117

Checking drive Belts

EBS00OGC

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

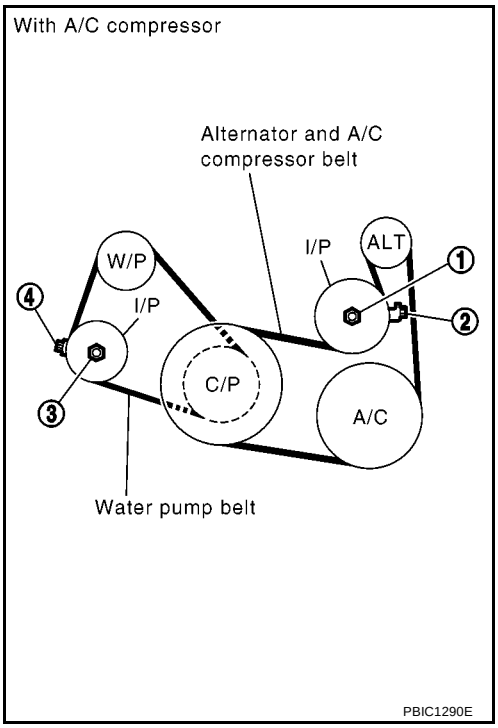
- **When the belt is replaced with new one, adjust the belt tension to the value for “New belt”, because new belt will not fully seat in the pulley groove.**
- **When tension of the belt being used exceeds “Limit”, adjust it to the value for “At adjustment”.**
- **When installing a belt, make sure that 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-14, "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-38, "Checking Drive Belts" .

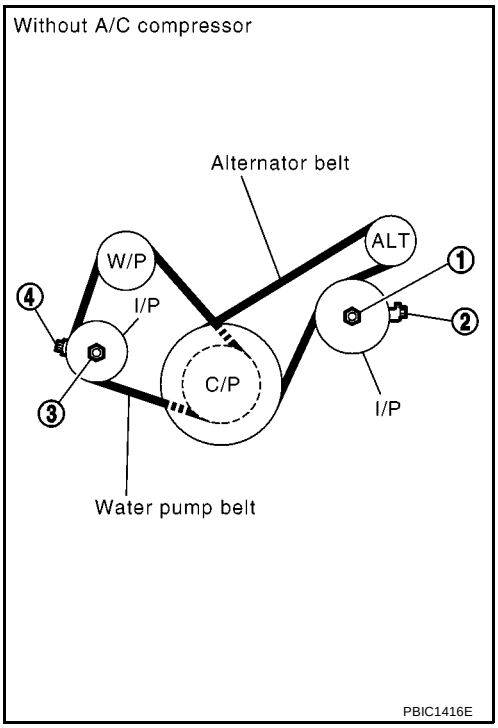


ALTERNATOR BELT (WITHOUT A/C MODELS)

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-14, "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-38, "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-14, "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-38, "Checking Drive Belts" .

Removal and Installation

EBS00OGE

REMOVAL

- Fully loosen each belt while referring to EM-14, "Tension Adjustment" . Remove them one by one, starting with the one in the front.

INSTALLATION

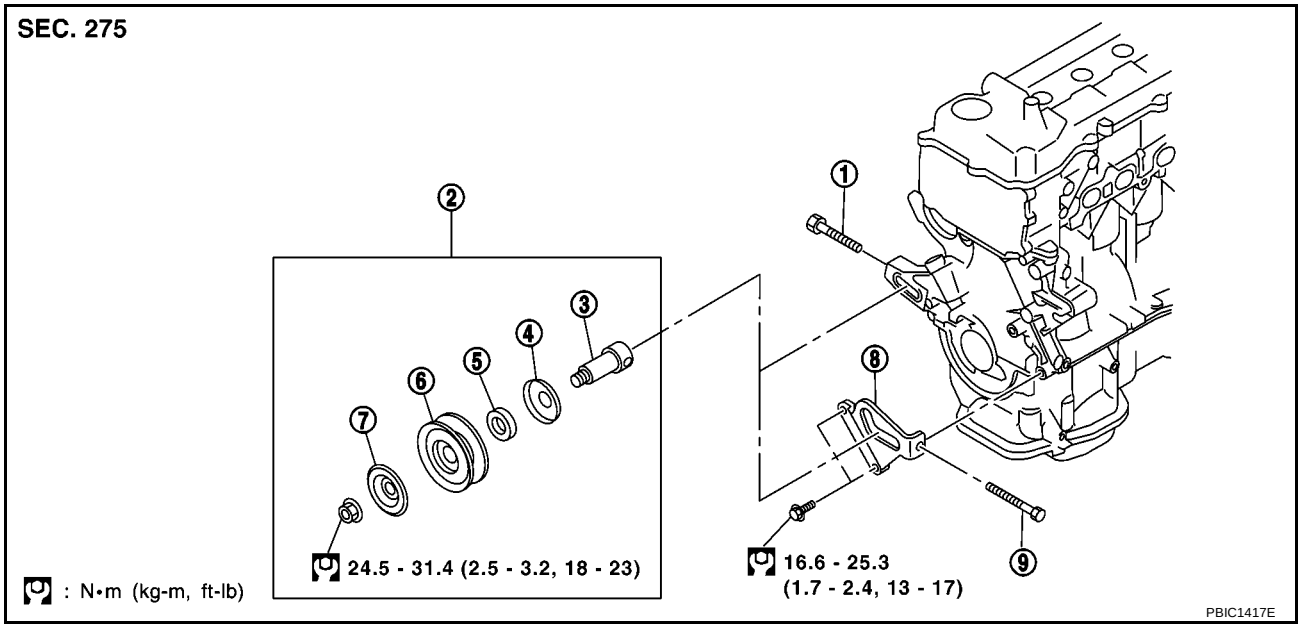
1. Install belts to the pulley in the reverse order of removal.

   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-16, "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.

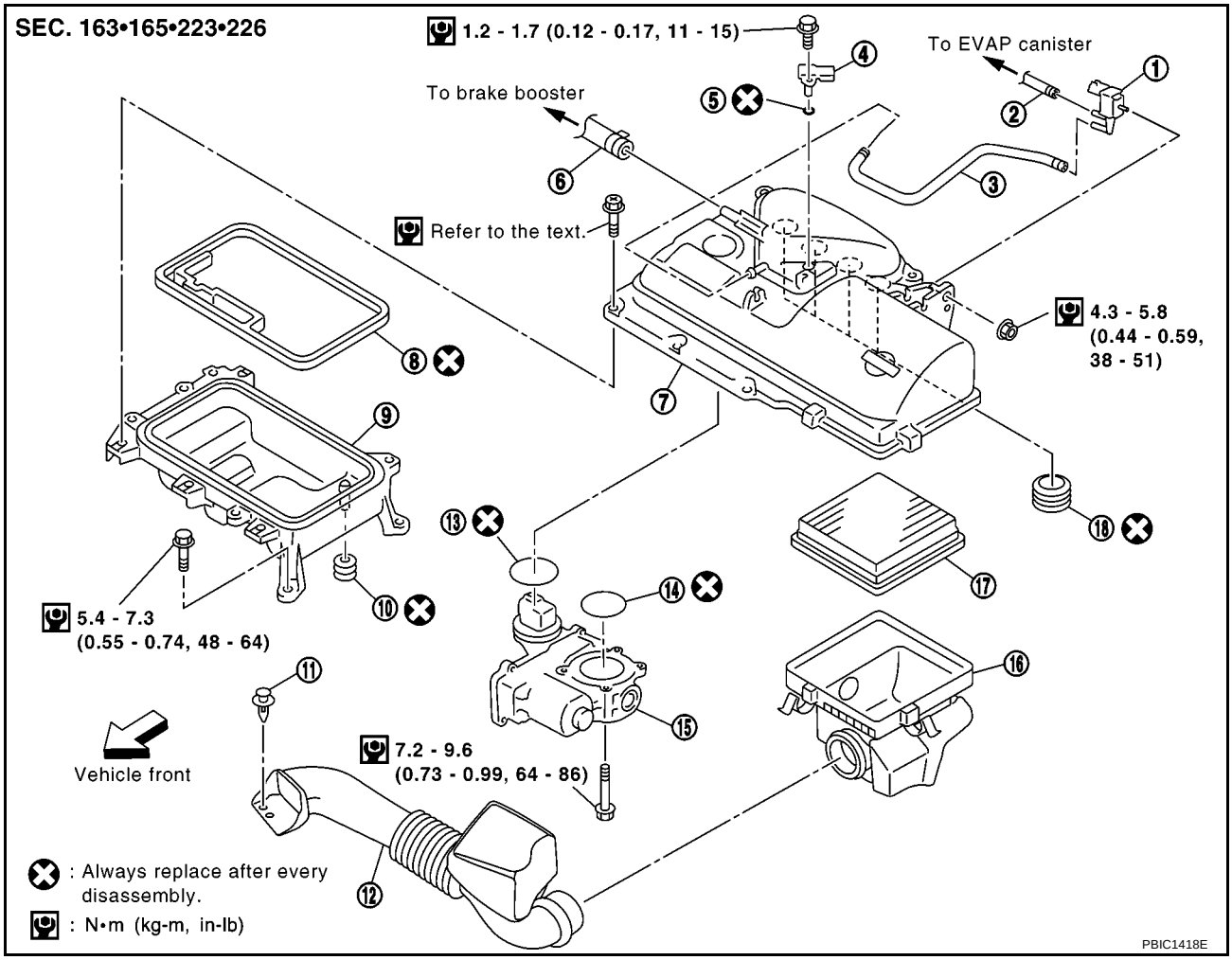
   CAUTION:
   - **Make sure belt is correctly engaged with the pulley groove.**
   - **Check for oil and coolant on belt and each pulley groove.**
2. Adjust belt tension. Refer to EM-14, "Tension Adjustment" .
3. Tighten each adjusting bolt and nut to the specified torque.
4. Make sure that tension of 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.)**

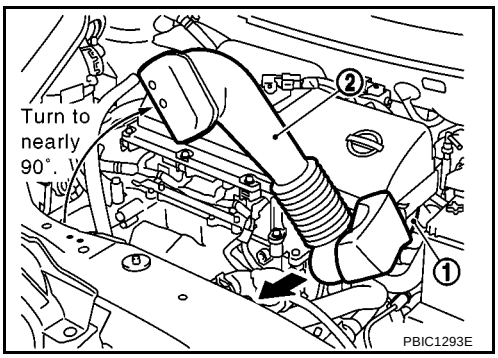
2. Remove the harness connector and vacuum hose and then the EVAP canister purge volume control solenoid valve.

   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).

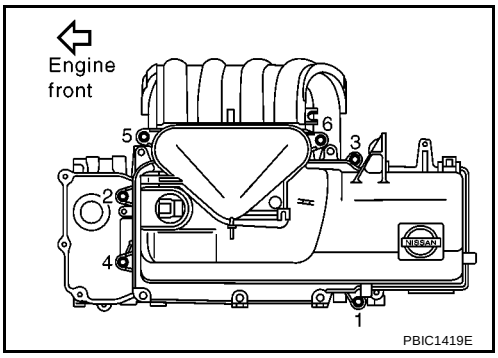


4. Remove the clips, pull the air cleaner body down then forward, and then remove the air cleaner body and the air cleaner filter.

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.

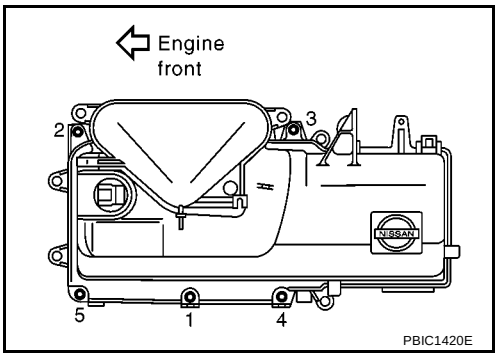
a. Separate the harness connector from the electronic throttle control actuator.
b. Separate the brake booster vacuum hose.
c. Loosen bolts in the reverse of the order shown in figure.



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).



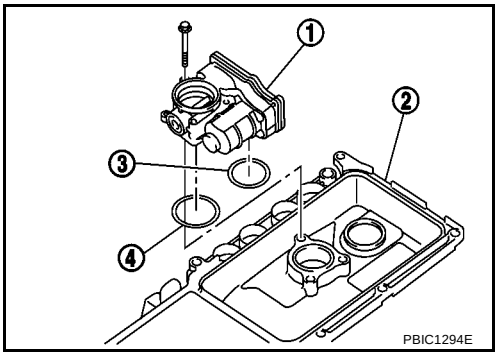
9. Remove the electronic throttle control actuator from the air cleaner case (upper).
   - Turn the air cleaner case (upper) over on the protective sheet to make sure the surface does not get scratched.
   - The electronic throttle control actuator should be handled with the following precautions in 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-49, "Throttle Valve Closed Position Learning" (WITH EURO-OBD), EC-479, "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-49, "Idle Air Volume Learning" and EC-49, "Throttle Valve Closed Position Learning" (WITH EURO-OBD), EC-479, "Idle Air Volume Learning" and EC-479, "Throttle Valve Closed Position Learning" (WITHOUT EURO-OBD).

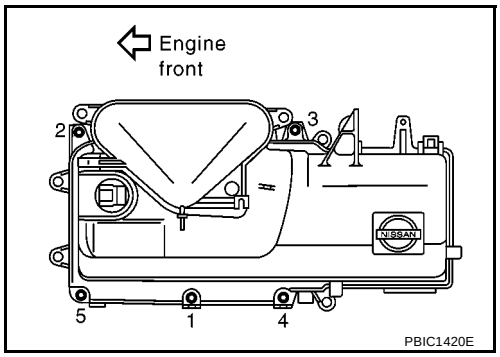
2. Assemble the air cleaner case (upper) and (lower).
   - Tighten bolts evenly in two steps in the order shown in figure.

   1st step

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

   2nd step

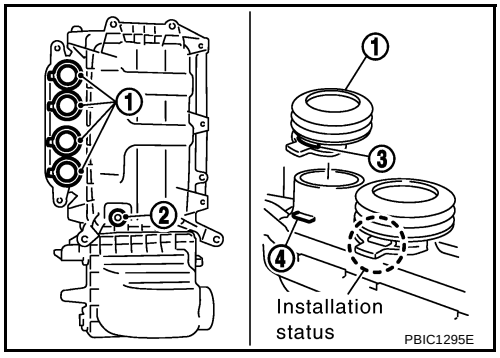
   : 3.8 - 4.4 N·m (0.40 - 0.44 kg-m, 35 - 38 in-lb)



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.

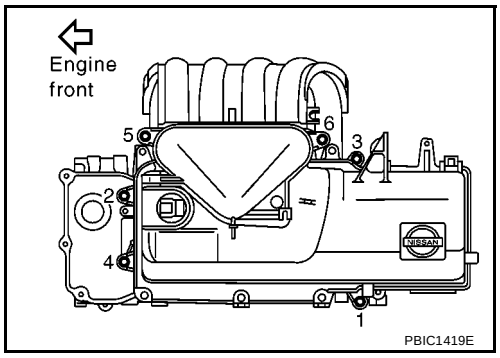
b. Insert the air cleaner case assembly into the intake manifold.
   - At the same time, insert the bottom path protrusions into the PCV path holes on the rocker cover.



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-21, "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.

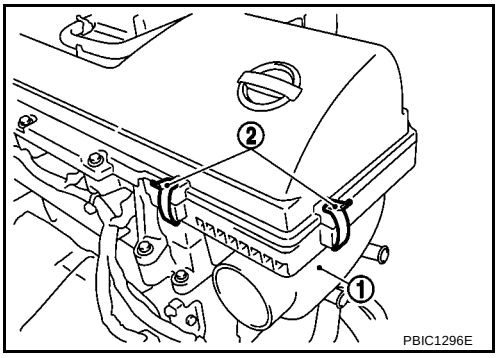
Changing Air Cleaner Filter

EBS00OEP

REMOVAL

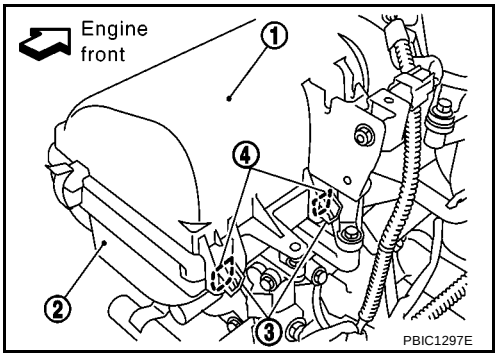
1. Remove air duct. Refer to EM-18, "REMOVAL" .
2. Remove clips (2) of air cleaner body (1).
3. After moving the air cleaner body downward, remove it by pulling it forward.
   - While pressing down the radiator upper hose, remove air cleaner body (1).
4. Remove air cleaner filter from the air cleaner 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.

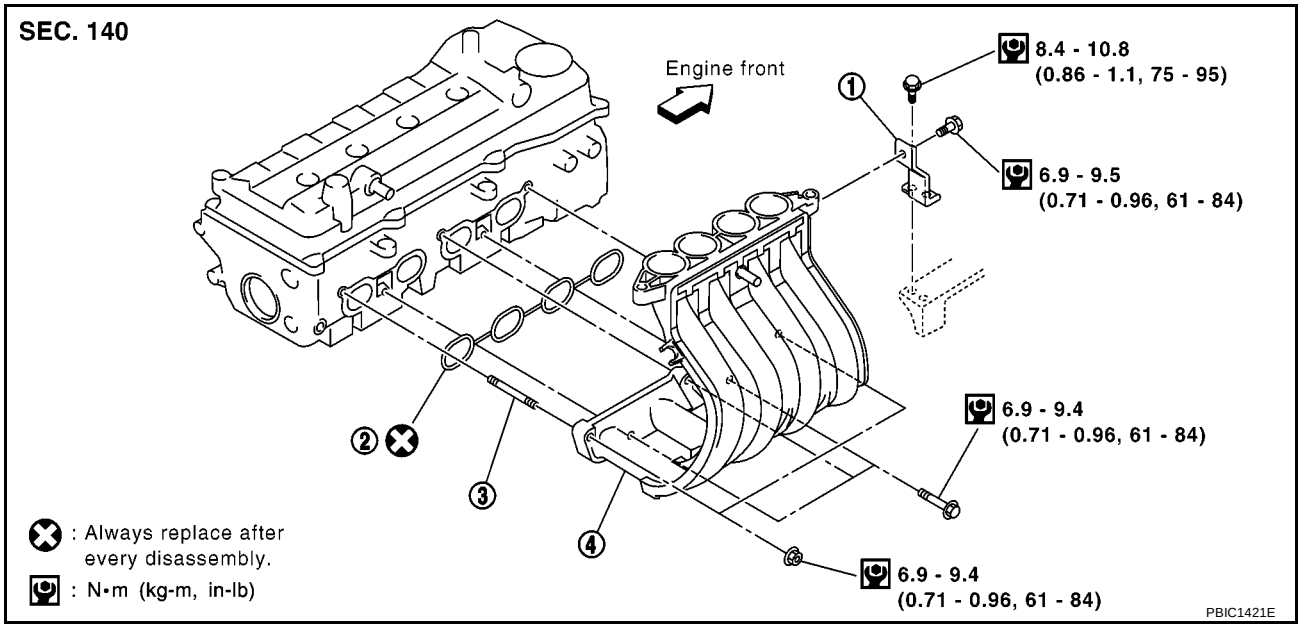


INTAKE MANIFOLD

PFP:14003

Removal and Installation

EBS00OEQ

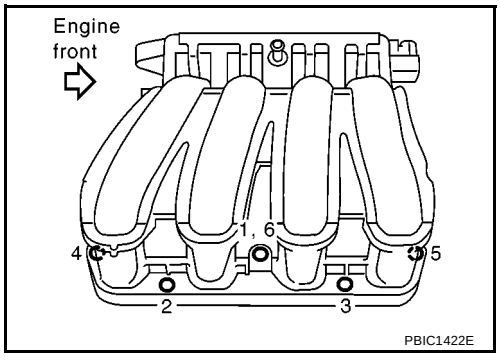


1. Support bracket
2. Gasket
3. Stud bolt
4. Intake manifold

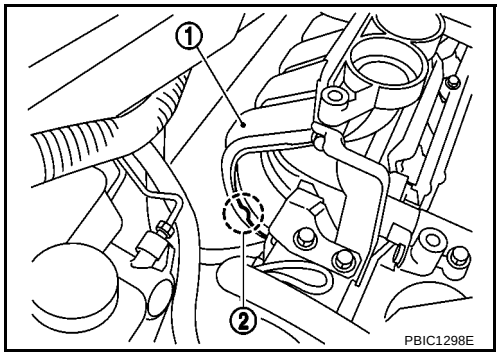
REMOVAL

1. Remove air duct and air cleaner case assembly. Refer to EM-18, "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)



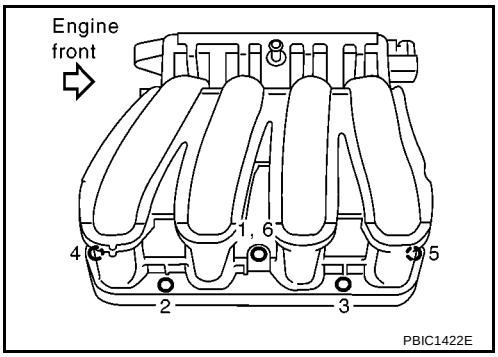
INSTALLATION

- 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-33, "INSTALLATION" .

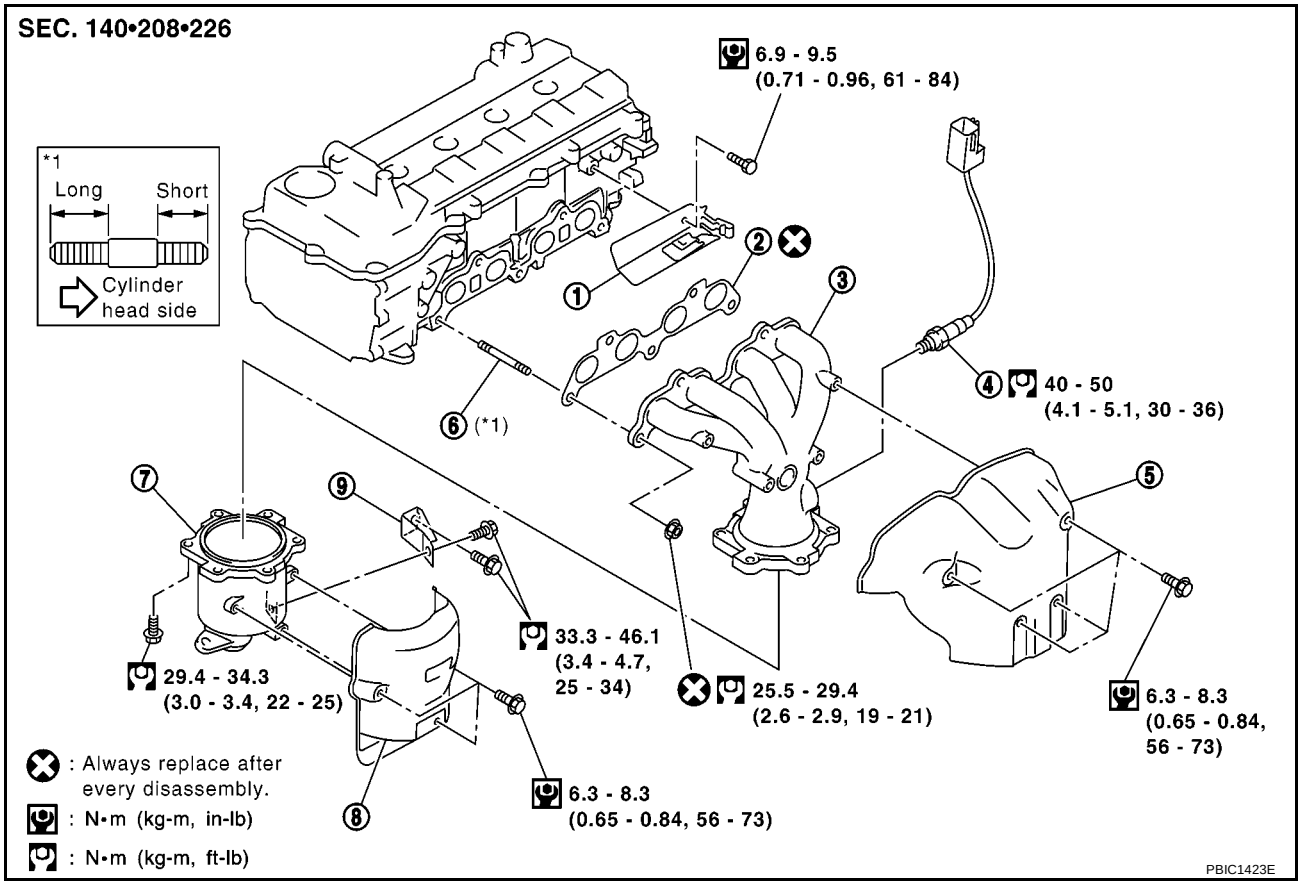


EXHAUST MANIFOLD AND THREE WAY CATALYST

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

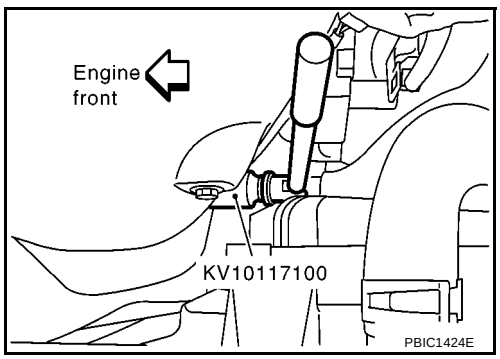
1. Remove air duct. Refer to EM-18, "AIR CLEANER AND AIR DUCT" .
2. Remove RH front fender protector.
3. Remove alternator and A/C compressor belt. Refer to EM-14, "DRIVE BELTS" .
4. Remove A/C compressor with piping connected, move A/C compressor to body side and secure it onto body with a rope.
5. Remove exhaust front tube connection at front. Refer to EX-4, "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.

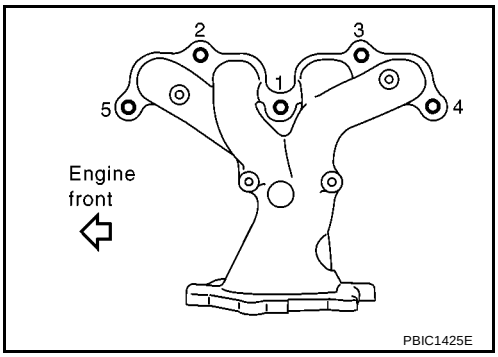
   CAUTION:
   - **Handle it carefully, avoid any chance of impact caused by dropping.**



- **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.

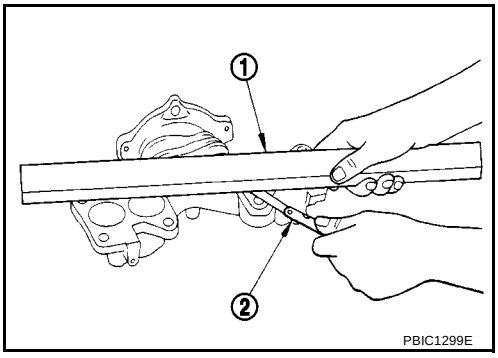
INSPECTION AFTER REMOVAL

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.

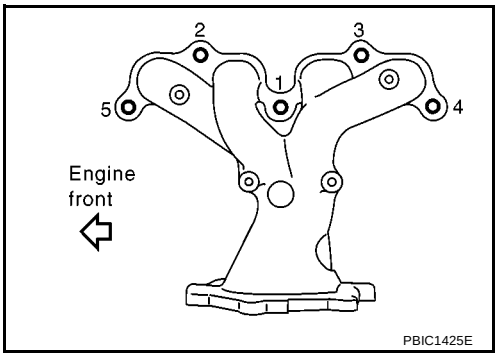


INSTALLATION

- 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:

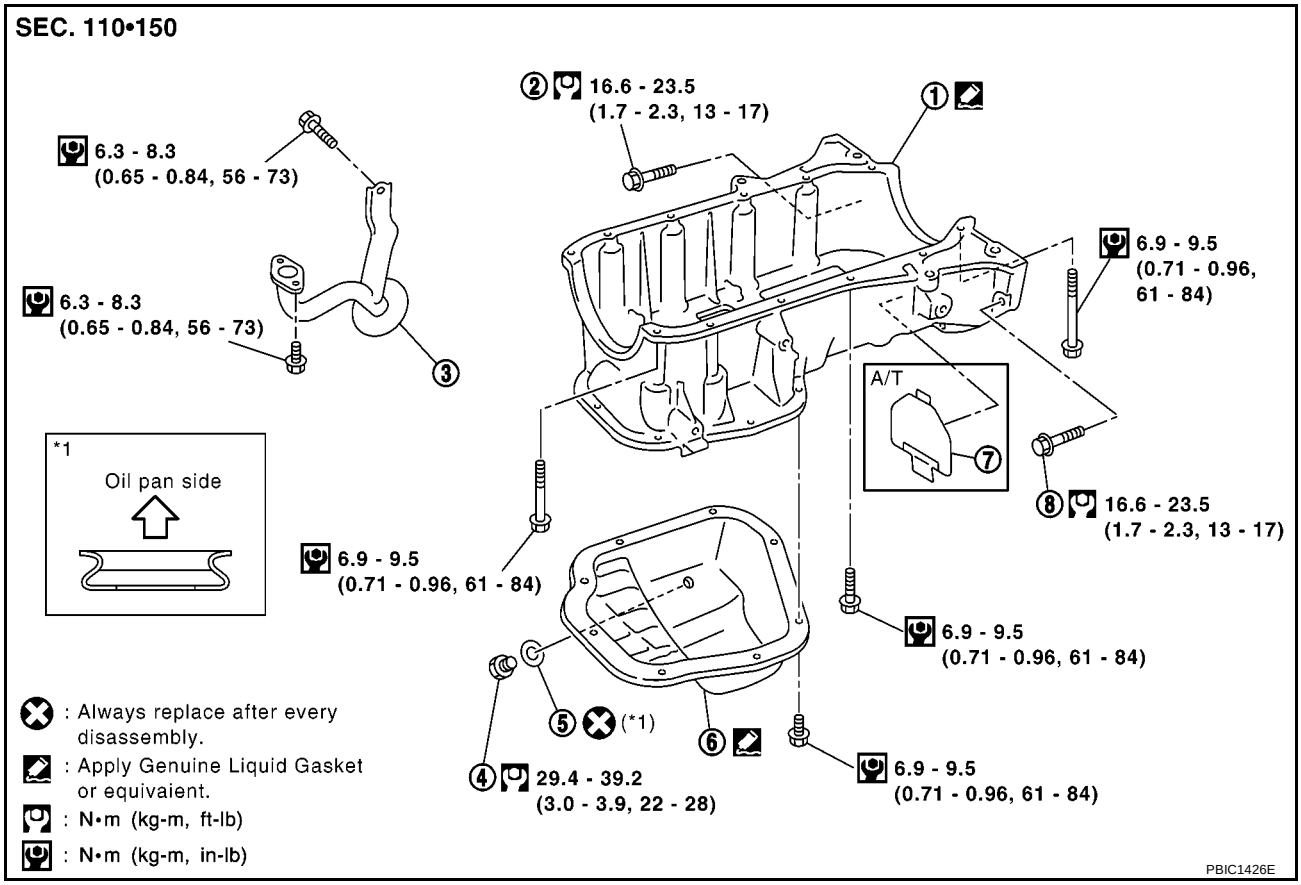
- **Do not over torque the heated oxygen sensor. Doing so may cause damage to the heated oxygen sensor, resulting in the MI coming on.**

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

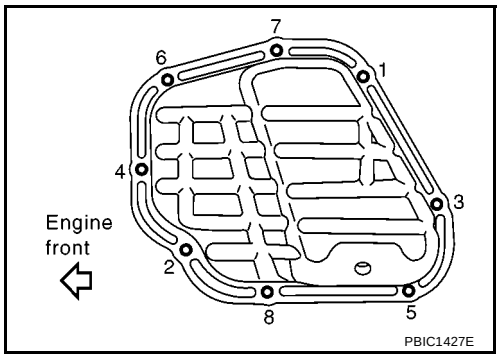
NOTE:

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-14, "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.

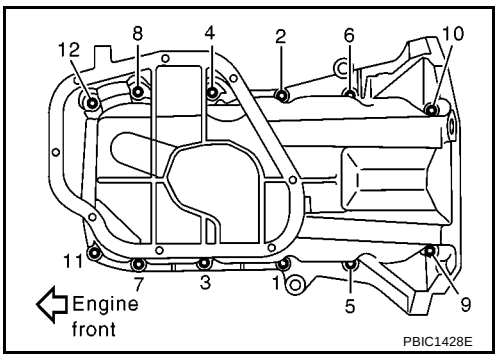
7. Remove the exhaust front tube. Refer to EX-4, "EXHAUST SYSTEM" .

8. Remove three way catalyst support. Refer to EM-24, "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-61, "Removal and Installation" .
b. Lift with a hoist and position engine.
c. Remove transaxle. Refer to EM-70, "Removal and Installation" .

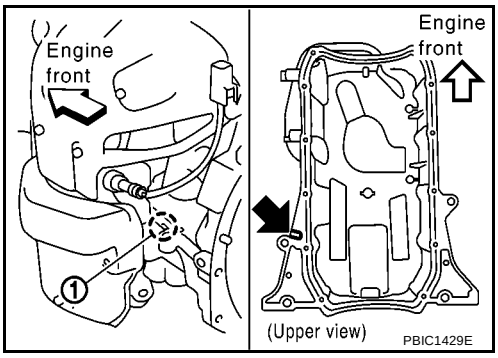
10. Remove oil pan (upper) with the following procedure.

a. Remove oil pan (upper) to transaxle connecting bolts (A/T models). Refer to AT-357, "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

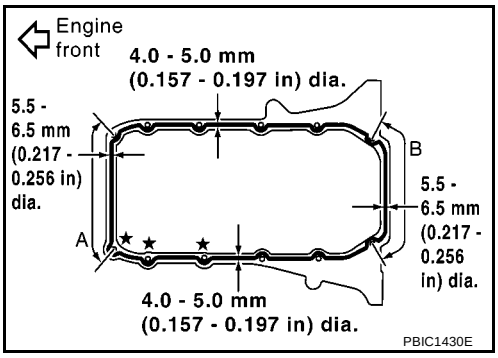
1. Install oil strainer.

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.

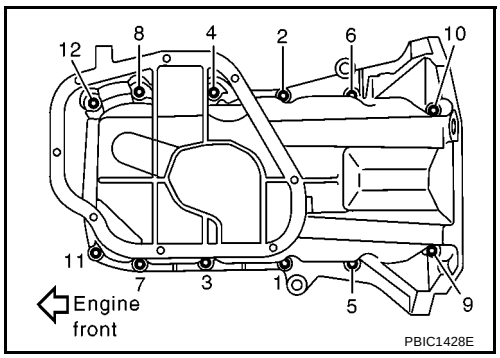
CAUTION:
- **For bolt holes with ★ marks (3 locations), apply liquid gasket outside the holes.**
- **Apply a bead of 5.5 to 6.5 mm (0.127 - 0.256 in) in diameter to area “A” and “B”.**



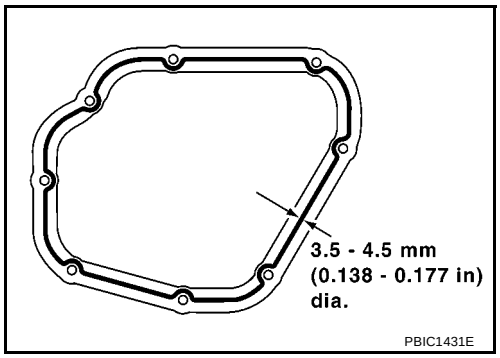
b. Tighten bolts in the numerical order shown in figure.

NOTE:
See below for mounting positions of bolts

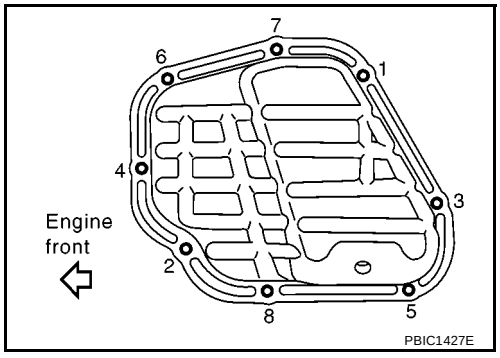
Under head 70 mm (2.76 in) : 4, 8, 12
Under head 90 mm (3.54 in) : 9,10
Under head 25 mm (0.98 in) : Other than the above



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-26, "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

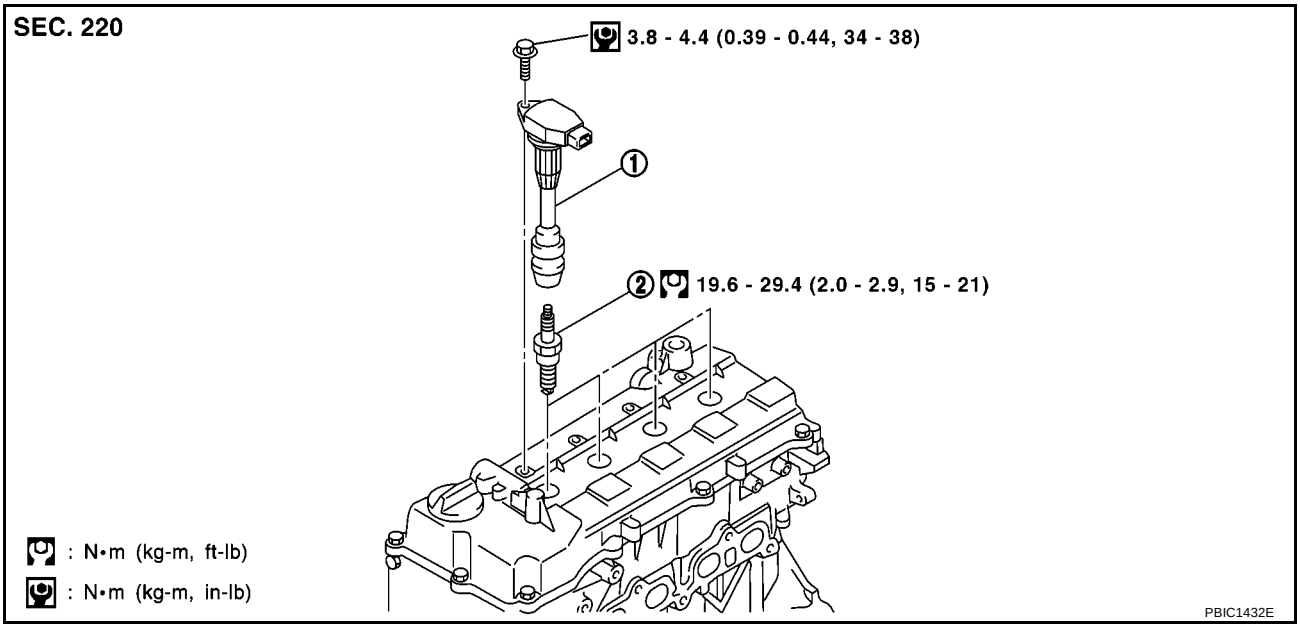
- Check engine oil level. Refer to LU-6, "ENGINE OIL" .
- Warm up engine and check the oil amount and no leakage of oil. Refer to LU-6, "ENGINE OIL" .

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-18, "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

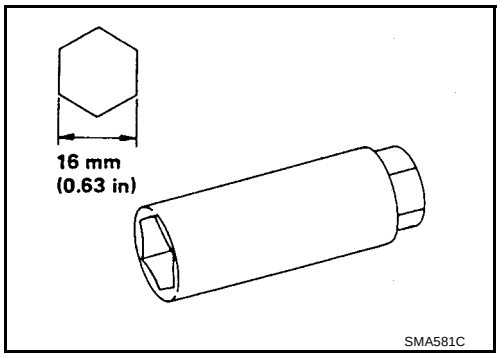
Removal and Installation

EBS00OEU

REMOVAL

1. Remove ignition coil. Refer to EM-29, "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)

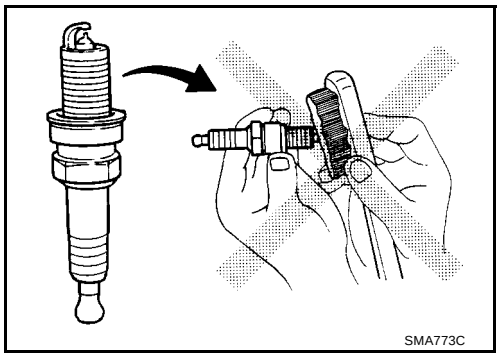
CAUTION:
- **Do not use a wire brush for cleaning.**
- **If plug tip is covered with carbon, spark plug cleaner may be used.**

Cleaner air pressure:

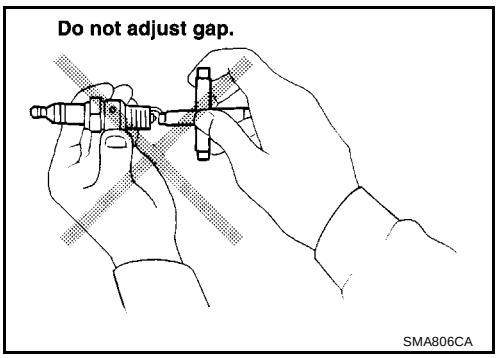
Less than 588 kPa (6 kg/cm^2 , 85 psi)

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

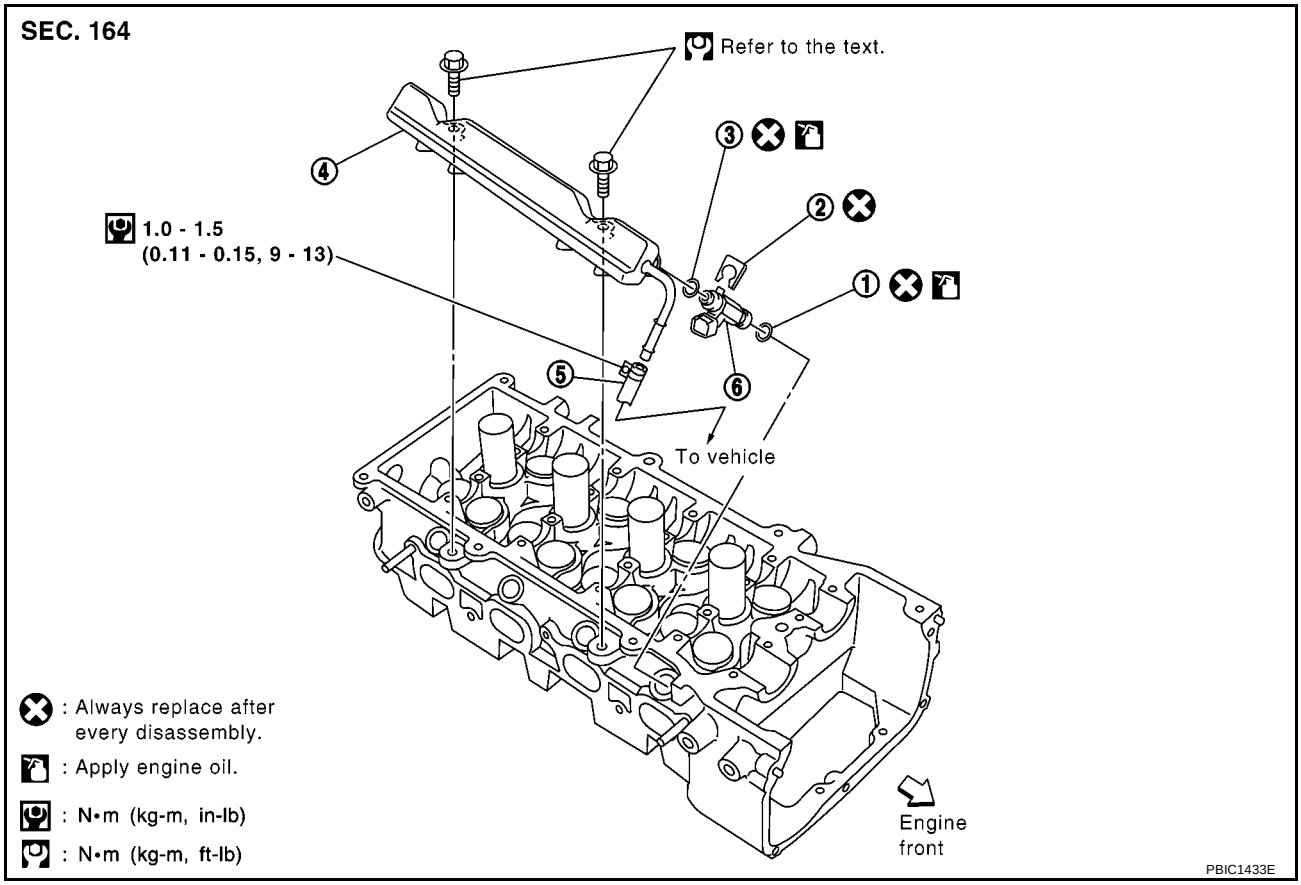
: 19.6 - 29.4 N·m (2.0 - 3.0 kg-m, 15 - 21 ft-lb)

FUEL INJECTOR AND FUEL TUBE

PFP:16600

Removal and Installation

EBS00OGG



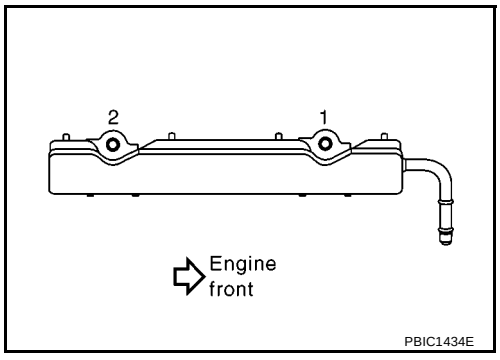
1. O-ring (brown)
2. Clip
3. O-ring (black)
4. Fuel tube
5. Fuel feed hose
6. Fuel injector

REMOVAL

1. Release fuel pressure. Refer to EC-51, "FUEL PRESSURE RELEASE" (WITH EURO-OBD), EC-482, "FUEL PRESSURE RELEASE" (WITHOUT EURO-OBD).
2. Remove air duct and air cleaner case assembly. Refer to EM-18, "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.**



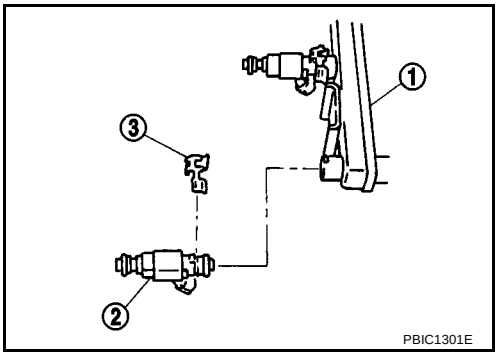
7. Remove the fuel injector (2) from the fuel tube (1) in the following order.

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).

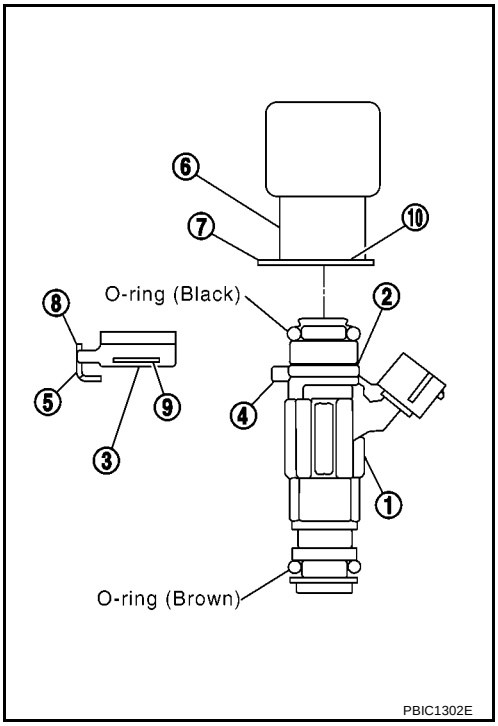
CAUTION:

- **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.

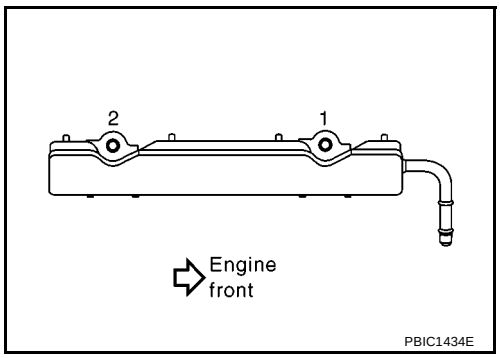
- Tighten bolts evenly in two steps in the order shown in figure.

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.

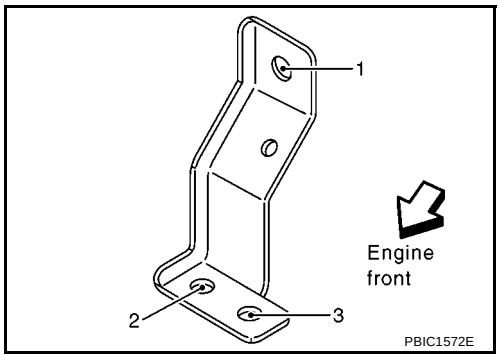
- Tighten mounting bolts in the following order.
  - Tighten bolts temporarily in numerical order shown in the figure.
  - Tighten bolts to the specification in numerical order shown in the figure.

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.

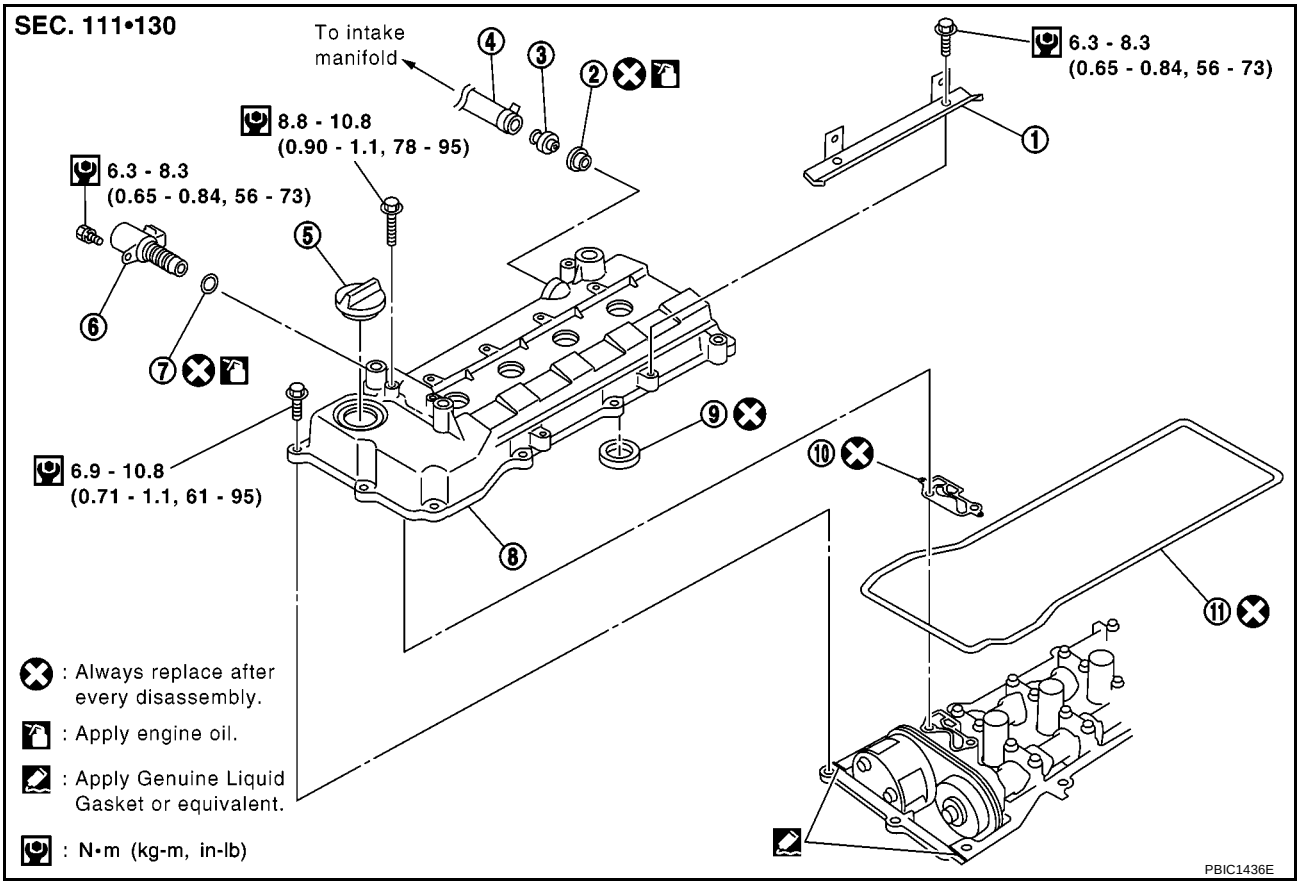
1. Turn the ignition switch to ON (do not start engine), and with fuel pressure applied in the fuel line, check to make sure there no fuel leaks from the connection.
2. Start the engine, and with the increased speed, check again to see if there are any fuel leaks from the connection.

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	

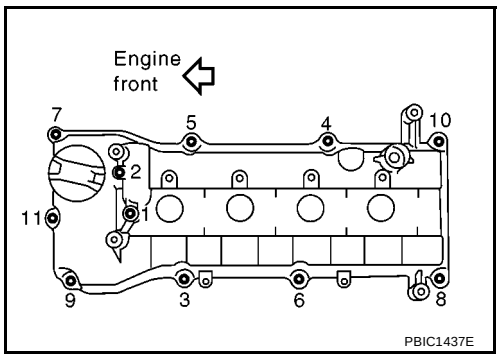
REMOVAL

1. Remove air duct and air cleaner case assembly. Refer to EM-18, "AIR CLEANER AND AIR DUCT" .
2. Remove RH engine mount stay. Refer to EM-70, "Removal and Installation" .

   NOTE:
   It is not necessary to support the engine using a jack.
3. Remove ignition coil. Refer to EM-29, "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.

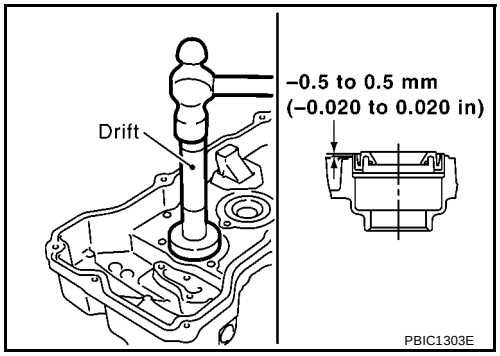


9. Remove the rocker cover oil seal using a screwdriver.

CAUTION:
Be careful not to damage the rocker cover.

INSTALLATION

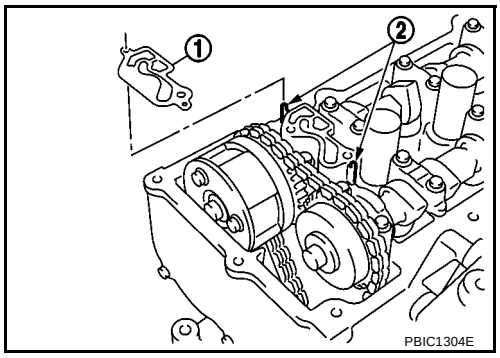
1. Install rocker cover oil seal.
   - Using drift with outer diameter 97 mm (3.82 in) and inner diameter 83 mm (3.27 in) to 88 mm (3.46 in), press oil seal in.
   - Press-fit the oil seal evenly to the mounting surface.



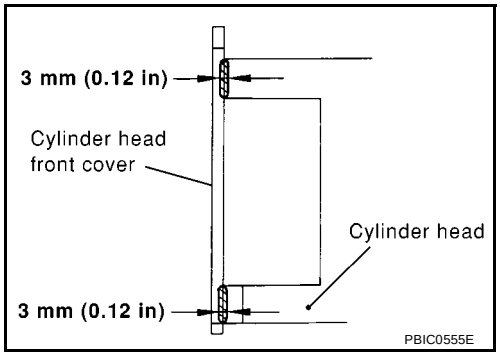
2. Install the rocker cover in the following procedure:

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.



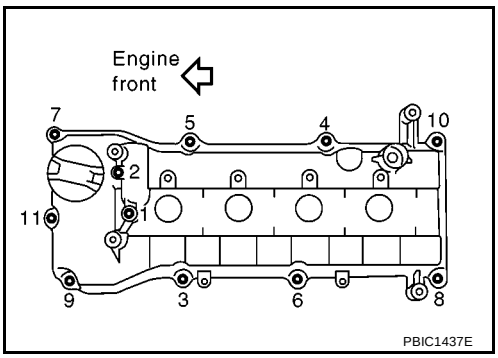
c. Apply the liquid gasket to the position shown in figure.
Use Genuine Liquid Gasket or equivalent.



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)



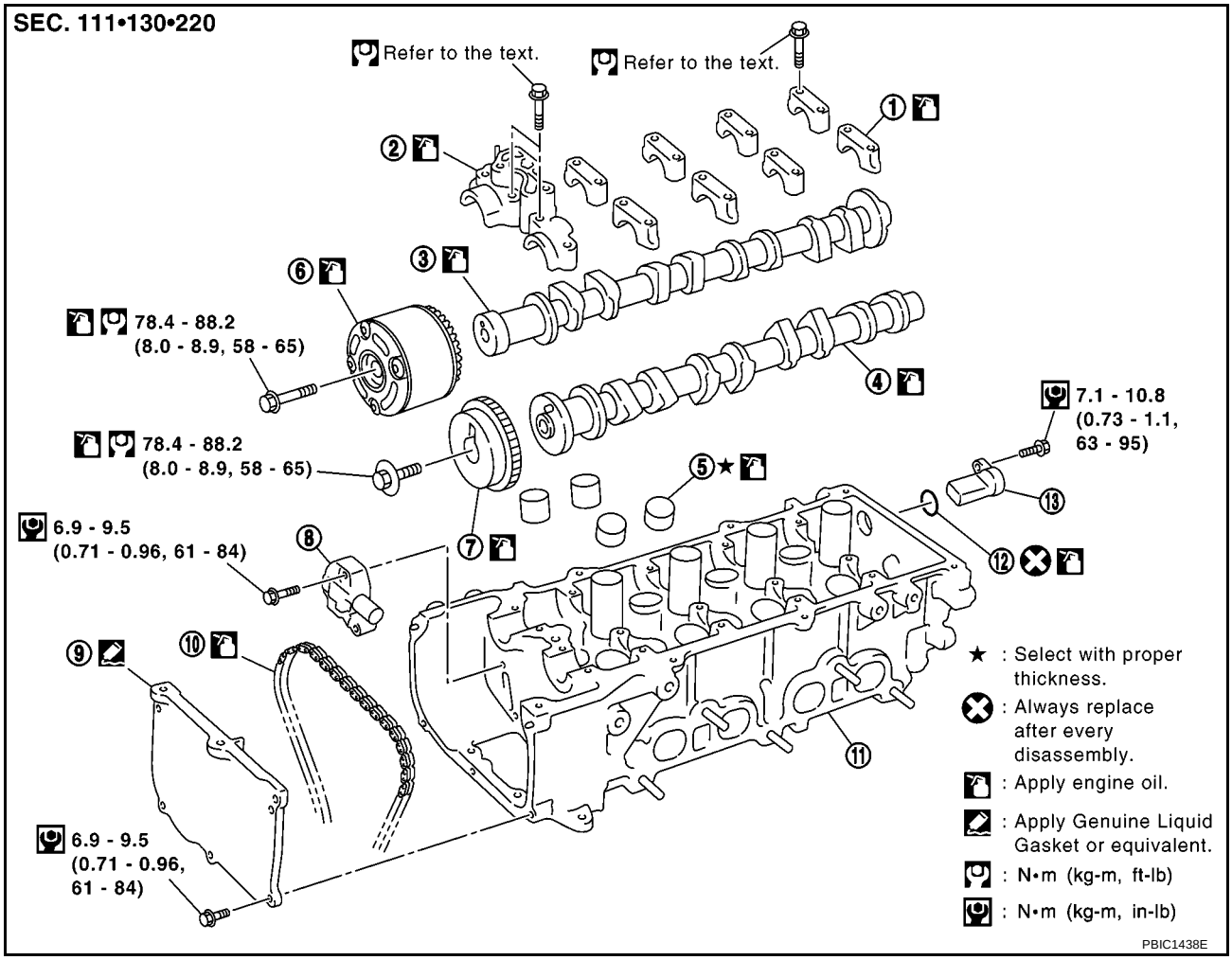
3. Install intake valve timing control solenoid valve.
   - Make sure no foreign particles attach to the flange, O-ring, or attachment hole.
   - Tighten the mounting bolt after making sure it is fully inserted into the mounting hole.
4. Install PCV control valve.
   - Insert until the flange is flush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

CAMSHAFT

PFP:13001

Removal and Installation

EBS00OEY



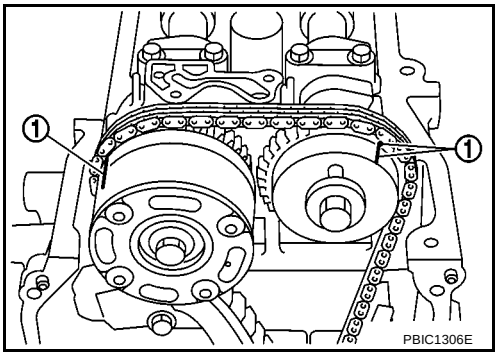
1. Camshaft bracket (No. 2 - 5)
2. Camshaft bracket (No. 1)
3. Camshaft (intake)
4. Camshaft (exhaust)
5. Valve lifter
6. Camshaft sprocket (intake)
7. Camshaft sprocket (exhaust)
8. Chain tensioner
9. Cylinder head front cover
10. Timing chain
11. Cylinder head
12. O-ring
13. Camshaft position sensor (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-70, "Removal and Installation" .
   - Mount engine slingers and hook with hoist. Refer to EM-70, "Removal and Installation" .
   - Support the oil pan bottom with a jack stand, etc.
3. Remove rocker cover. Refer to EM-35, "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-7, "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

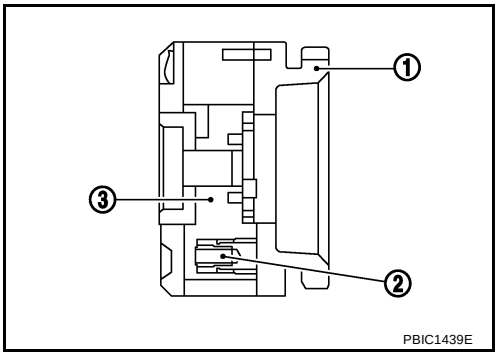
a. Turn the crankshaft pulley clockwise.
b. When doing this, make sure both the intake and exhaust cam noses on cylinder No. 1 are facing outwards. (No. 1 cylinder at TDC of its compression stroke)
c. Confirm mating marks (1) stamped on intake and exhaust sprockets are located as shown.
   - If there is no position mark at the position in the figure, turn the crankshaft pulley once more to position them as in the figure.
d. 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).**

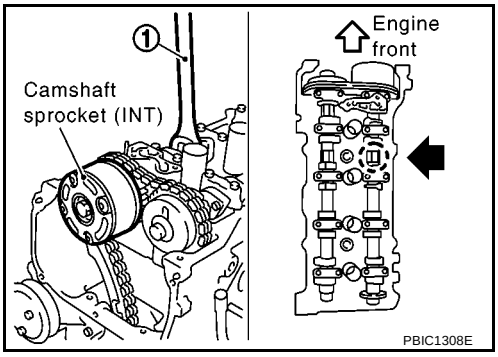


- Put the intake camshaft sprocket in the most advance position in the following steps.

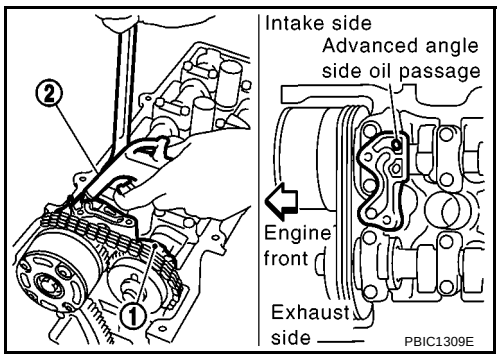
CAUTION:
The chain tensioner must not be removed before doing this step.

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

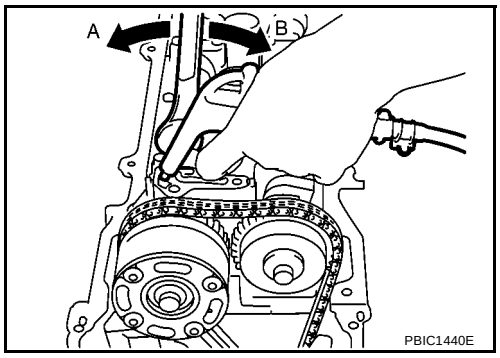
NOTE:
The air pressure is used to move the lock pin into the disengage position.

- 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.

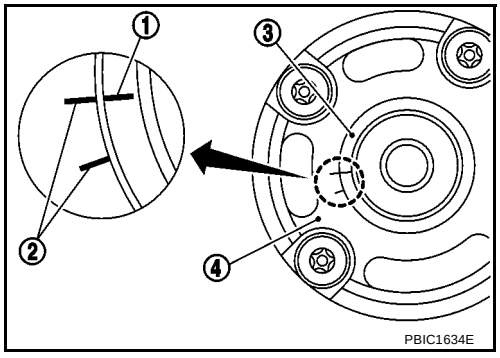
CAUTION:
Also be sure the wrench immobilizing the camshaft does not come loose.

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.

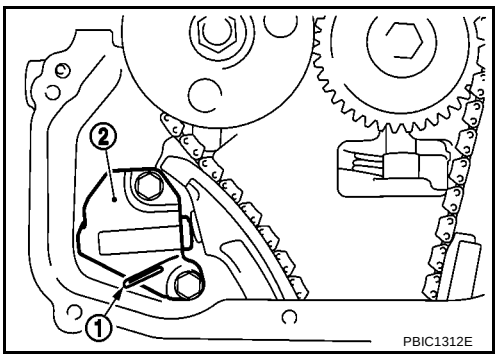
- Keep the air pressure on.
- If there is no click, as soon as the vane (camshaft coupling) starts moving independently of the camshaft sprocket, the lock pin has become disengaged.
- If the lock pin does not become disengaged, shake the wrench immobilizing the camshaft slightly.
- If this still does 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).

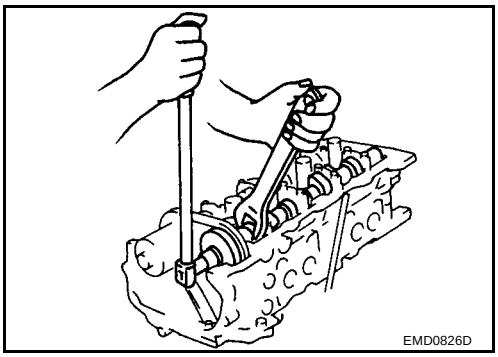


10. Keeping the wrench on the camshaft hexagonal part, loosen the mounting bolts and remove the intake and exhaust camshaft sprockets.

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.

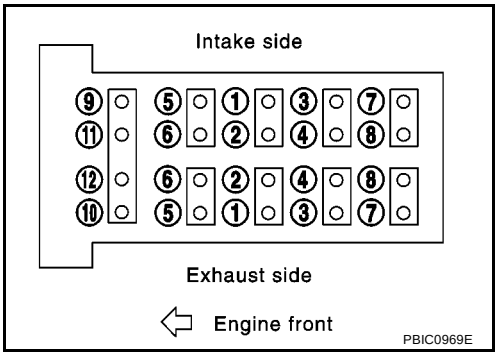
a. Reinstall the intake camshaft sprocket to the intake camshaft and tighten the mounting bolts enough to prevent air leaking out when the air pressure is applied later.

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.

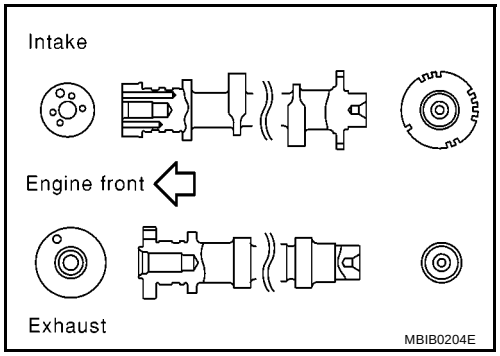
13. Remove valve lifter.
    - Identify installation position of each valve. Arrange removed valve lifters so they cannot be mixed up.

INSTALLATION

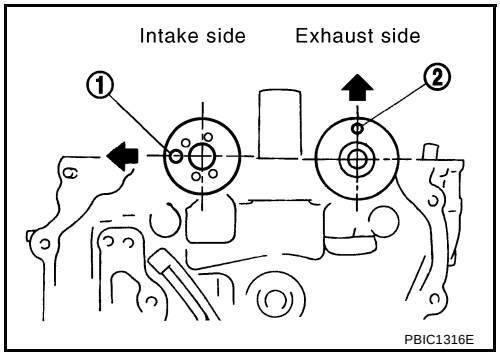
1. Install valve lifter.

- Install it in its original positions.

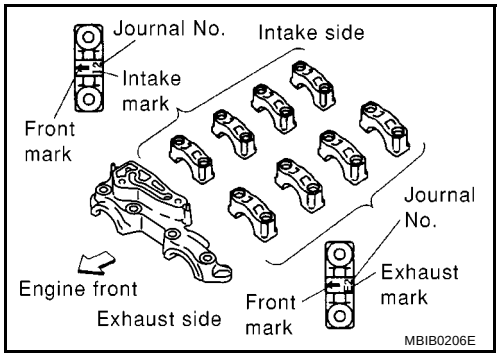
2. Install camshaft.
   - You can distinguish between the intake and the exhaust by looking at the different shapes of the front and rear ends of the camshaft.



   - 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.

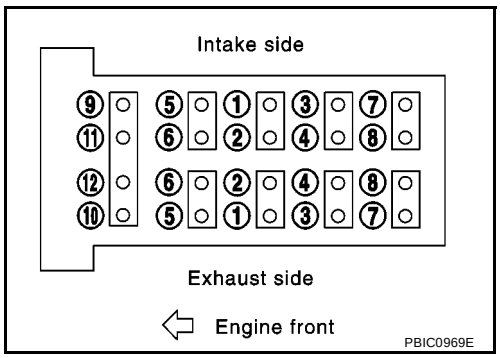
: 2.0 N·m (0.2 kg-m, 18 in-lb)

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

: 5.9 N·m (0.6 kg-m, 52 in-lb)

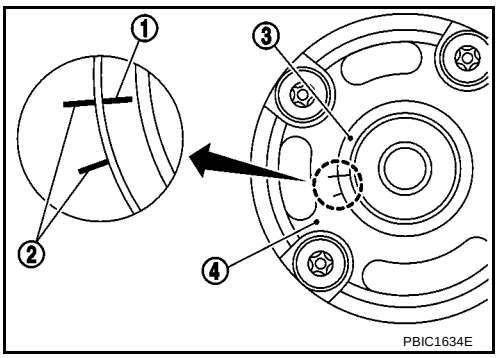
d. Retighten all bolts in numerical order shown in the figure.

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

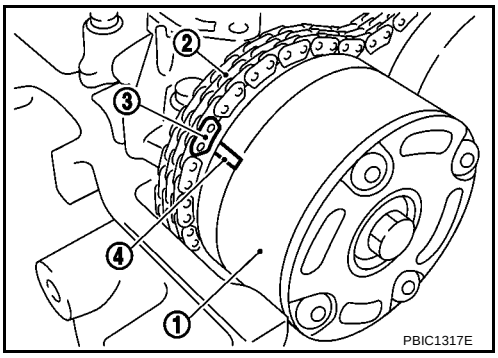


5. Install the intake camshaft sprocket in the following procedure:

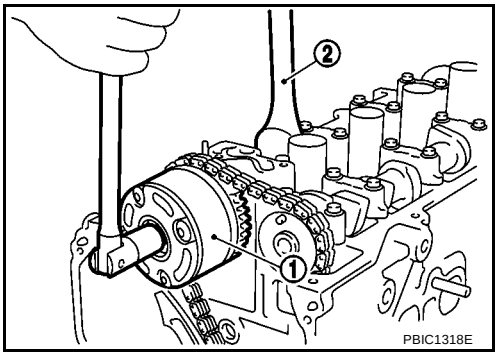
- Make sure the most advanced position checking intake valve timing control advance mark (1) of vane (3) and alignment mark (2) of sprocket (4) are located as shown in the figure.



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).



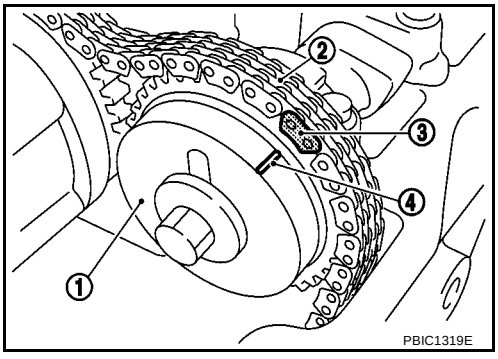
c. Remove adhesive tape or equivalent from camshaft sprocket.

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

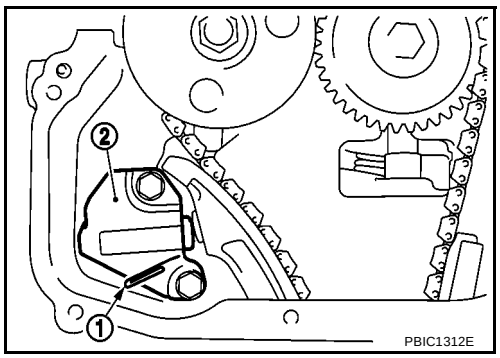
a. Install timing chain (2) by aligning its mating mark (3) (marked when timing chain is removed) with mark (4) on camshaft sprocket (1).
   - Install by aligning the dowel pin groove of the sprocket with dowel pin on the camshaft.

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

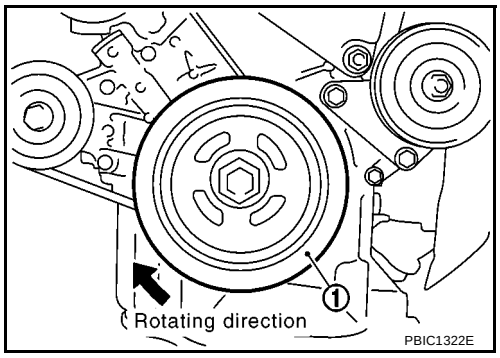
c. Make sure the markings for the intake and the exhaust camshaft sprockets and the timing chain are all lined up.



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.

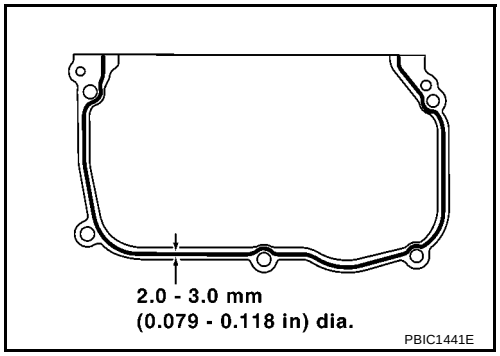


8. Turn the crankshaft pulley (1) slowly clockwise to return the intake camshaft sprocket to the most retarded position.



   - 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-47, "Valve Clearance" .
12. Reinstall removed parts in reverse order of removal.



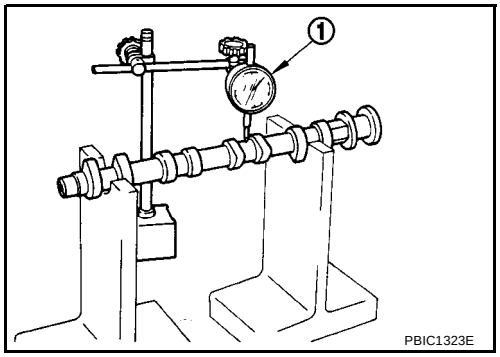
INSPECTION AFTER REMOVAL

Camshaft Runout

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

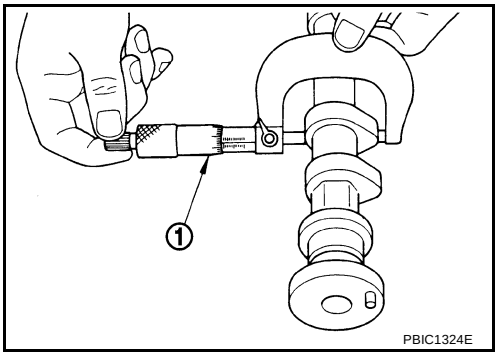
  CAUTION:
  Do not support journal No. 1 (on the side of the camshaft sprocket) because it has a different diameter from the other four locations.
- Set a dial gauge (1) vertically onto journal No. 3.
- Rotate the camshaft in one direction by hand and read indication on the gauge. (Total indication reading)

  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)

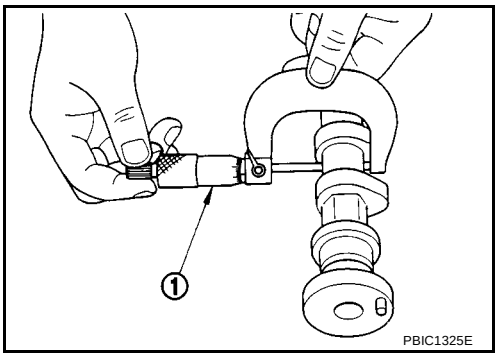
Exhaust : 39.743 - 39.933 mm (1.5647 - 1.5722 in)

- If it exceeds the standard, replace the camshaft.

Camshaft Journal Clearance

Outer Diameter of Camshaft Journal

- Measure with a micrometer (1).



Standard

No. 1

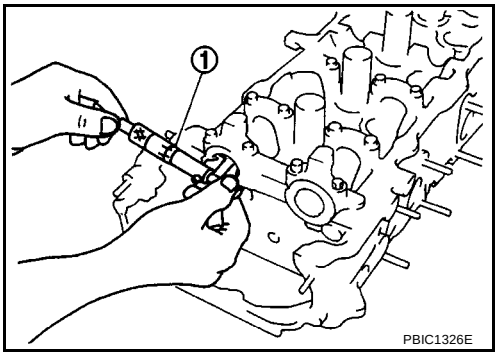
: 27.935 - 27.955 mm (1.0998 - 1.1006 in)

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:

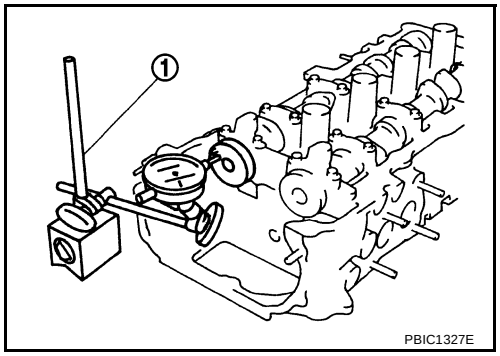
Since the camshaft brackets and the cylinder head are machined together, replacement must be done using the cylinder head assembly.

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

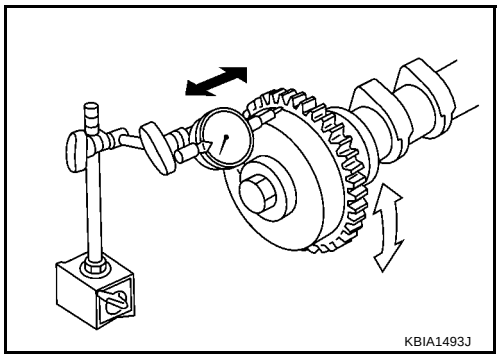
- Put V block on precise flat bed, and support No. 2 and No. 5 journal of camshaft.
- Using a dial gauge, measure camshaft sprocket runout.

  Limit

  Intake : 0.20 mm (0.0079 in)

  Exhaust : 0.15 mm (0.0059 in)

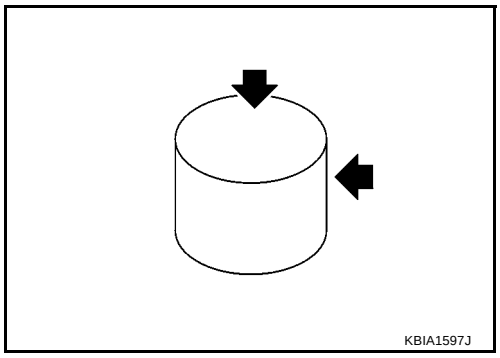
- If it exceeds the limit, replace camshaft sprocket.



Valve Lifter

Check for cracks and wear on valve lifter surface.

- If anything above is found, replace valve lifter.

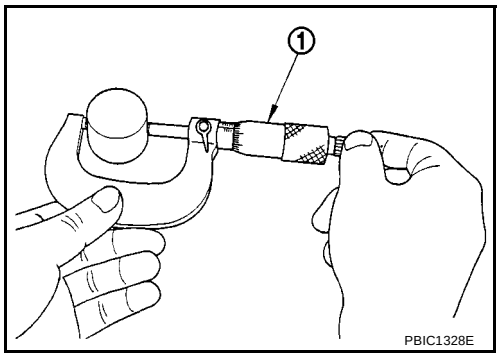


Valve Lifter Clearance

Outer Diameter of Valve Lifter

- Measure with a micrometer (1).

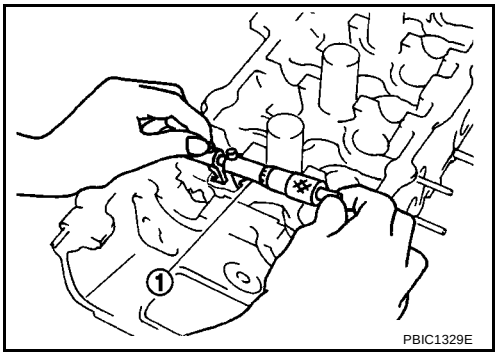
  Standard : 29.960 - 29.975 mm(1.1795 - 1.1801 in) dia.



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.

INSPECTION AFTER INSTALLATION

Inspection of Camshaft Sprocket (INT) Oil Groove

CAUTION:

- **Perform this inspection only when DTC P0011 is detected in self-diagnostic results of CONSULT-II and it is directed according to inspection procedure of EC section. Refer to EC-107, "SELF-DIAG RESULTS MODE" (WITH EURO-OBD) or EC-521, "SELF-DIAG RESULTS MODE" (WITHOUT EURO-OBD).**
- **Check when the engine is cold so as to prevent burns from any splashing engine oil.**

1. Check the engine oil level. Refer to LU-6, "ENGINE OIL" .
2. Perform the following procedure so as to prevent the engine from being unintentionally started while checking.

a. Release fuel pressure. Refer to EC-51, "FUEL PRESSURE RELEASE" (WITH EURO-OBD) or EC-482, "FUEL PRESSURE RELEASE" (WITHOUT EURO-OBD).

b. Disconnect ignition coil and injector harness connectors.

3. Remove intake valve timing control solenoid valve. Refer to EM-38, "CAMSHAFT" .
4. Crank the engine, and then make sure that engine oil comes out from intake valve timing control cover oil hole. End crank after checking.

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

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

- Clean oil groove between oil strainer and intake valve timing control solenoid valve if engine oil does not come out from intake valve timing control cover oil hole. Refer to LU-5, "LUBRICATION SYSTEM" .

5. Remove components between intake valve timing control solenoid valve and camshaft sprocket (INT), and then check each oil groove for clogging.
   - Clean oil groove if necessary. Refer to LU-5, "LUBRICATION SYSTEM" .
6. After inspection, install removed parts.

Valve Clearance

EBS00OEZ

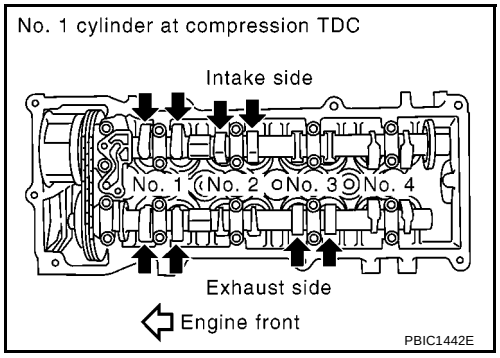
INSPECTION

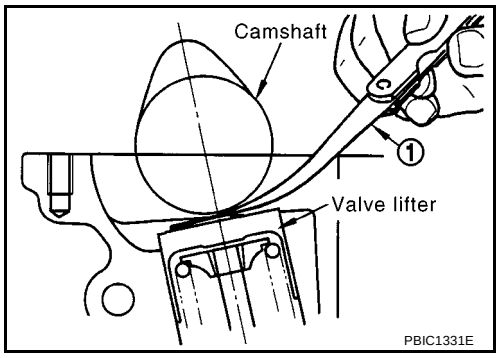
- Whenever the camshaft and valve related parts are removed and installed or replaced, or symptoms due to changes in valve clearance as a result of aging (poor starting, rough idle, unusual noise) are obvious, check valve clearance with the following procedure:

1. Warm up engine and stop it.

2. Remove the following parts.
   - RH front fender protector
   - Rocker cover; Refer to EM-35, "ROCKER COVER" .
3. Turn the crankshaft pulley clockwise.
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	×		×	





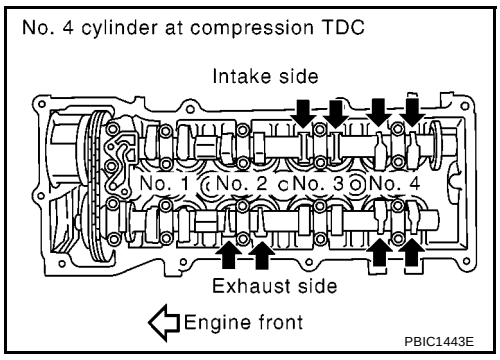
Valve clearance standard:

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		×		×



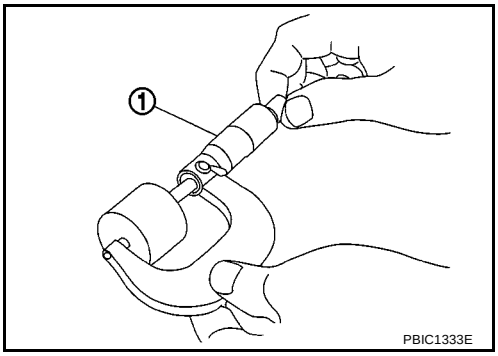
8. Adjustment of places outside range of standard values is done as follows.

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-38, "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

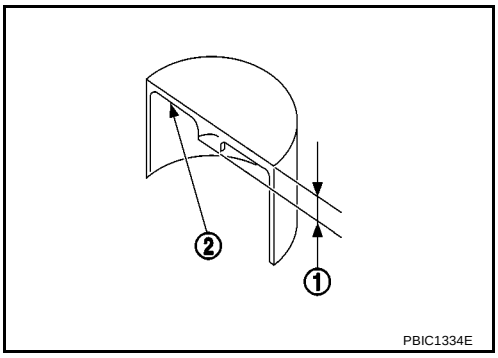
C_1 = Valve clearance measurement

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.

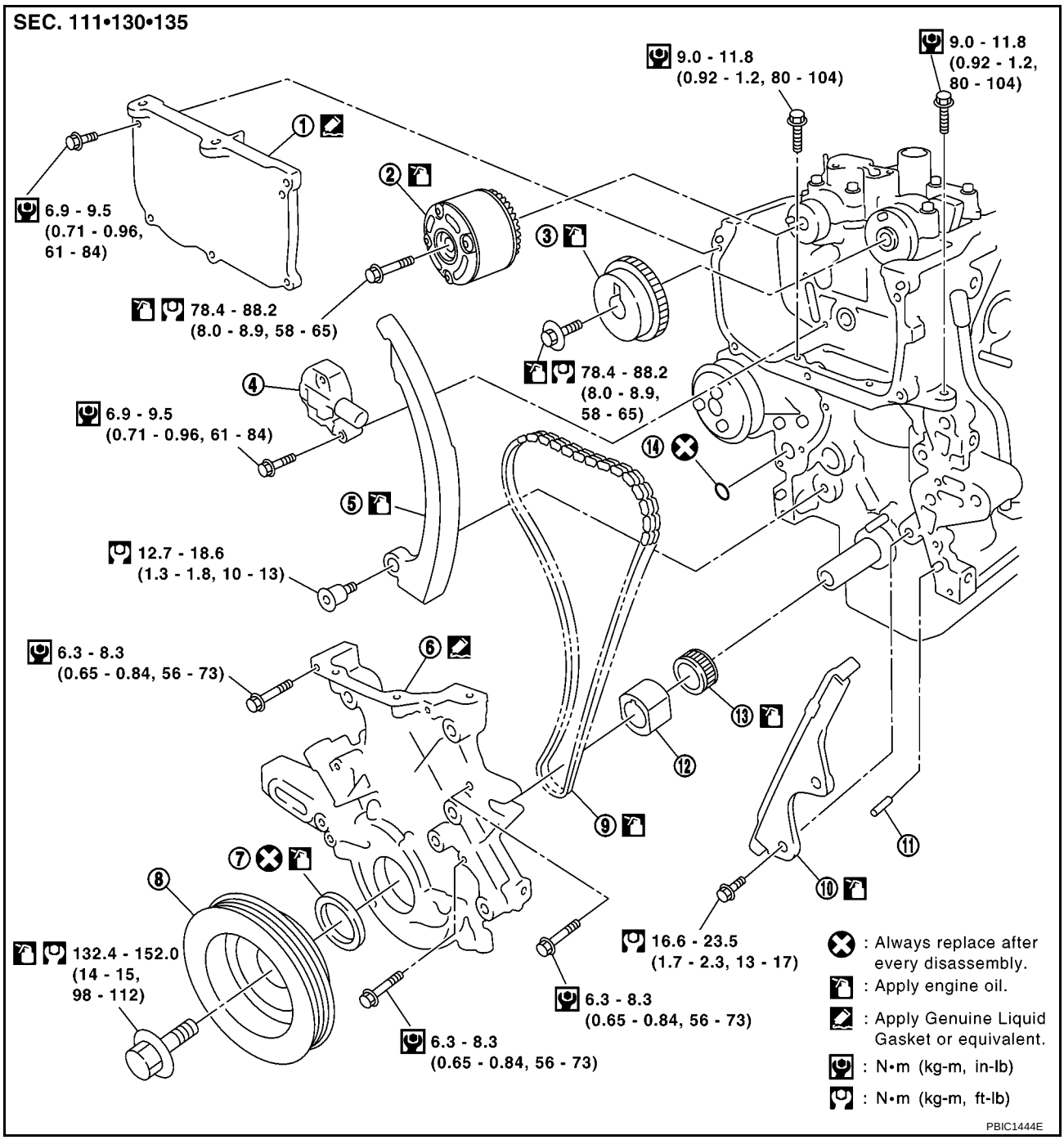
5. Install selected valve lifter.
6. Install camshaft. Refer to EM-38, "Removal and Installation" .
7. Manually turn crankshaft a few turns.
8. Make sure that the valve clearance is within the standard using the reference value when engine is cold.
9. After restoring, make sure the valve clearance is 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-70, "Removal and Installation" .

2.Separate engine from transaxle. Refer to EM-70, "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.

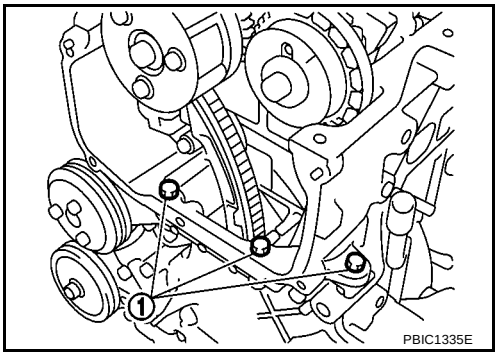
1. Remove RH front wheel and RH front fender protector.
2. Drain the engine oil.
3. Remove the following parts.
   - Drive belts and drive belt idler pulleys; Refer to EM-14, "DRIVE BELTS" .
   - Rocker cover; Refer to EM-35, "ROCKER COVER" .
   - Exhaust front tube; Refer to EX-4, "EXHAUST SYSTEM" .
   - Starter motor; Refer to SC-46, "STARTING SYSTEM" .
   - Oil pan (lower and upper) and oil strainer; Refer to EM-26, "OIL PAN AND OIL STRAINER" .
   - RH headlamp; Refer to LT-7, "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-70, "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-70, "Removal and Installation" .

5. Remove alternator. Refer to SC-16, "CHARGING SYSTEM" .
6. Remove cylinder head front cover. Refer to EM-38, "CAMSHAFT" .
7. Remove the cylinder head auxiliary bolts (1).

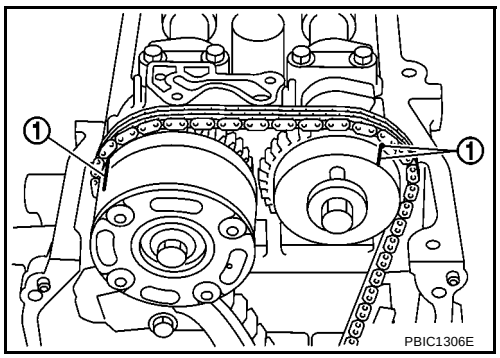


8. Set No. 1 cylinder at TDC on its compression stroke.

a. Turn the crankshaft pulley clockwise.

b. 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)

c. 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.

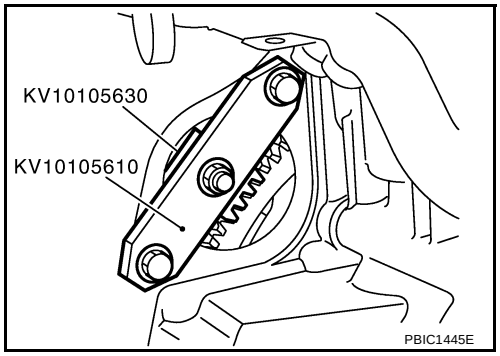


9. Remove the crankshaft pulley in the following order.

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.

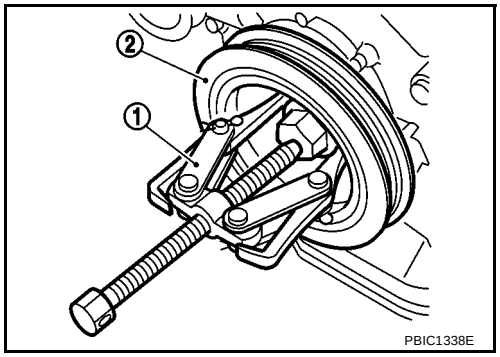
CAUTION:
Do not remove the mounting bolts as they will be used as a supporting point for the pulley puller.



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.

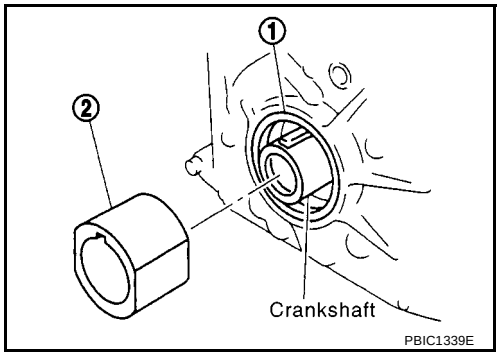
10. Remove the idler pulley bracket assembly for drive belts from the front cover. Refer to EM-14, "DRIVE BELTS" .



11. Remove the front cover in the following order.

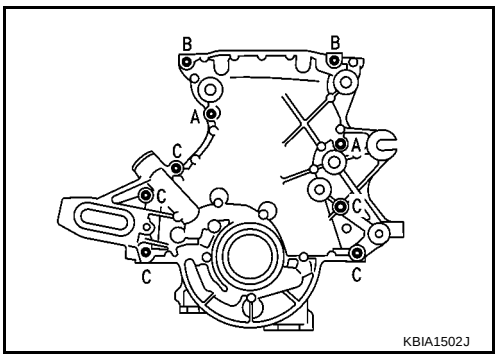
a. To give more freedom to the front cover position during installation and removal, pull out the oil pump drive spacer (2) over the front oil seal (1).
   - Pull out straight, using long nosed pliers or two screwdrivers, etc.

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.**

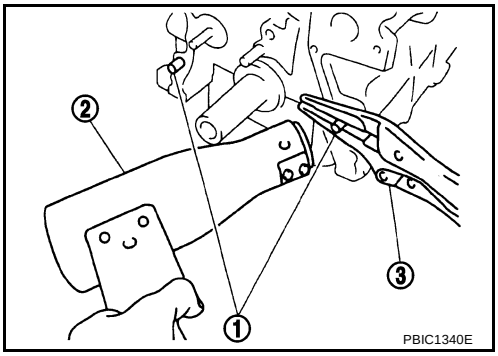


KBIA1502J

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.



PBIC1340E

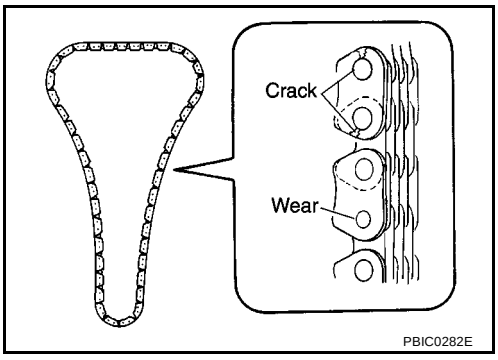
13. Remove the front oil seal from the front cover.
    - Insert a screwdriver behind the oil seal and pull up to remove.
14. Secure the intake camshaft sprocket in the most advanced position. Refer to EM-38, "CAMSHAFT" .

    NOTE:
    The following steps are for removing the timing chain and other related parts.
15. Remove chain tensioner. Refer to EM-38, "CAMSHAFT" .
16. Remove camshaft sprocket. Refer to EM-38, "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.



PBIC0282E

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.**

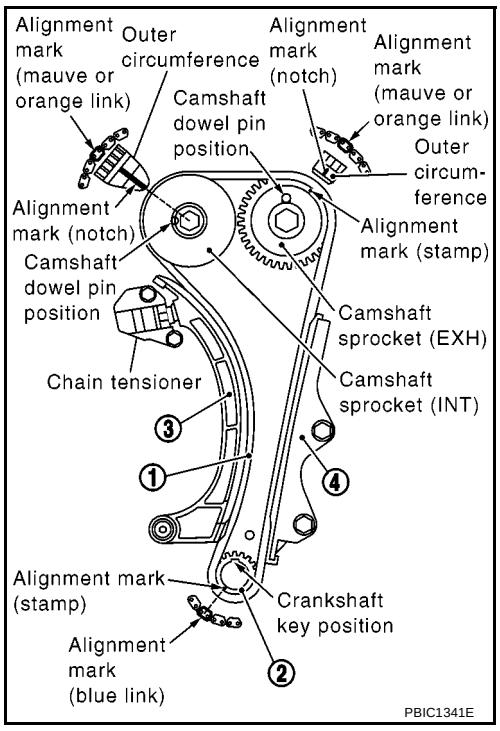
1. Install the timing chain and related parts in the following steps.

- 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-38, "CAMSHAFT" .
- Align the mating marks on camshaft sprocket and timing chain here.



d. Install chain tensioner. Refer to EM-38, "CAMSHAFT" .

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

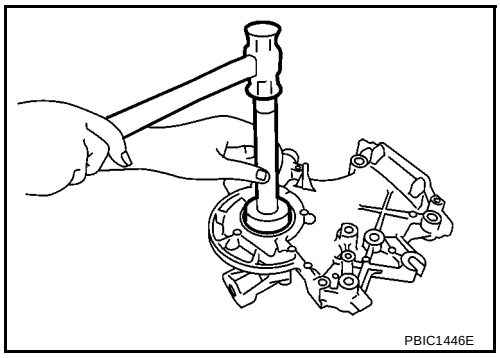
f. Temporarily install the oil pump drive spacer, the crankshaft pulley, and the crankshaft pulley bolt, and make it so that the crankshaft can be turned.

g. Turn the crankshaft clockwise viewing from engine front. Place intake side camshaft in the most retarded position. Refer to EM-38, "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.

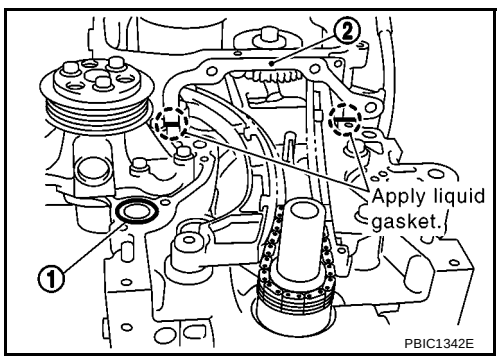
2. Install front oil seal to front cover.
- Make sure the oil seal lettering is towards the engine front.
- Using suitable drift, press oil seal in until it is flush with end surface of mounting position.
- Do this without damaging the outer diameter of the oil seal.



3. Install the front cover with the following procedure:

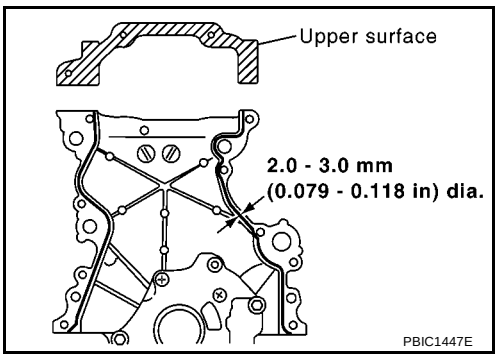
a. Install O-ring (1) to the cylinder block.

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.

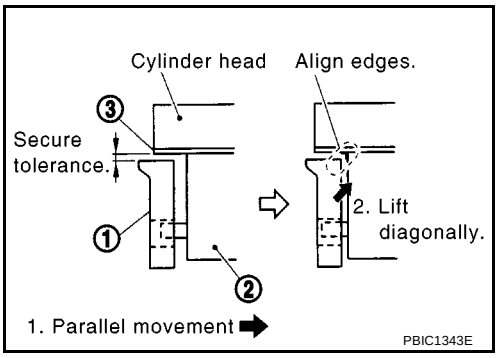


e. With the inner rotor internal diameter part of the oil pump resting on the top of the crankshaft [with a space between the top of the front cover and the bottom of the cylinder head gasket (3)], bring the front cover (1) as close as possible to the cylinder block. (To the left in the figure)

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)

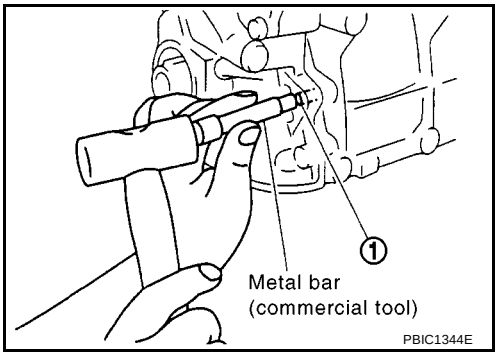
CAUTION:

- **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.

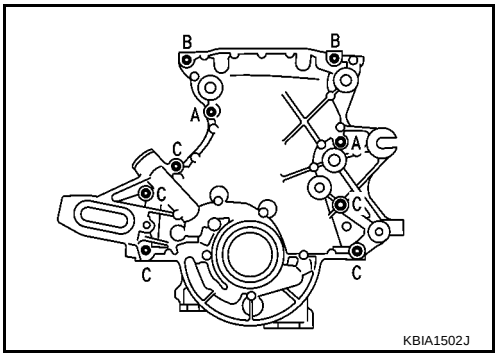


i. Temporarily tighten the front cover bolts.

- 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)]

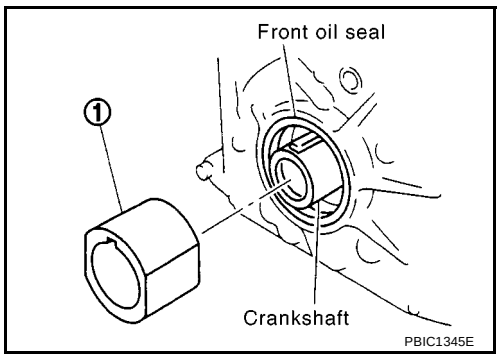
j. Temporarily tighten the cylinder head auxiliary bolts.

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



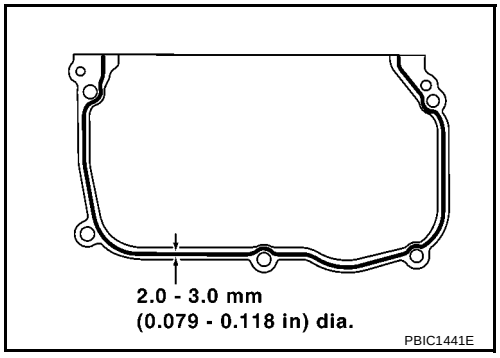
4. Install oil pump drive spacer (1).
   - When installing, align with flat face of oil pump inner rotor.
   - If they are not aligned properly, turn the inner rotor with a screwdriver until they do.

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



5. Install the drive belt idler pulley bracket assembly. Refer to EM-14, "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-70, "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

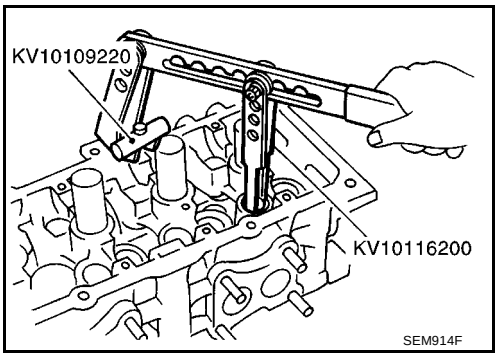
Removal and Installation of Valve Oil Seal

EBS00OF1

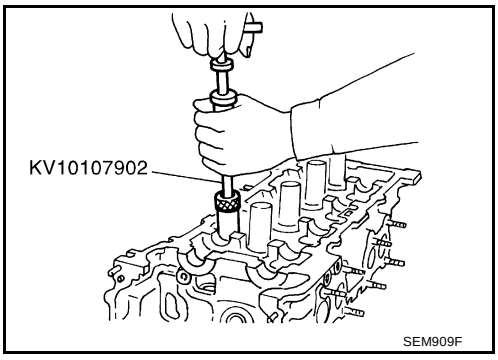
REMOVAL

1. Remove camshaft. Refer to EM-38, "CAMSHAFT" .
2. Remove valve lifter. Refer to EM-38, "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.

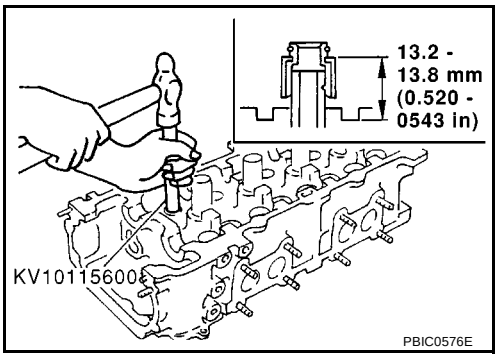


5. Using a valve oil seal puller (special service tool), remove the valve oil seal.



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

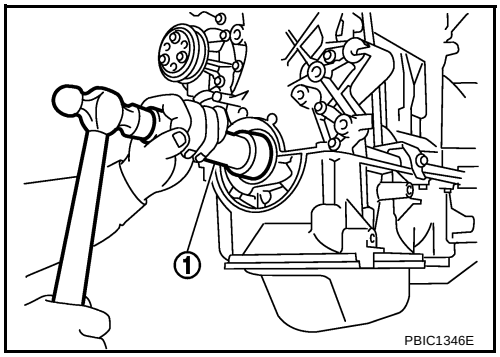
1. Remove the following parts.
   - RH front fender protector
   - Drive belt; Refer to EM-14, "DRIVE BELTS" .
   - Crankshaft pulley; Refer to EM-50, "TIMING CHAIN" .
2. Using a screwdriver, remove the front oil seal.

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

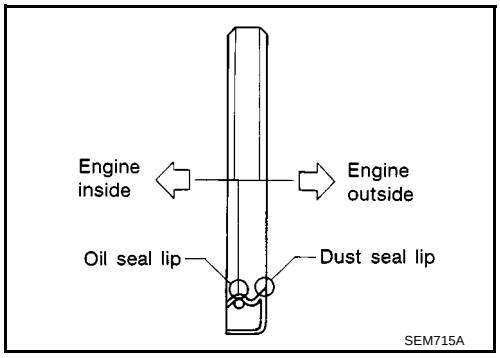
INSTALLATION

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

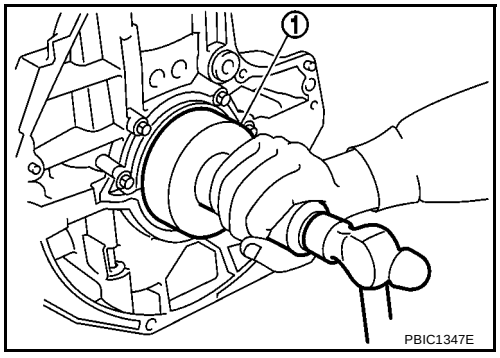
1. Remove transaxle assembly.
   - M/T: Refer to MT-7, "REMOVAL AND INSTALLATION" .
   - A/T: Refer to AT-357, "Removal and Installation" .
2. Remove clutch cover and clutch disc. (M/T models) Refer to CL-12, "CLUTCH DISC, CLUTCH COVER AND FLYWHEEL" .
3. Remove flywheel (M/T models), drive plate and adopter (A/T models). Refer to EM-74, "CYLINDER BLOCK" .
4. Using a screwdriver, remove the rear oil seal.

   CAUTION:
   Be careful not to damage the mounting surface.

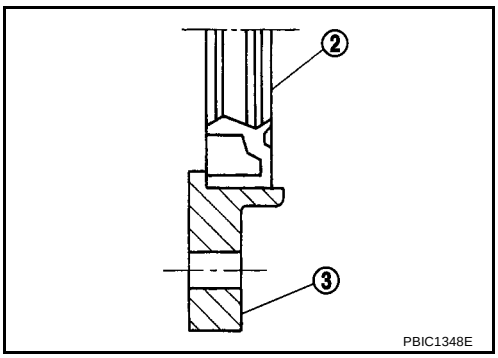
INSTALLATION

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

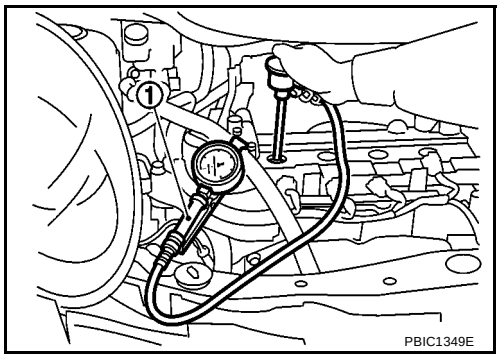
1. Warm up engine thoroughly. Then, stop it.
2. Release fuel pressure with the following procedure.

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.

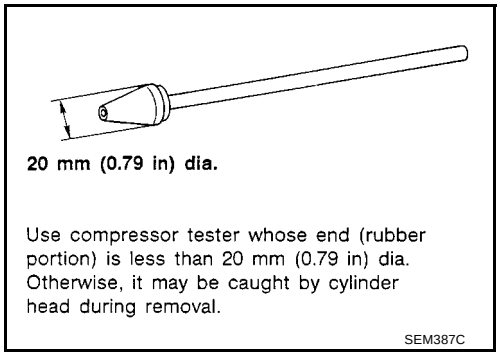
CAUTION:

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-29, "IGNITION COIL" and EM-30, "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	CR12DE, CR14DE
Standard	1,383 (13.83, 14.1, 201)
Minimum	1,187 (11.87, 12.1, 172)
Difference limit among cylinders	98 (0.98, 1.0, 14)

CAUTION:

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

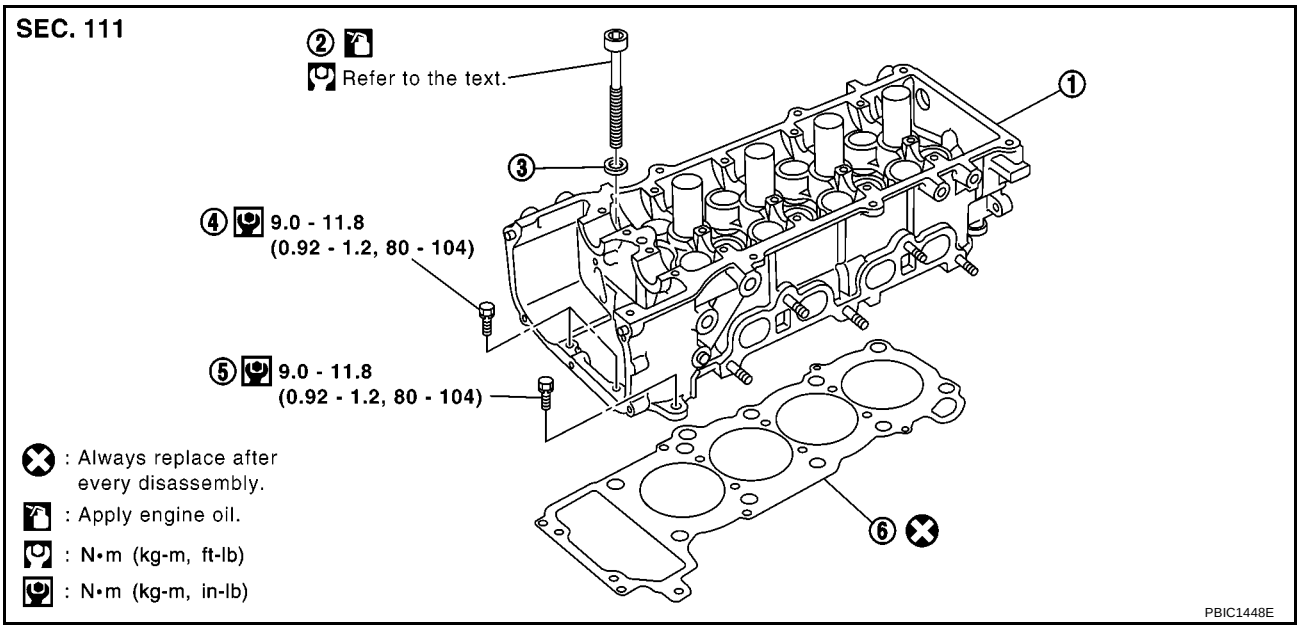
- If the engine speed is out of specified range, check battery liquid for proper gravity. Check engine speed again with normal battery gravity.
- If compression pressure is below minimum value, check valve clearances and parts associated with combustion chamber (Valve, valve seat, piston, piston ring, 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



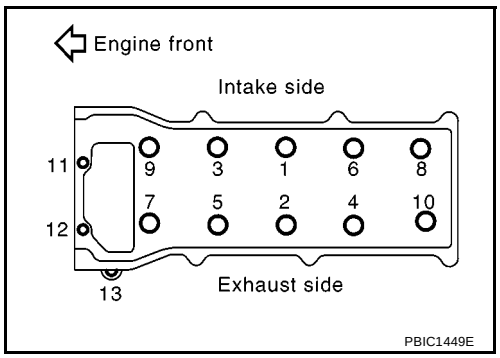
1. Cylinder head assembly
2. Cylinder head bolt
3. Washer
4. Cylinder head auxiliary bolt
5. Cylinder head auxiliary bolt
6. Gasket

REMOVAL

1. Release the fuel pressure. Refer to EC-51, "FUEL PRESSURE RELEASE" (WITH EURO-OBD), EC-482, "FUEL PRESSURE RELEASE" (WITHOUT EURO-OBD).
2. Drain engine coolant. Refer to CO-9, "ENGINE COOLANT" .
3. Remove the following components and related parts.
   - RH front fender protector
   - Alternator and A/C compressor drive belt; Refer to EM-14, "DRIVE BELTS" .
   - Air duct and air cleaner case assembly; Refer to EM-18, "AIR CLEANER AND AIR DUCT" .
   - Intake manifold; Refer to EM-22, "INTAKE MANIFOLD" .
   - Fuel injector and fuel tube assembly; Refer to EM-32, "FUEL INJECTOR AND FUEL TUBE" .
   - Radiator upper hose and lower hose; Refer to CO-13, "RADIATOR" .
   - Alternator and alternator bracket; Refer to SC-16, "CHARGING SYSTEM" .
   - Exhaust manifold and three way catalyst assembly; Refer to EM-24, "EXHAUST MANIFOLD AND THREE WAY CATALYST" .
   - Ignition coil; Refer to EM-29, "IGNITION COIL" .
   - Rocker cover; Refer to EM-35, "ROCKER COVER" .
   - Camshaft; Refer to EM-38, "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-24, "EXHAUST MANIFOLD AND THREE WAY CATALYST" .
   - Water outlet, thermostat, engine coolant temperature sensor and heater pipe; Refer to CO-25, "THERMOSTAT" .
   - Water suction pipe mounting bolt; Refer to CO-23, "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.



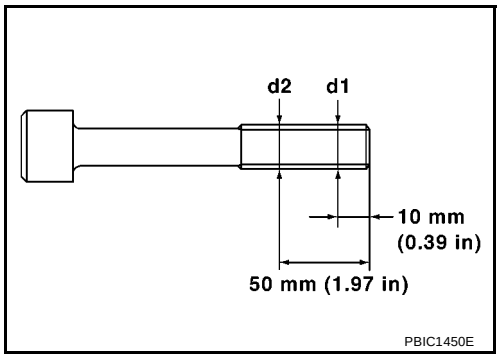
INSPECTION AFTER REMOVAL

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.

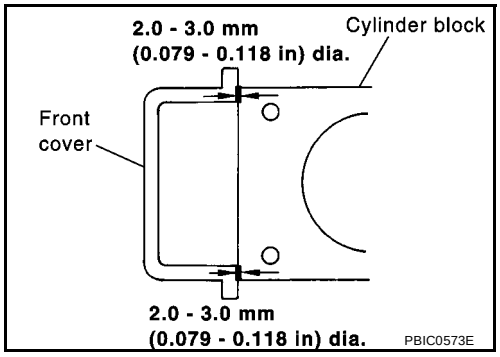
  Limit (d1 - d2) : 0.12 mm (0.0047 in)

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



INSTALLATION

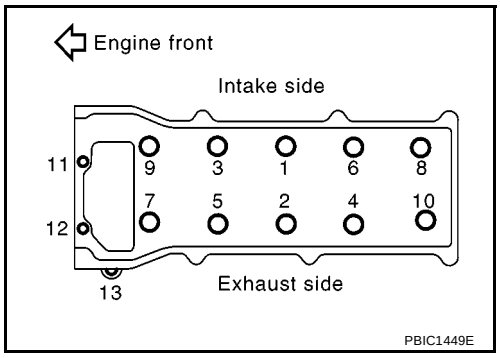
1. Evenly apply the liquid gasket to the position in the figure and then install the cylinder head gasket.
   Use Genuine Liquid Gasket or equivalent.



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.

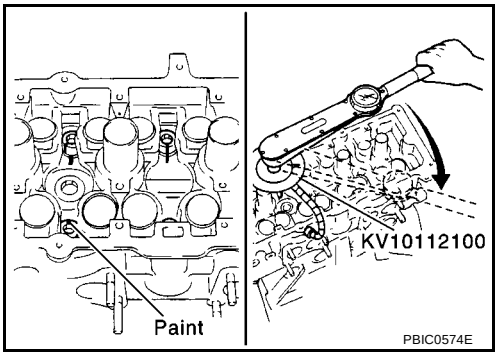
   NOTE:
   Bolts 11 to 13 should be tightened in step 3 after tightening bolts 1 to 10.



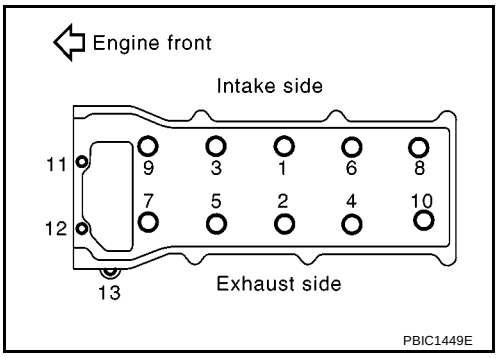
a. Apply new engine oil to threads and seat surfaces of bolts.
b. Tighten at 61.7 - 71.7 N·m (6.3 - 7.3 kg-m, 46 - 52 ft-lb).
c. Loosen completely to 0 N·m (0 kg-m).
d. Tighten at 22.5 - 32.5 N·m (2.3 - 3.3 kg-m, 17 - 23 ft-lb).
e. Tighten with 90 - 95 degrees clockwise [Target: 90 degrees]. (Angle tightening)

   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.

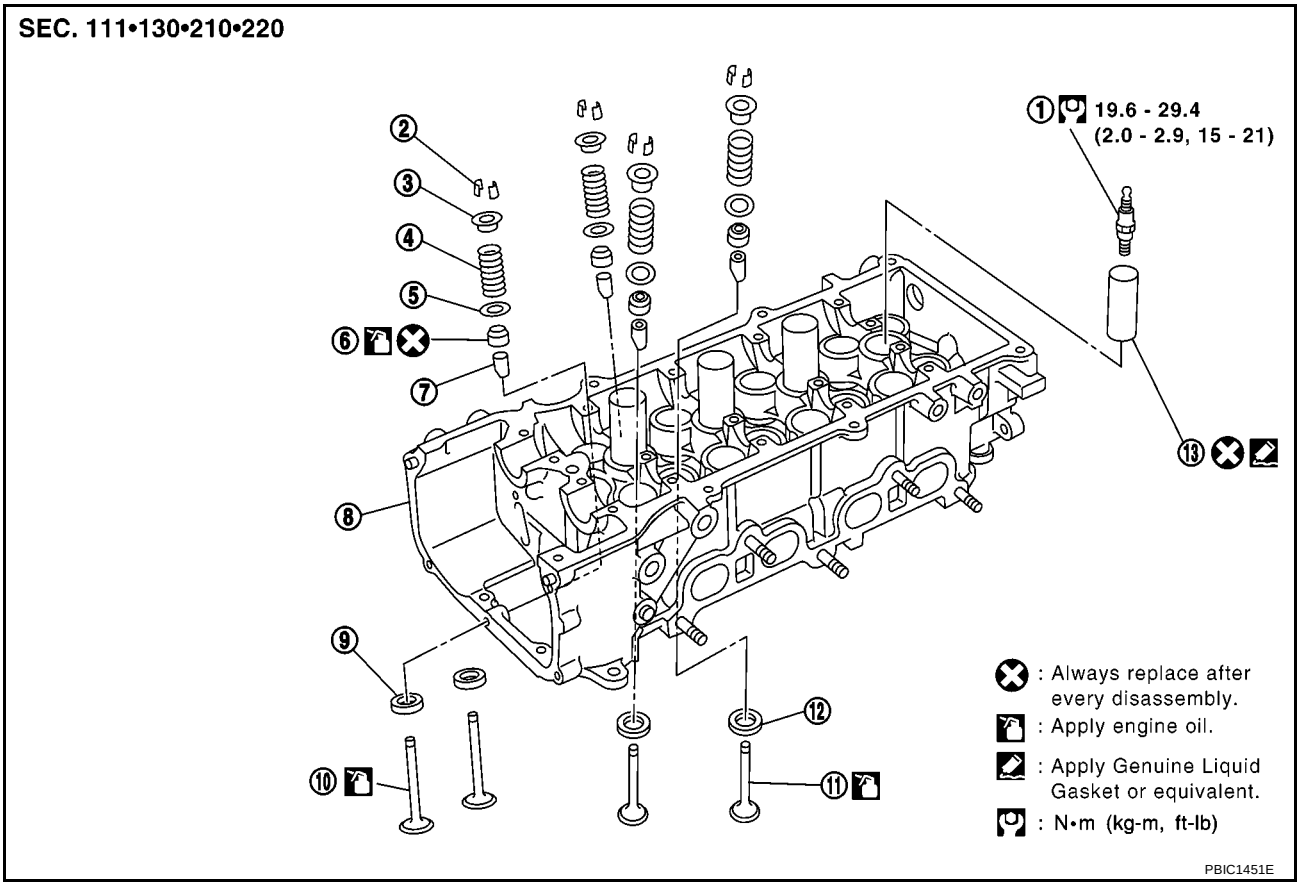


4. Reinstall removed parts in reverse order of removal.

Disassembly and Assembly

EBS00OF6

SEC. 111•130•210•220



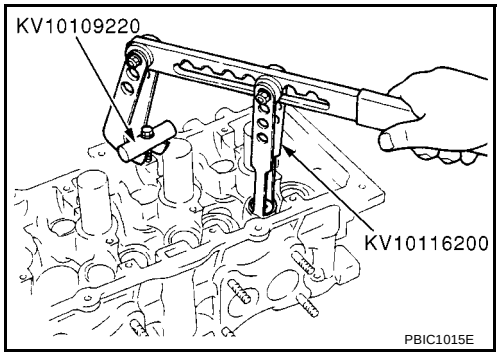
1. Spark plug
2. Valve collet
3. Valve spring retainer
4. Valve spring
5. Valve spring seat
6. Valve oil seal
7. Valve guide
8. Cylinder head
9. Valve seat (INT)

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

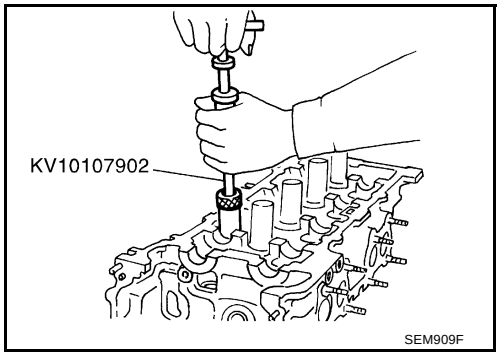
DISASSEMBLY

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-66, "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-67, "Replacement of Valve Seat" .
9. When valve guide replacement is necessary, refer to EM-66, "Valve Guide Replacement" .
10. Remove spark plug tube, as necessary.
    - Using a pair of pliers, pull spark plug tube out of cylinder head.

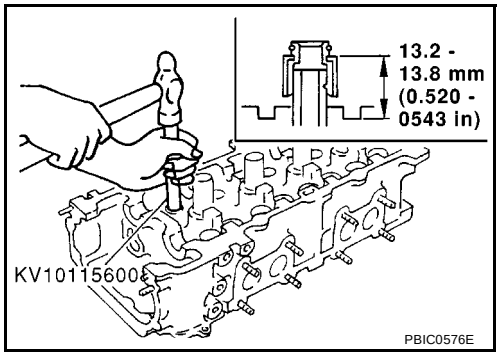


CAUTION:

- **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-66, "Valve Guide Replacement" .
2. Install valve seat. Refer to EM-67, "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.

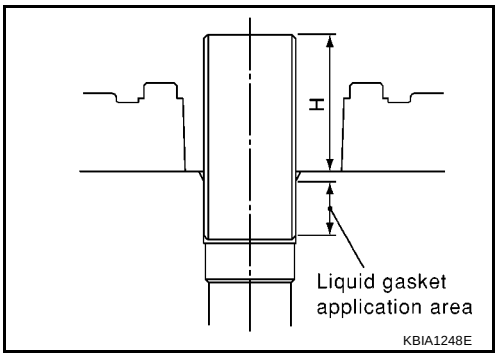


6. Install valve spring.
7. Install valve spring retainer.
8. Install valve collet.
   - Use a valve spring compressor (special service tool) to compress the valve spring, then install collet with a magnetic finger.

- 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.

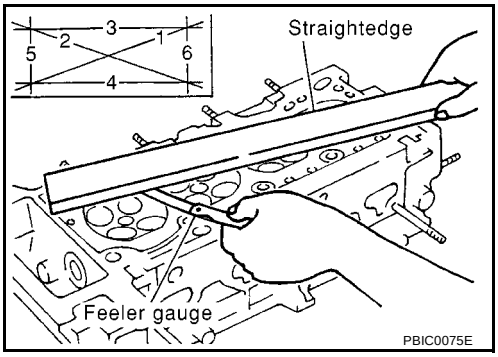
INSPECTION AFTER DISASSEMBLY

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.

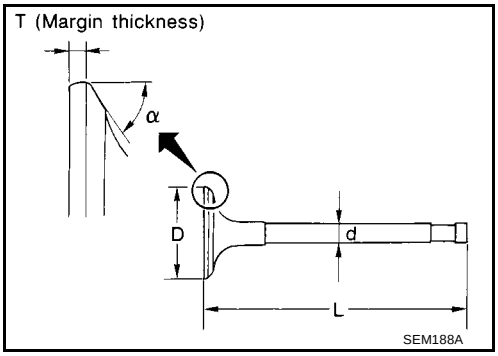


Limit : 0.1 mm (0.004 in)

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

Valve Dimensions

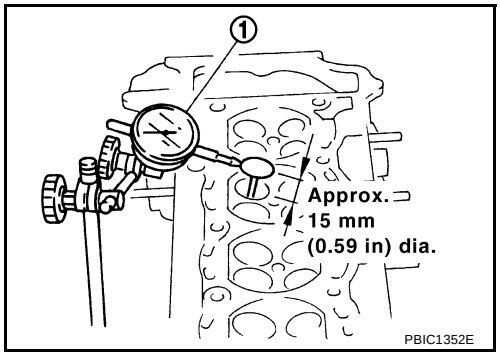
- Check dimensions of each valve. For dimensions, refer to EM-96, "VALVE" .
- If dimensions are out of the standard, replace valve.



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

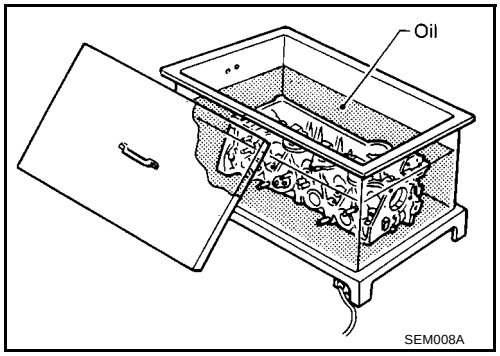
Intake : 0.020 - 0.053 mm (0.0008 - 0.0021 in)

Exhaust : 0.040 - 0.073 mm (0.0016 - 0.0029 in)

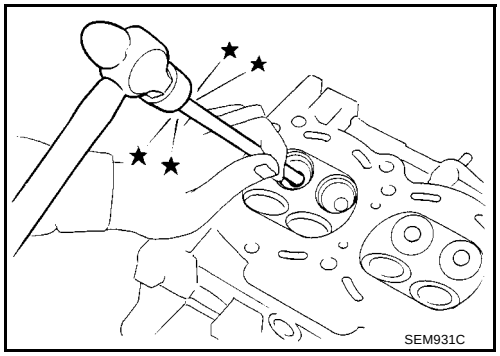
Valve Guide Replacement

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

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



2. Drive out valve guide with a press [under a 20 kN (2 ton, 2.2 US ton, 2.0 lmp ton) pressure] or hammer and suitable tool.

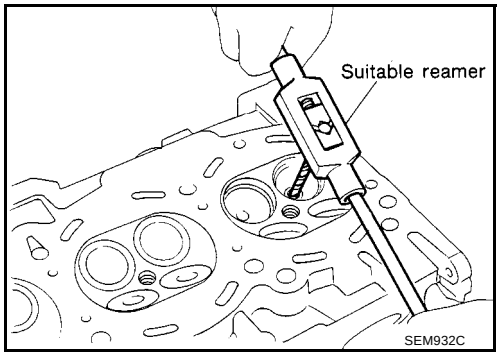


3. Ream cylinder head valve guide hole.

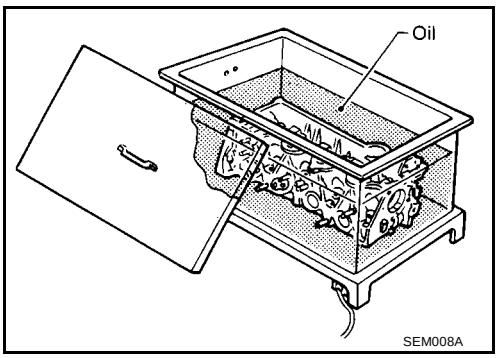
Valve guide hole diameter (for service parts):

Intake and exhaust

: 9.685 - 9.696 mm (0.3813 - 0.3817 in) dia.

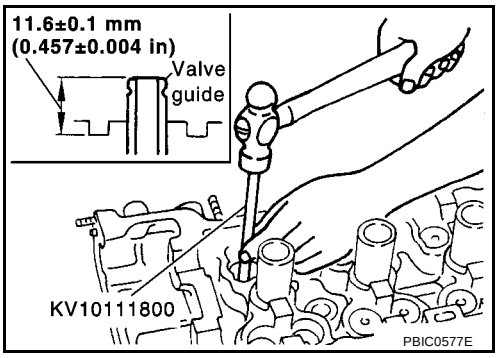


4. Heat cylinder head to 110 to 130°C (230 to 266°F) by soaking in heated oil.



5. Press valve guide from camshaft side to dimensions as in illustration.

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

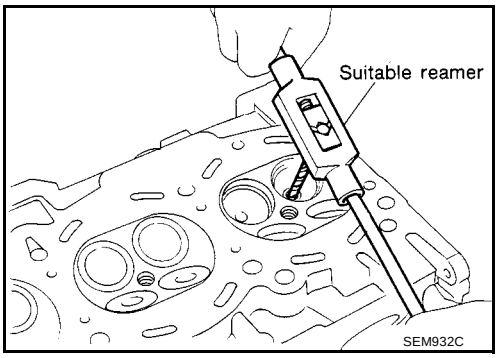


6. Using valve guide reamer, apply reamer finish to valve guide.

Standard

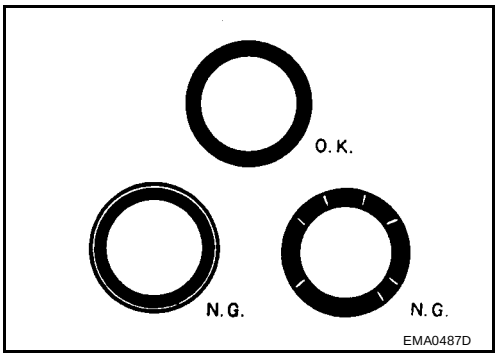
Intake and exhaust

: 5.500 - 5.518 mm (0.2165 - 0.2172 in) dia.



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

When valve seat is removed, replace with oversized [0.5 mm (0.020 in)] valve seat.

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

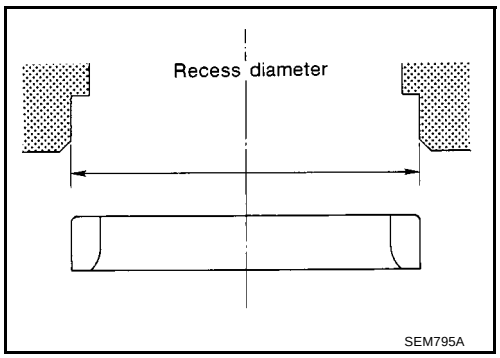
2. Ream cylinder head recess diameter for service valve seat.

Oversize [0.5 mm (0.020 in)]:

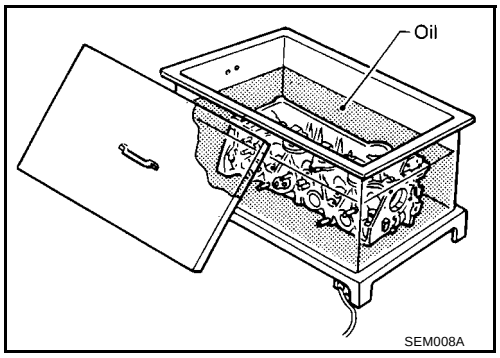
Intake: 29.000 - 29.016 mm (1.1417 - 1.1424 in)

Exhaust: 24.000 - 24.016 mm (0.9449 - 0.9455 in)

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



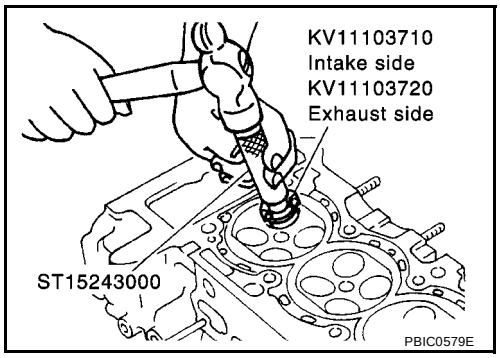
3. Heat cylinder head to 110 to 130°C (230 to 266°F) by soaking in heated oil.



4. Provide valve seats cooled well with dry ice. Force fit valve seat into cylinder head.

CAUTION:

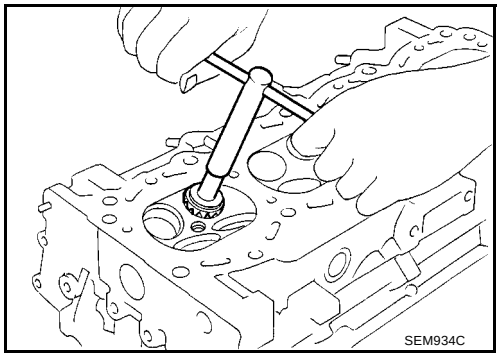
- **Avoid directly to touching cold valve seats.**
- **Cylinder head contains heat. When working, wear protective equipment to avoid getting burned.**



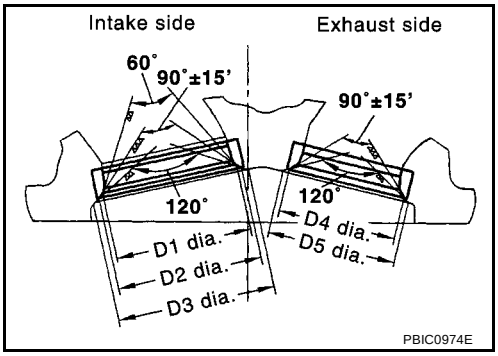
5. Using valve seat cutter set (commercial service tool) or valve seat grinder, finish the seat to the specified dimensions.

CAUTION:

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



Grind to obtain the dimensions indicated in figure.



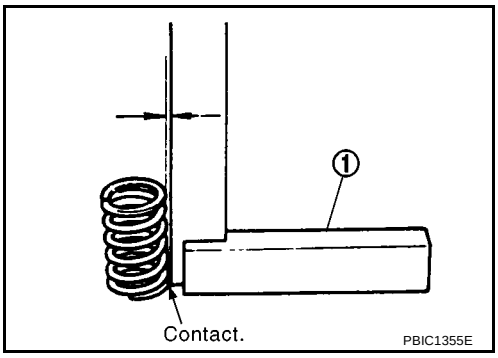
Standard:

D1 dia.	**: 25.4 mm (1.000 in)**
D2 dia.	**: 27.0 - 27.2 mm (1.062 - 1.070 in)**
D3 dia.	**: 28.7 - 28.9 mm (1.129 - 1.137 in)**
D4 dia.	**: 22.0 - 22.2 mm (0.866 - 0.874 in)**
D5 dia.	**: 23.7 - 23.9 mm (0.933 - 0.940 in)**

6. Using compound, grind to adjust valve fitting.
7. Check again for normal contact.

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).

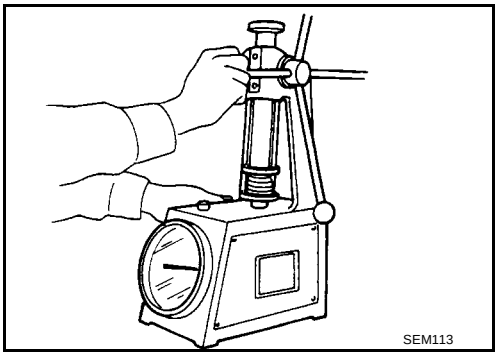


Limit : 1.6 mm (0.063 in)

- 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

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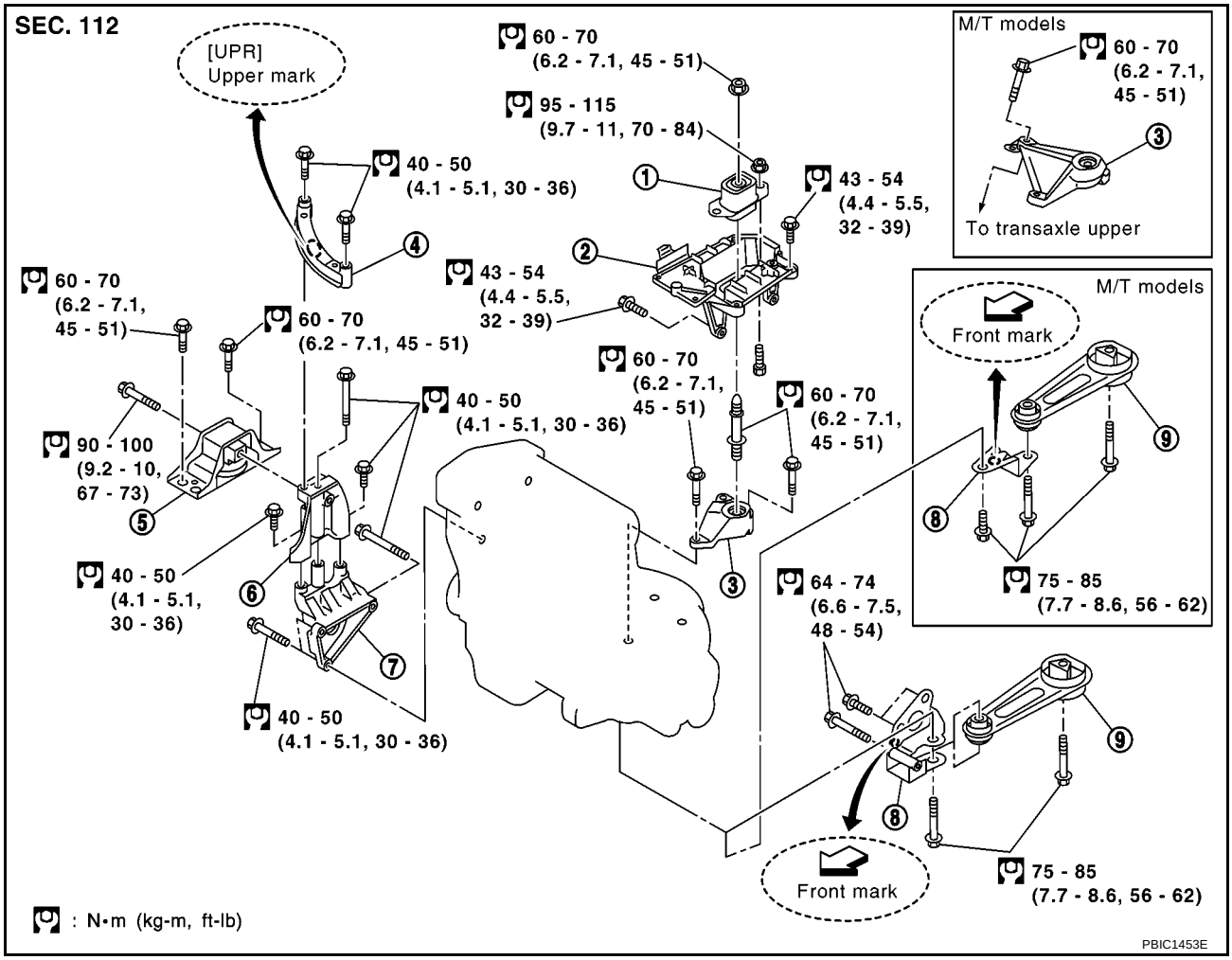


1. LH engine mount insulator	2. LH engine mount bracket (vehicle side)	3. LH engine mount bracket (transaxle side)
4. RH engine mount stay (The shape may not be the same as figure)	5. RH engine mount insulator	6. RH engine mount bracket (upper)
7. RH engine mount bracket (lower)	8. Rear engine mount 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-38, "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-51, "FUEL PRESSURE RELEASE" (WITH EURO-OBD), EC-482, "FUEL PRESSURE RELEASE" (WITHOUT EURO-OBD).
3. Drain engine coolant. Refer to CO-9, "ENGINE COOLANT" .
4. Remove the following parts.
   - RH and LH front wheel
   - RH and LH front fender protector
   - Exhaust front tube; Refer to EX-4, "EXHAUST SYSTEM" .
   - Drive belt; Refer toEM-14, "DRIVE BELTS" .
   - Air duct; Refer to EM-18, "AIR CLEANER AND AIR DUCT" .
   - Battery
   - Radiator; Refer to CO-13, "RADIATOR" .

Engine room LH

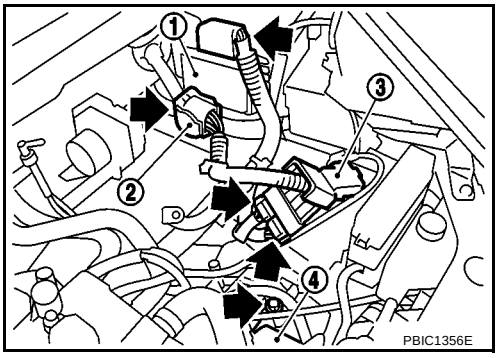
5. Disconnect the harness connectors and terminals from the following parts.

   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-12, "CONTROL LINKAGE" .
   - A/T: Refer to AT-340, "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

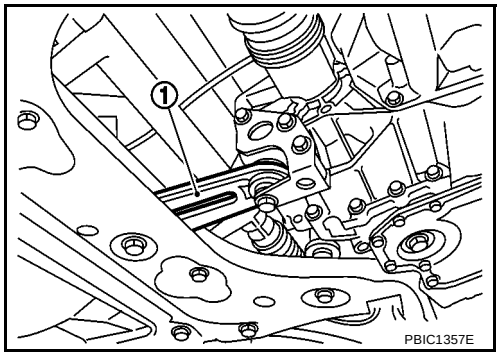
10. Remove the ground wire between the alternator bracket and the vehicle.
11. Remove RH engine mount stay, alternator bracket, and alternator.
12. Remove A/C compressor from engine with piping connected, and temporarily install it to vehicle with rope to avoid putting stress on air conditioner pipes.
13. Remove fuel tube protector. Refer to EM-32, "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-21, "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.



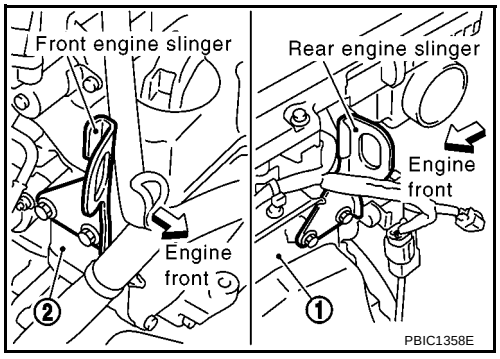
Removal

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.

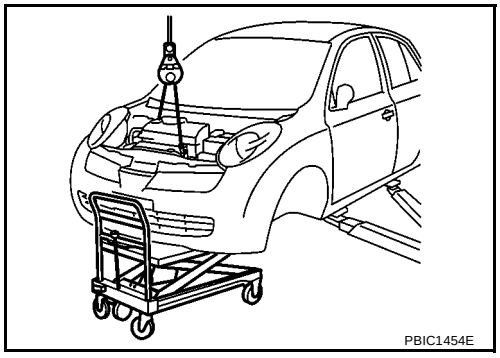
    : 16.6 - 23.5 N·m (1.7 - 2.3 kg-m, 13 - 17 in)

    - For front side, remove harness bracket under fuel tube protector and mount by using harness bracket mounting hole. Refer to EM-32, "FUEL INJECTOR AND FUEL TUBE" .

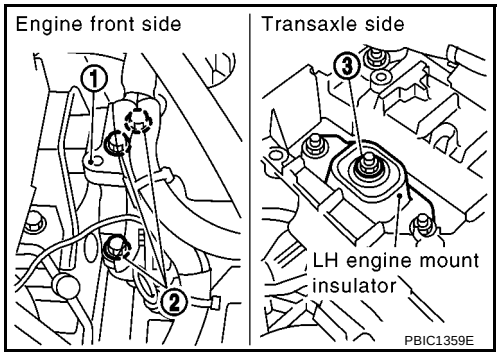


20. Lift to a height sufficient to allow easy work, support the bottom of the engine with either a manual lift table caddy (commercial service tool) or two suitable jacks, and adjust the tension of the hoist.

    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-46, "STARTING SYSTEM" .
25. Separate the engine and the transaxle.
    - M/T: Refer to MT-7, "REMOVAL AND INSTALLATION" .
    - A/T: Refer to AT-357, "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-70, "Removal and Installation" .
- Make sure all mount insulators are seated properly, then tighten nuts and bolts.

INSPECTION AFTER INSTALLATION

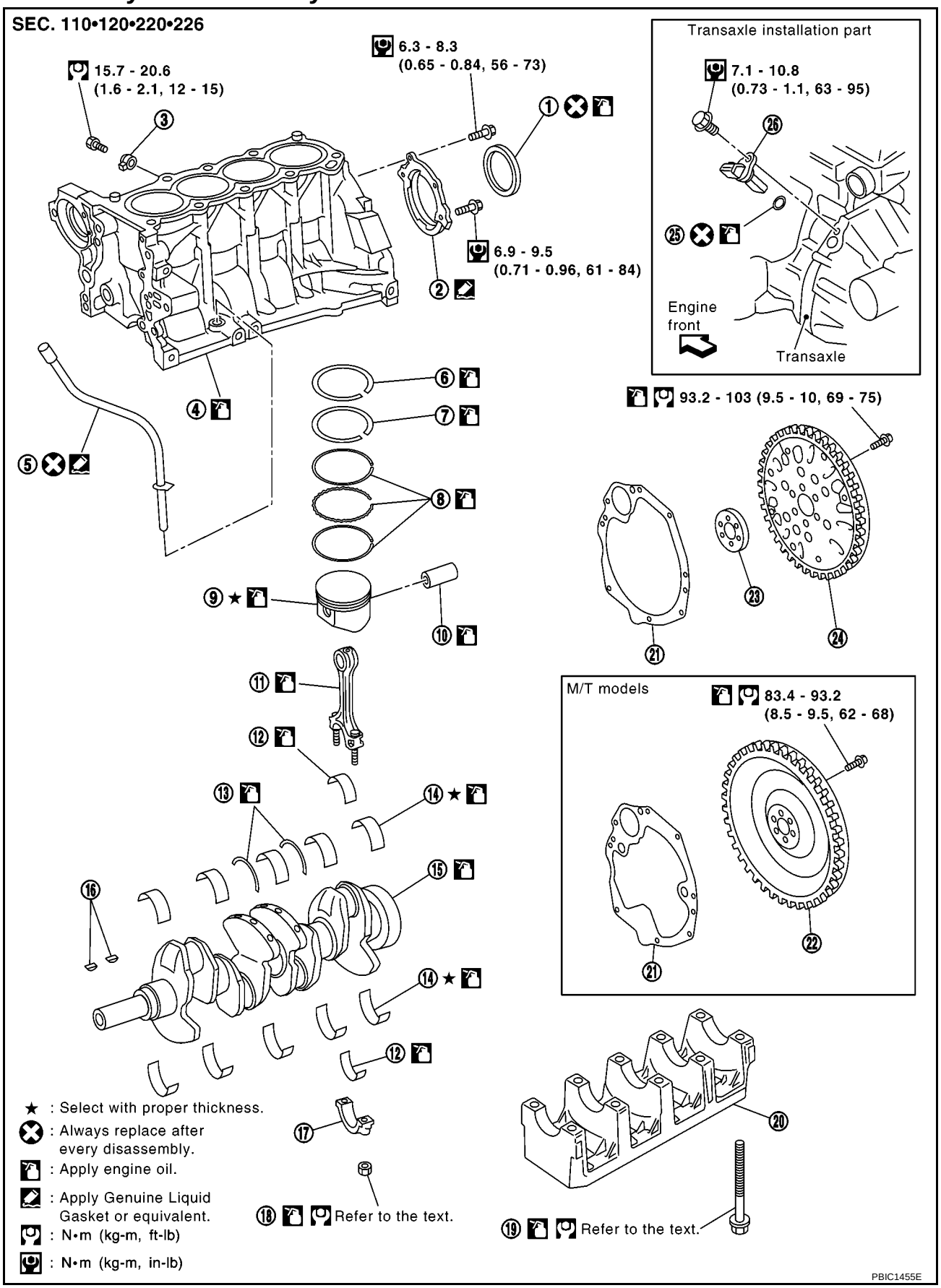
- Before starting engine, check the levels of engine coolant, lubrications and working oils. If less than required quantity, fill to the specified level.
- Use procedure below to check for fuel leakage.
  - Turn ignition switch ON (with engine stopped). With fuel pressure applied to fuel piping, check 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-70, "Removal and Installation" .
2. Install engine to engine stand in the following procedure.

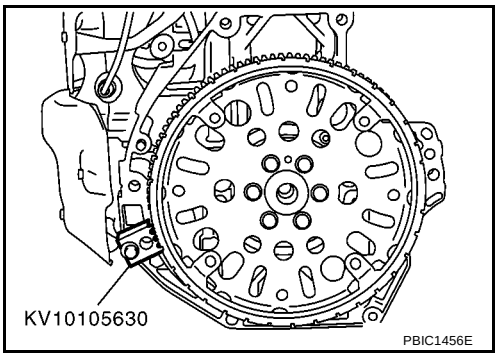
NOTE:
We will use as an example the engine stand (commercial service tool) specified to support the cylinder block rear (transaxle mounting surface).

a. Remove clutch cover and clutch disc. (M/T models) Refer to CL-12, "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.

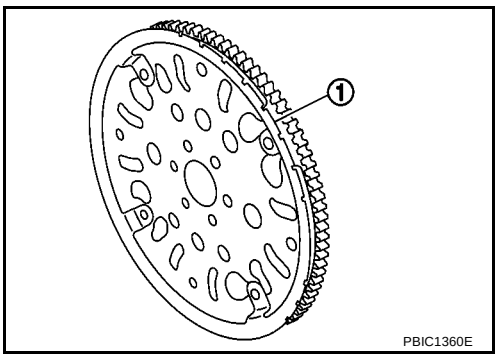
NOTE:
Figure shows the drive plate.



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

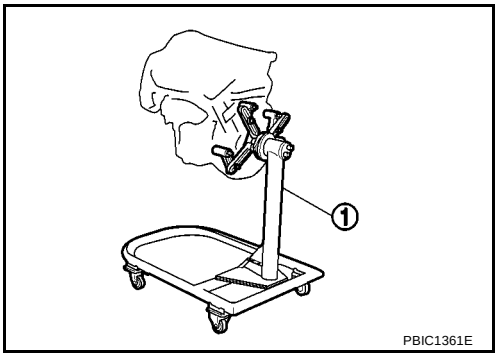
NOTE:
Figure shows the drive plate.

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-70, "Removal and Installation" .

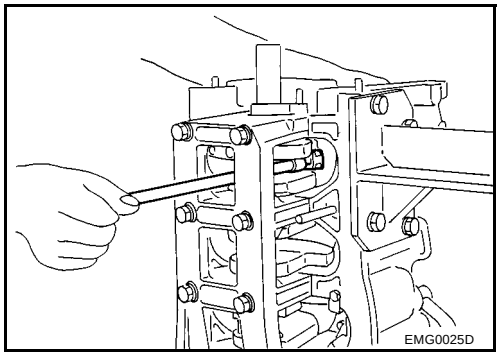


3. Drain engine oil and engine coolant from engine.
4. Remove following components and related parts.
   - Air cleaner case assembly; Refer to EM-18, "AIR CLEANER AND AIR DUCT" .
   - Intake manifold; Refer to EM-22, "INTAKE MANIFOLD" .
   - Fuel injector and fuel tube assembly; Refer to EM-32, "FUEL INJECTOR AND FUEL TUBE" .
   - Ignition coil; Refer to EM-29, "IGNITION COIL" .
   - Rocker cover; Refer to EM-35, "ROCKER COVER" .
   - Oil pan and oil strainer; Refer to EM-26, "OIL PAN AND OIL STRAINER" .
   - Front cover and timing chain; Refer to EM-50, "TIMING CHAIN" .
   - Camshaft; Refer to EM-38, "CAMSHAFT" .
   - Cylinder head assembly; Refer to EM-60, "CYLINDER HEAD" .
   - Oil filter; Refer to LU-9, "OIL FILTER" .
   - Oil pressure switch; Refer to LU-6, "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.

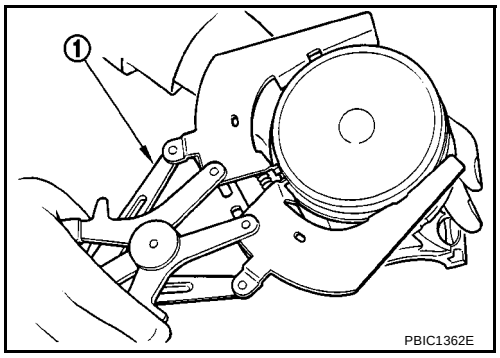
   CAUTION:
   Make sure the rear oil seal retainer is not damaged.
9. Remove piston and connecting rod assembly.
   - Before removing connecting rod, check connecting rod side clearance. Refer to EM-86, "CONNECTING ROD SIDE CLEARANCE" .



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).

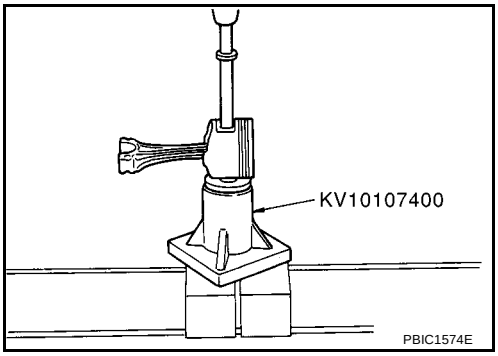
    CAUTION:
    - **Be careful not to damage piston.**
    - **Do not expand piston rings excessively. It can damage piston rings.**
    - Before removal of piston ring, check piston ring side clearance. Refer to EM-86, "PISTON RING SIDE CLEARANCE" .



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.



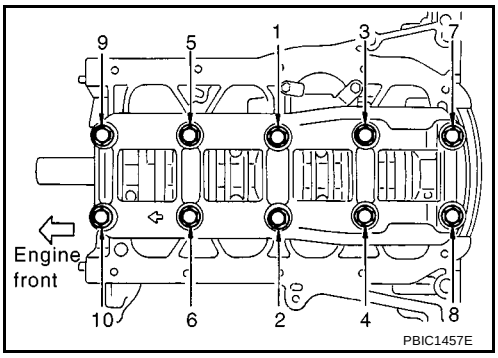
13. Remove the main bearing cap in the following order.

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-85, "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.

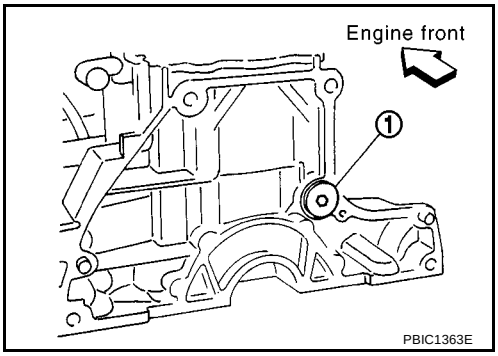


CAUTION:
Identify installation position of each part. Arrange removed parts so as not to mix them up.

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.

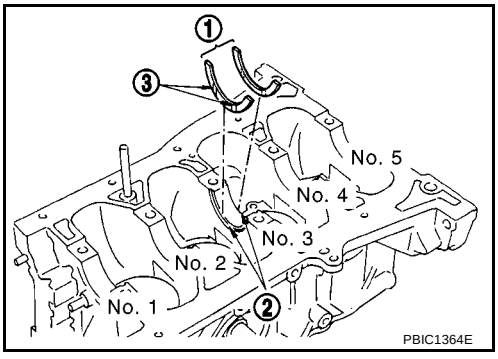
     : 58.8 - 68.6 N·m (6.0 - 6.9 kg-m, 44 - 50 ft-lb)



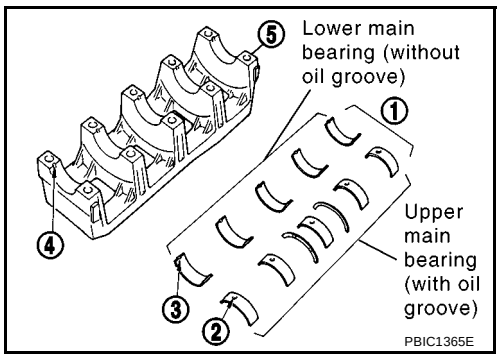
3. Install main bearings and thrust bearings.

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).



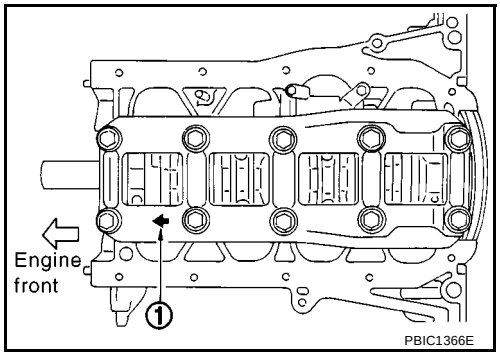
c. Install main bearing (1) in paying attention to the direction.
- Install main bearing with oil groove and oil hole (2) to cylinder block, and the one without oil groove and oil hole to main bearing cap (5).
- Before installing the main bearing, lubricate bearing surface (inside) with new engine oil. 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.

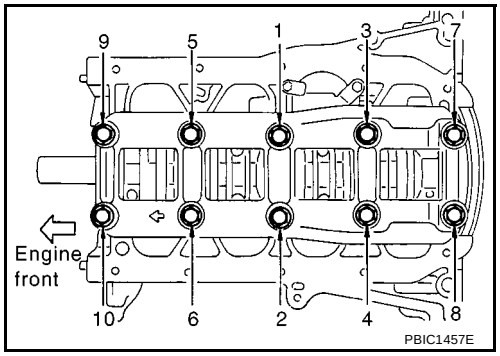


6. Tighten main bearing cap bolts in numerical order shown in figure with the following steps.

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).

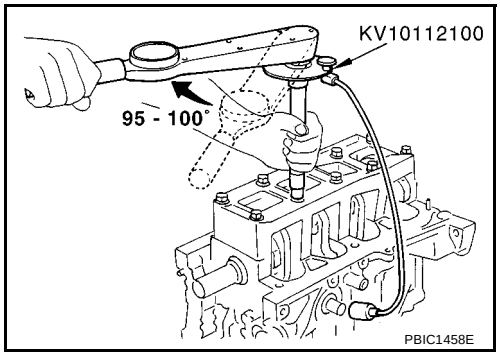
c. Tighten with 95 - 100 degrees clockwise [Target: 95 degrees].(Angle tightening)



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

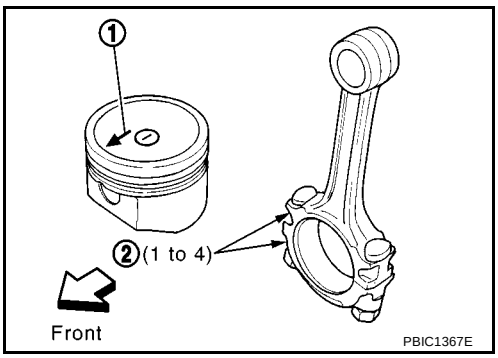
CAUTION:
Check tightening angle with an angle wrench. Do not visually check the tightening angle.

- After tightening main bearing cap bolts, rotate crankshaft by hand and make sure that it turns smoothly.
- Check crankshaft side clearance. Refer to EM-85, "CRANKSHAFT SIDE CLEARANCE" .



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

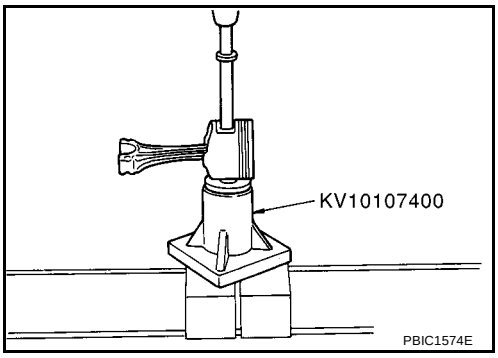
a. Set so that the piston front mark (1) on the piston head and the connecting rod cylinder number (2) engraving are in the position shown in figure.



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.

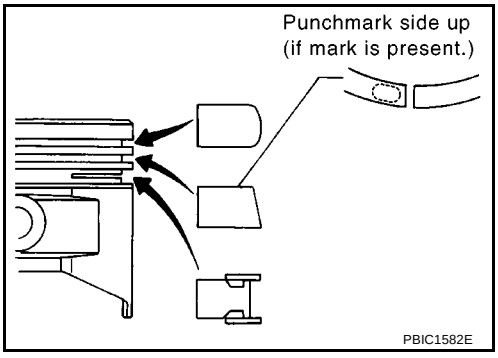
- After finishing work, make sure the piston moves freely.



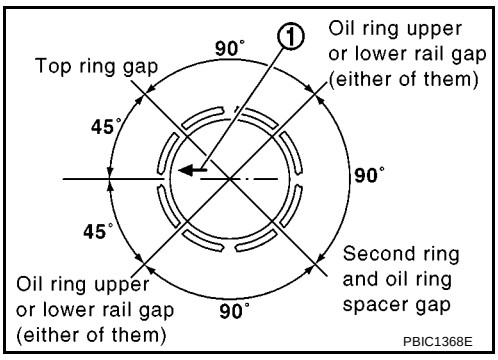
8. Install piston rings with piston ring expander as shown in the figure.

CAUTION:

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

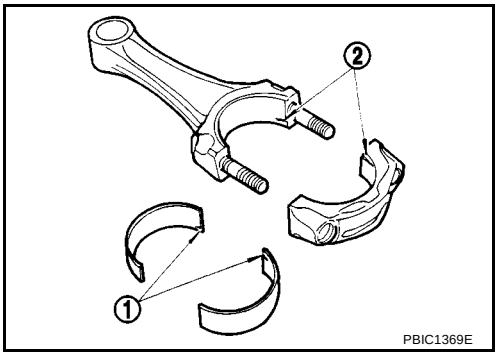


- Against the piston front mark (1), position end gaps of each piston ring as shown in figure.
- Install top ring and second ring with stamp mark side facing up.

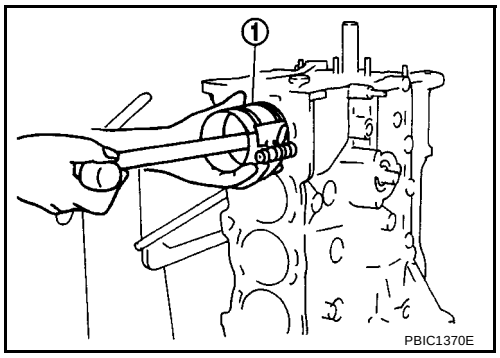


9. Install connecting rod bearing to connecting rod and connecting rod cap.

- 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.

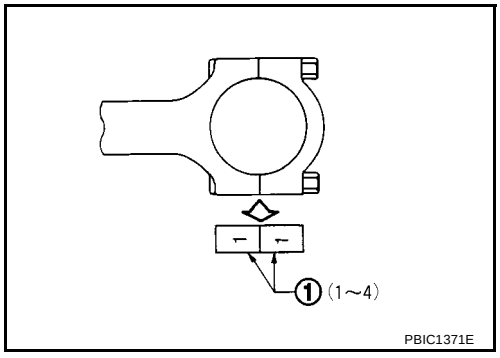


10. Install piston and connecting rod assembly to crankshaft.
    - Position the crankshaft pin corresponding to the connecting rod to be removal onto the bottom dead center.
    - Apply enough engine oil to cylinder bore, piston and crankshaft pin.
    - Install connecting rod to cylinder position corresponding 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.

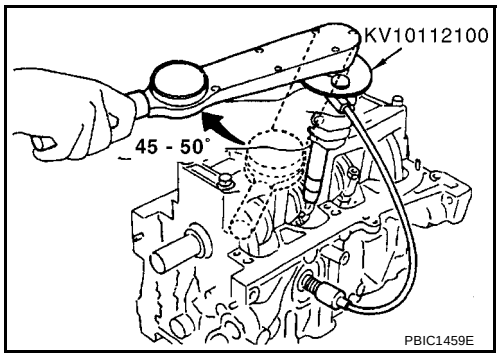


12. Tighten connecting rod nuts in following steps.

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).

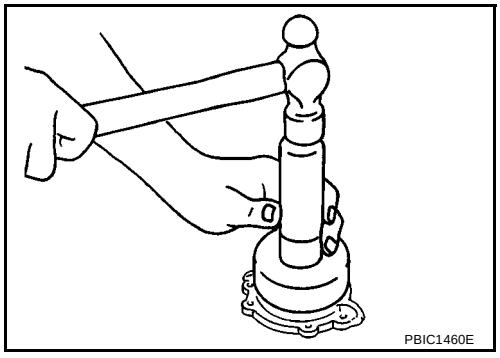
c. Tighten with 45 - 50 degrees clockwise [Target: 45 degrees]. (Angle tightening)



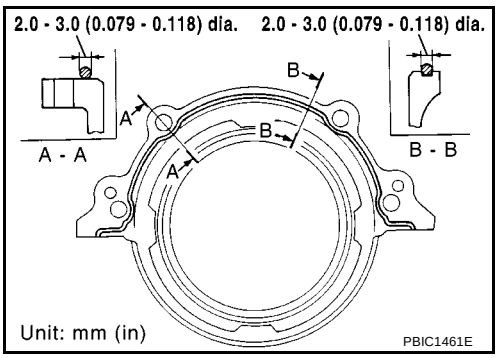
CAUTION:
Check tightening angle with an angle wrench (special service tool). Do not visually check the tightening angle.

- After the nuts were tightened, rotate crankshaft by hand and make sure that it turns smoothly.
- Check connecting rod side clearance. Refer to EM-86, "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.

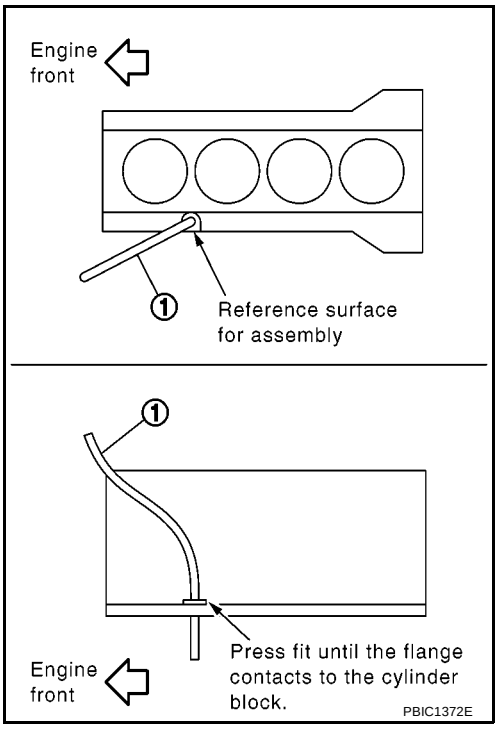


14. Install rear oil seal retainer.
    - Evenly apply the liquid gasket to the position shown in figure. Use Genuine Liquid Gasket or equivalent.
    - Install so that it matches up with the dowel pin on the cylinder block side.



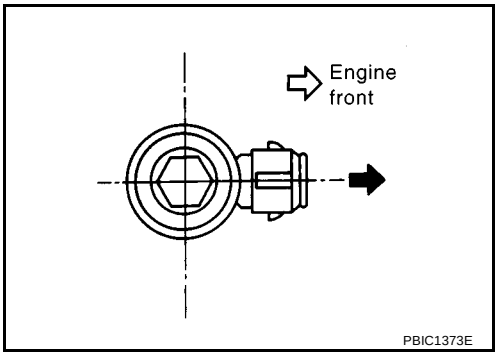
15. Install oil level gauge guide (1).
    - Press fit the oil level gauge guide (1) into the cylinder block with the assembly reference surface on the plate set as shown in the figure.
    - Apply sealant to the press fit areas.

    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.**

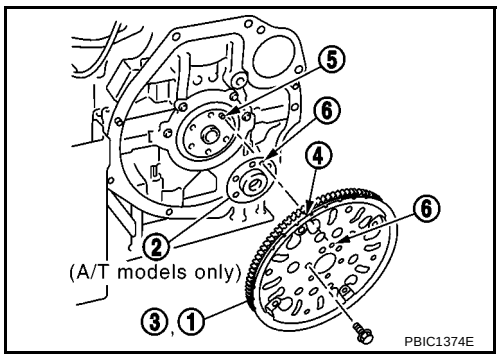


17. For the following, install the parts disassembled in step 4 in the reverse order.
18. Secure the position of the engine with the hoist, remove the bolts, and lower from the engine stand.
19. Install rear plate.

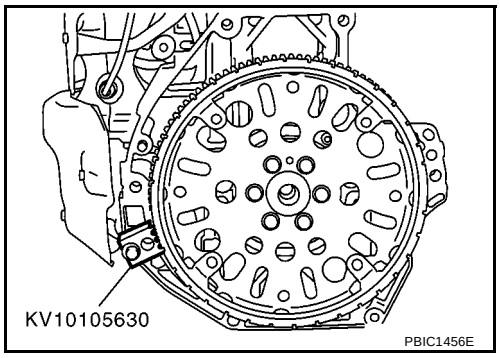
20. Install the flywheel (M/T models) (1), the adapter (A/T models) (2), and the drive plate (A/T models) (3).
    - Install so that signal plate (4) is towards the back of the engine.
    - Install by aligning the dowel pin hole (6) with the dowel pin (5) on the back of the crankshaft.

    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

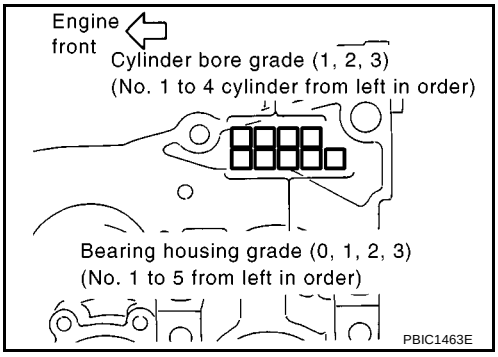
Selection points	Selection parts	Selection items	Selection methods
Between cylinder block and crankshaft	Main bearing	Main bearing grade (Bearing thickness)	Determined by cylinder block bearing housing grade (inner diameter of housing) and crankshaft journal grade (outer diameter of journal).
Between 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.

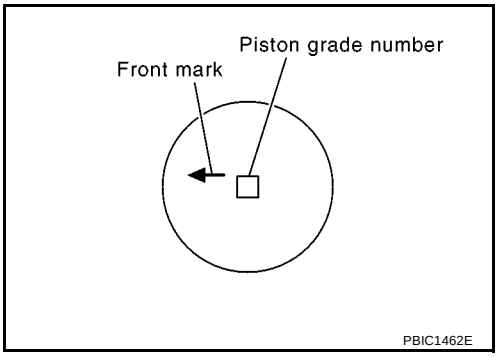
HOW TO SELECT PISTON

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

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

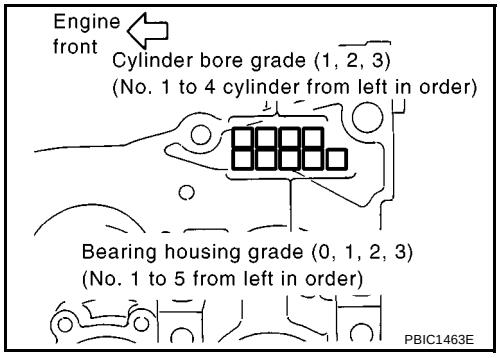
Unit: mm (in)

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)

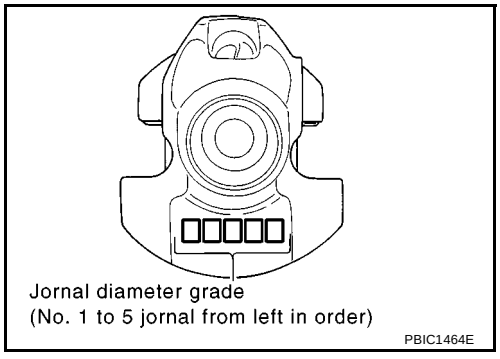
HOW TO SELECT MAIN BEARING

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

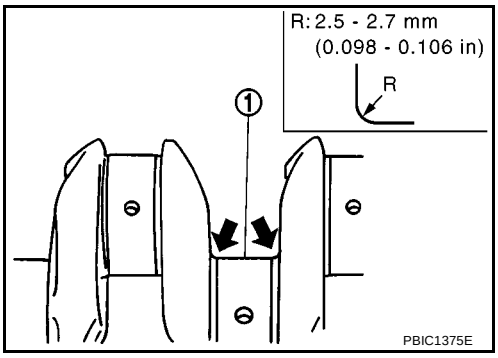
- If specified oil clearance cannot be obtained by standard size main bearing, use undersize (US) bearing.
- When using undersize bearing, install it, measure bearing inner diameter, and grind journal to obtain specified oil clearance.

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

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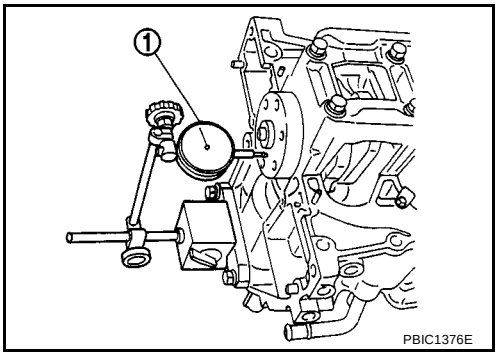
CRANKSHAFT SIDE CLEARANCE

- 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.

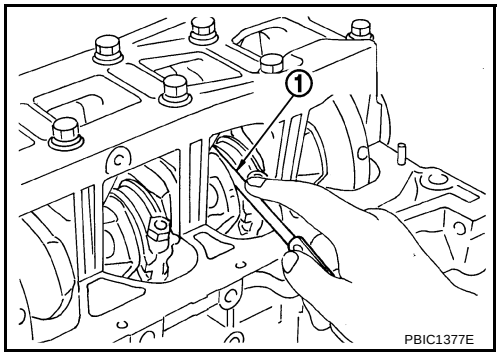


CONNECTING ROD SIDE CLEARANCE

- 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.

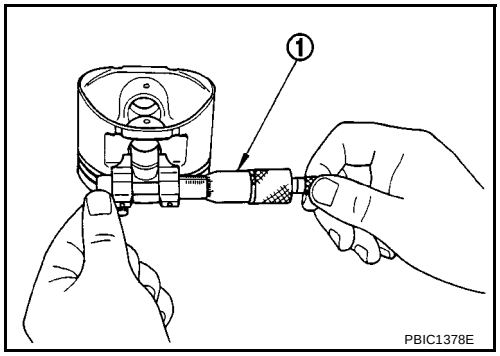


PISTON AND PISTON PIN CLEARANCE

Inner Diameter of Piston Pin

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

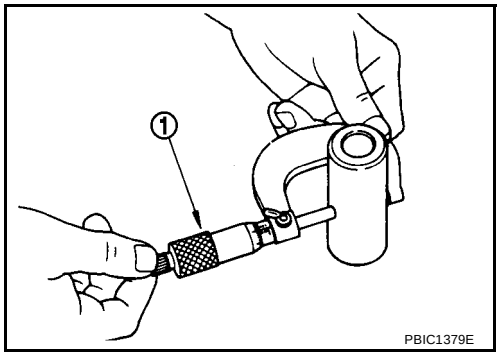
Standard : 18.008 - 18.012 mm (0.7090 - 0.7091 in)



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

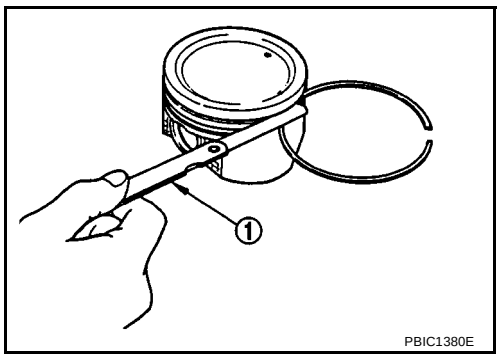
(Piston pin clearance) = (Piston pin bore diameter) – (Outer diameter of piston pin)

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-83, "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)

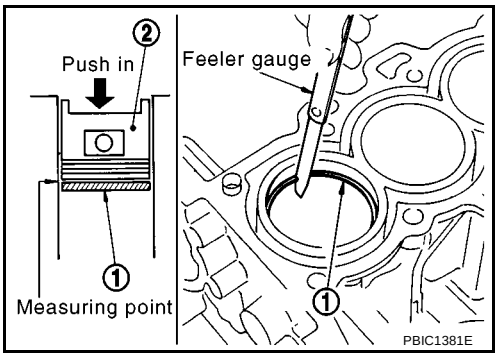
Limit:

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-89, "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

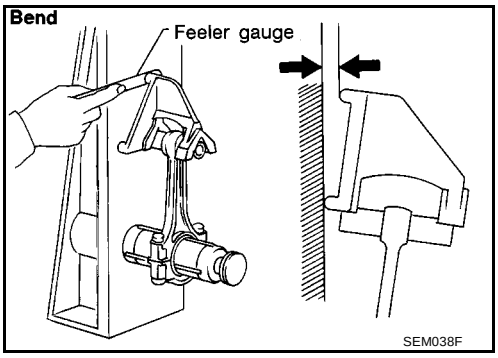
- Check connecting rod bend and torsion with a connecting rod aligner.

Bend:

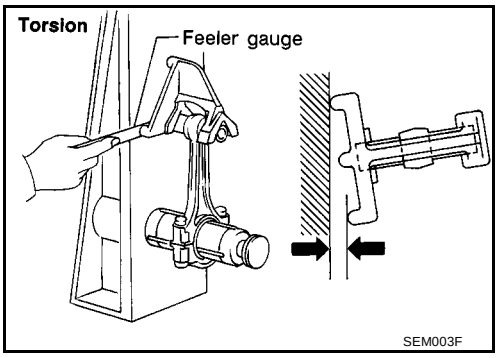
Limit : 0.15 mm (0.0059 in) per 100 mm (3.94 in) length

Torsion:

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



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

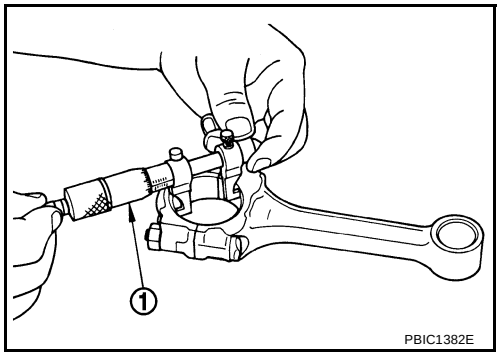


CONNECTING ROD BEARING HOUSING DIAMETER (BIG END)

- 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-77, "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.

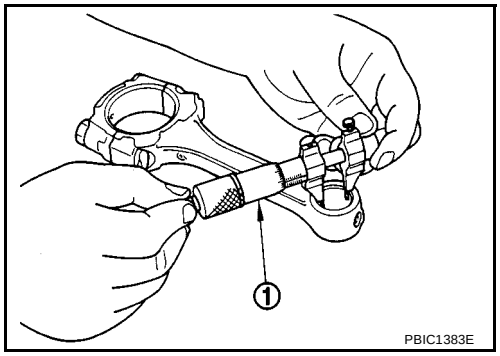


CONNECTING ROD BUSHING OIL CLEARANCE DIAMETER (SMALL END)

Inner Diameter of Connecting Rod Bushing (Small End)

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

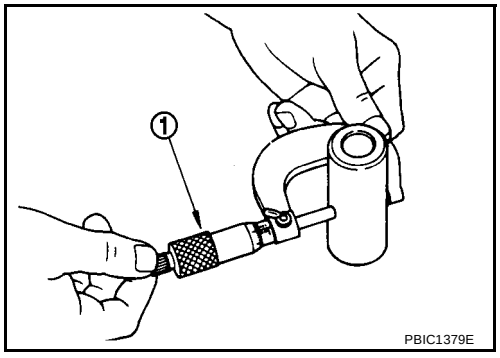
  Standard : 17.962 - 17.978 mm (0.7072 - 0.7078 in) dia.



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-83, "HOW TO SELECT PISTON" .

CYLINDER BLOCK DISTORTION

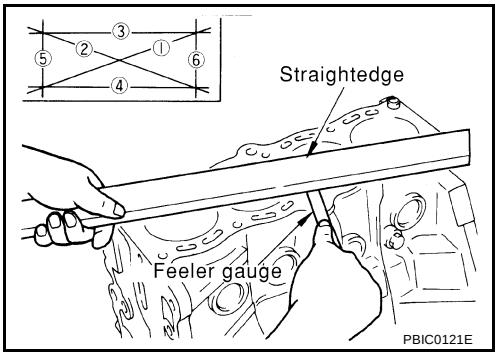
- Using a scraper, remove gasket on the cylinder block surface, and also remove oil, scale, carbon, or other contamination.

  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.



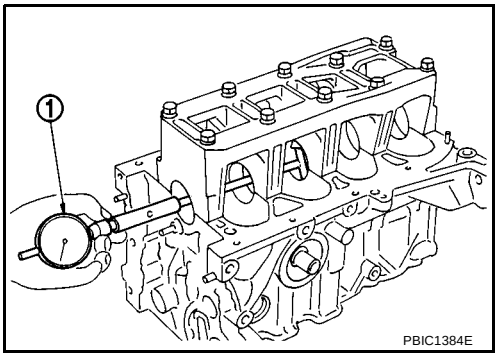
INNER DIAMETER OF MAIN BEARING HOUSING

- Install the main bearing cap with the main bearings removed, and tighten the mounting bolts to the specified torque. Refer to EM-77, "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.

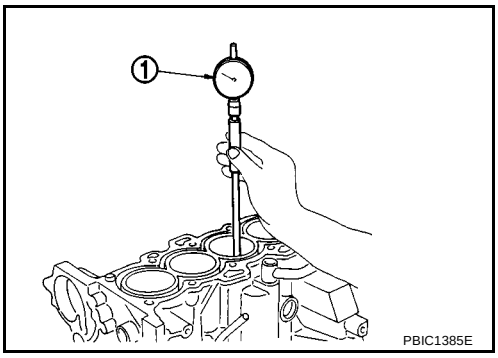
  NOTE:
  Cylinder block cannot be replaced as a single part because it is machined together with main bearing cap.



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:

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:

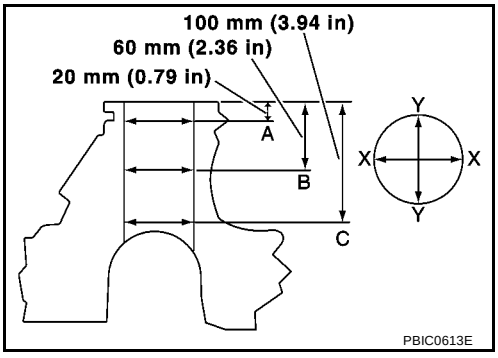
0.2 mm (0.008 in)

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)



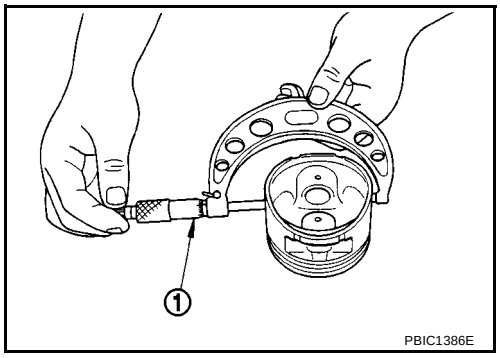
- If the measured value exceeds the limit, or if there are scratches and/or seizure on the cylinder inner wall, hone or rebore the inner wall.

- 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)
CR12DE : 34.3 mm (1.350 in)
CR14DE : 32.3 mm (1.272 in)
Standard
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-83, "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.

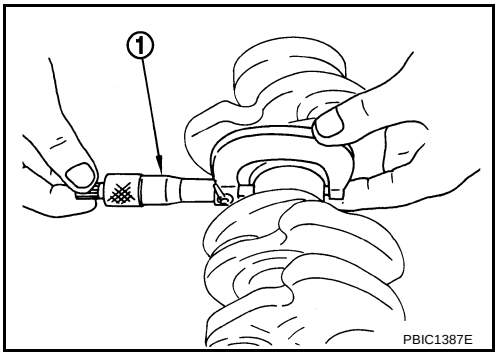
- When any cylinder needs boring, all other cylinders must also be bored.
- Do not cut too much out of cylinder bore at a time. Cut only 0.05 mm (0.0020 in) or so in diameter at a time.

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-92, "OIL CLEARANCE OF MAIN BEARING" .

OUTER DIAMETER OF CRANKSHAFT PIN

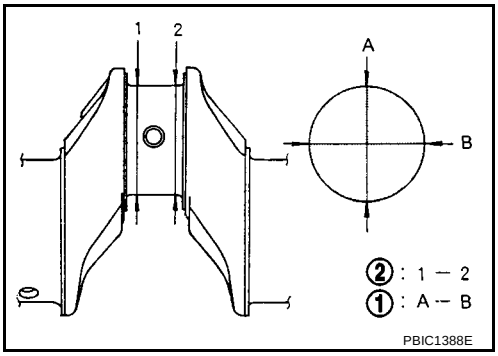
- Using a micrometer, measure outer diameter of crankshaft pin.

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-92, "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:

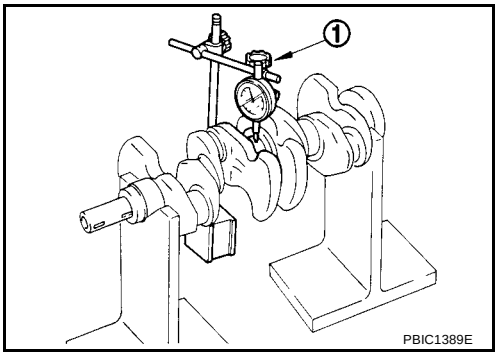
Out-of-round (X – Y) : 0.005 mm (0.0002 in)

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-92, "OIL CLEARANCE OF MAIN BEARING" or EM-92, "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)

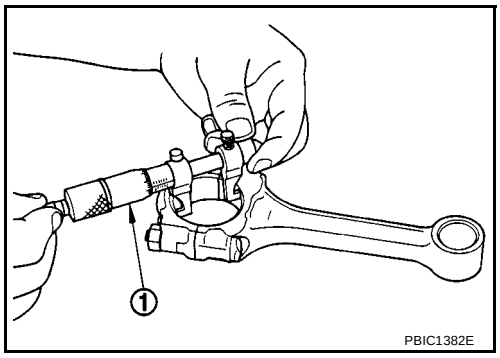


Limit : 0.05 mm (0.002 in)

- If it exceeds the limit, replace the crankshaft.

OIL CLEARANCE OF CONNECTING ROD BEARING

Method of Measurement

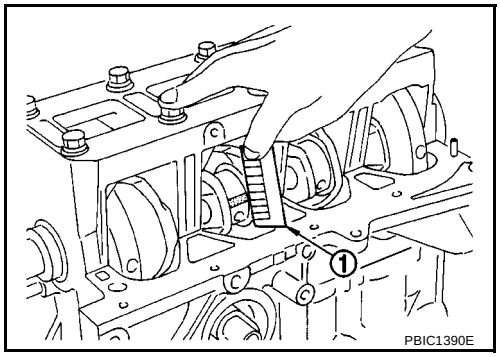


- Install the connecting rod bearings to the connecting rod and the cap, and tighten the connecting rod nuts to the specified torque. Using a inside micrometer (1) measure the inner diameter of connecting rod bearing. Refer to EM-77, "ASSEMBLY" for the tightening procedure.
  (Oil clearance) = (Inner 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-92, "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-77, "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”.

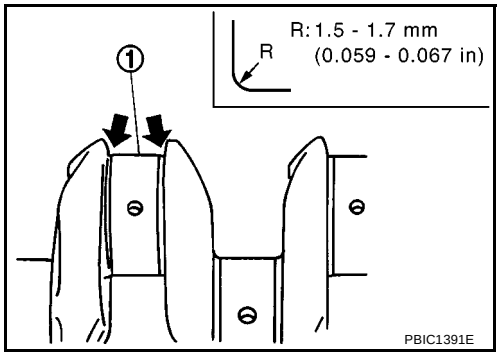
Undersize Bearing Usage Guide

- 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

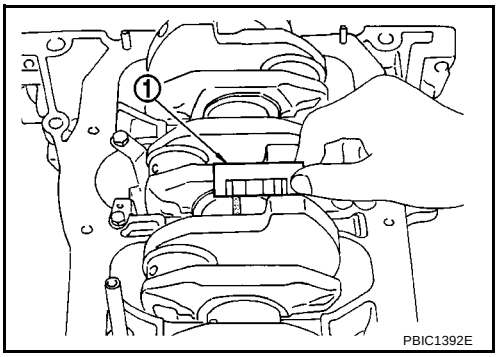
Method of Measurement

- 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-77, "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-84, "HOW TO SELECT MAIN BEARING" .

Method of Using Plastigage

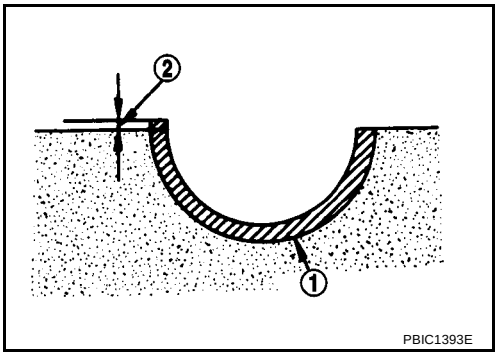


- Remove oil and dust on the crankshaft journal and the surfaces of each bearing completely.
- Cut a plastigage (1) slightly shorter than the bearing width, and place it in crankshaft axial direction, avoiding oil holes.
- Tighten the main bearing bolts with main bearing cap to the specified torque. Refer to EM-77, "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”.

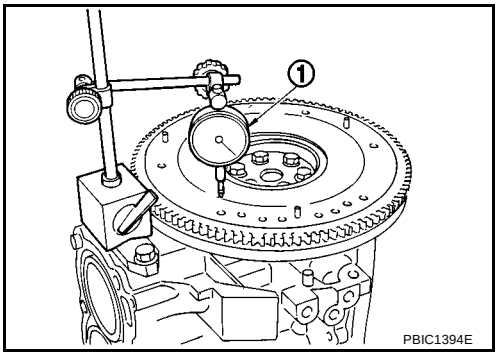
CRUSH HEIGHT OF MAIN BEARING OR CONNECTING ROD BEARING



- 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-77, "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)

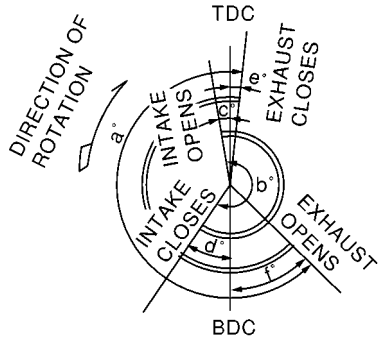
SERVICE DATA AND SPECIFICATIONS (SDS)

PFP:00030

Standard and Limit

EBS00OGK

GENERAL SPECIFICATIONS

Engine		CR12DE	CR14DE
Cylinder arrangement		4, in-line	
Displacement cm^3 (cu in)		1,240 (75.66)	1,386 (84.57)
Bore and stroke mm (in)		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		9.9	
Compression pressure kPa (bar, kg/cm^2, psi) / 350 rpm	Standard	1,383 (13.83, 14.1, 201)	
	Minimum	1,187 (11.87, 12.1, 172)	
	Differential limit between cylinders	98 (0.98, 1.0, 14)	
Valve timing (Intake valve timing control - OFF)			

PBIC0187E

Unit: degree

	a	b	c	d	e	f
CR12DE, CR14DE	216	224	– 11	55	4	32

INTAKE MANIFOLD AND EXHAUST MANIFOLD

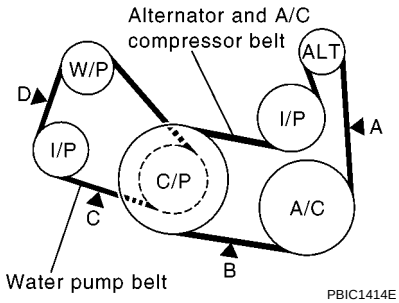
Unit: mm (in)

	Limit
Surface distortion	0.3 (0.012)

DRIVE BELTS

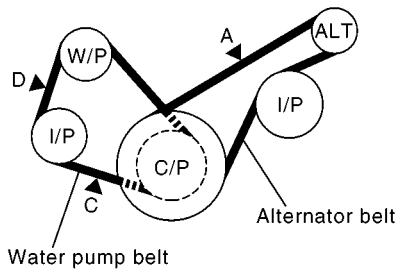
Location	Tension [N (kg, lb)]			Deflection [mm (in)] [When pressed by force of 98.1N (10 kg, 22lb)]			
	New	At adjustment	Limit	Measuring point	New belt	At adjustment	Limit
Alternator and A/C compressor belt	603 - 691 (61.5 - 70.5, 135.6 - 155.3)	495 - 583 (50.5 - 59.5, 111.3 - 131.1)	196 (20, 44.1)	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



PBIC1414E

Without A/C compressor



PBIC1415E

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

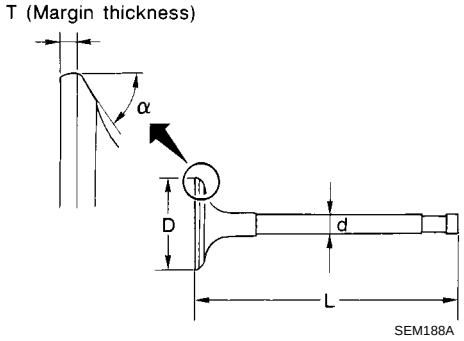
Unit: mm (in)

	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 Guide

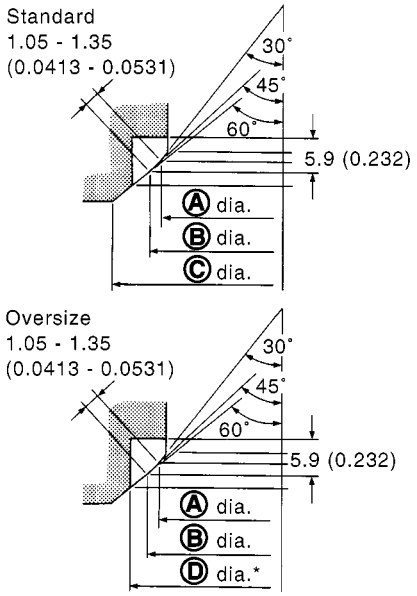
Unit: mm (in)

Engine Models		CR12DE, CR14DE			
		Intake		Exhaust	
		Standard	Service	Standard	Service
Valve guide	Outer diameter	9.522 - 9.534 (0.3749 - 0.3754)	9.723 - 9.734 (0.3828 - 0.3832)	9.522 - 9.534 (0.3749 - 0.3754)	9.723 - 9.734 (0.3828 - 0.3832)
	Inner diameter (Finished size)	5.500 - 5.518 (0.2165 - 0.2172)		5.500 - 5.518 (0.2165 - 0.2172)	
Cylinder head valve guide hole diameter		9.475 - 9.496 (0.3730 - 0.3739)	9.685 - 9.696 (0.3813 - 0.3817)	9.475 - 9.496 (0.3730 - 0.3739)	9.685 - 9.696 (0.3813 - 0.3817)
Interference fit of valve guide		0.026 - 0.059 (0.0010 - 0.0023)	0.027 - 0.049 (0.0011 - 0.0019)	0.026 - 0.059 (0.0010 - 0.0023)	0.027 - 0.049 (0.0011 - 0.0019)
Stem to guide clearance		0.020 - 0.053 (0.0008 - 0.0021)		0.040 - 0.073 (0.0016 - 0.0029)	
Valve deflection limit (Dial gauge reading)		0.2 (0.0079)		0.2 (0.0079)	

Valve Seat

Unit: mm (in)

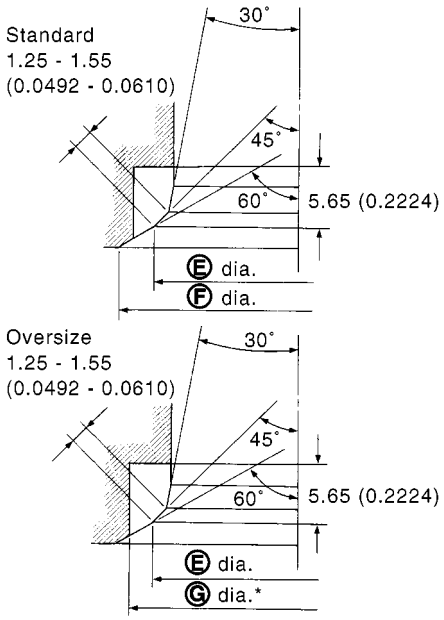
INTAKE



* Cylinder head machining data

MBIB1127E

EXHAUST



* Cylinder head machining data

MBIB1128E

Dia.	CR12DE, CR14DE
A	25.4 (1.00)
B	27.0 - 27.2 (1.062 - 1.070)
C	28.7 - 28.9 (1.129 - 1.137)
D	29.000 - 29.016 (1.1417 - 1.1424)
E	22.0 - 22.2 (0.866 - 0.874)
F	23.7 - 23.9 (0.933 - 0.940)
G	24.000 - 24.016 (0.9449 - 0.9455)

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

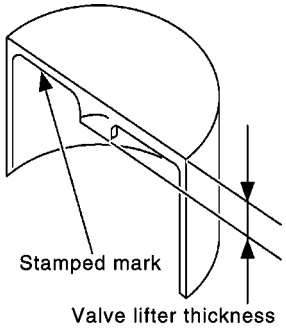
Unit: mm (in)

	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

Thickness mm (in)	Identification Mark
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



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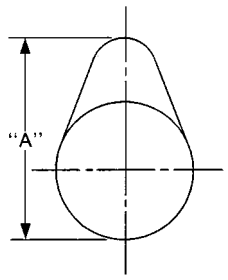
CAMSHAFT AND CAMSHAFT BEARING

Unit: mm (in)

	Standard
Camshaft runout [TIR*]	0.04 (0.0016)



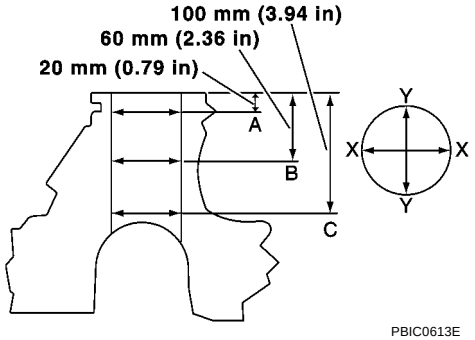
SEM671

		CR12DE, CR14DE
		Standard
Cam height "A"	Intake	40.359 - 40.549 (1.5889 - 1.5964)
	Exhaust	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

	CR12DE	CR14DE	Limit
	Standard		
Surface flatness	—		0.1 (0.004)
Height "H" (nominal)	189 (8.4232 - 8.4271)		—

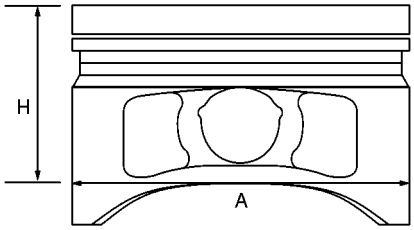
Cylinder bore inner diameter	Grade No. 1	71.000 - 71.010 (2.7953 - 2.7957)	73.000 - 73.010 (2.8740 - 2.8744)	0.2 (0.008)*
	Grade No. 2	71.010 - 71.020 (2.7957 - 2.7961)	73.010 - 73.020 (2.8744 - 2.8748)	
	Grade No. 3	71.020 - 71.030 (2.7961 - 2.7965)	73.020 - 73.030 (2.8748 - 2.8752)	
Out-of-round (Difference 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

		CR12DE	CR14DE
		Standard	
Piston skirt diameter “A”	Grade No. 1	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)	72.990 - 73.000 (2.8736 - 2.8740)
	Grade No. 3	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)	73.180 - 73.210 (2.8811 - 2.8823)
“H” dimension		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)

		CR12DE, CR14DE
Center distance		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)

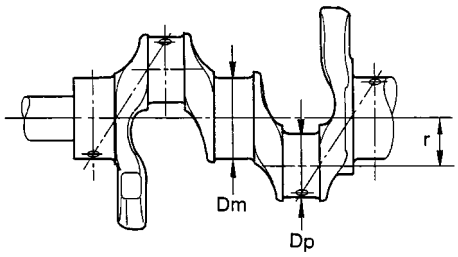
Connecting rod bushing inner diameter* (small end)	Standard	17.962 -17.978 (0.7072 - 0.7078)
Connecting rod big end inner diameter	Standard	43.000 - 43.013 (1.6929 - 1.6934)
Side clearance	Standard	0.050 - 0.420 (0.0020 - 0.0165)
	Limit	0.5 (0.0197)

*: 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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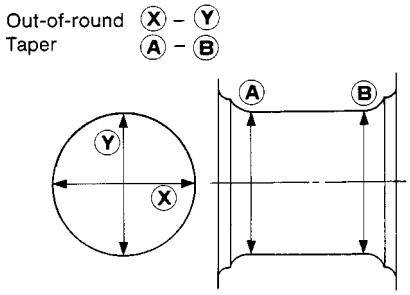


SEM715

*: 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

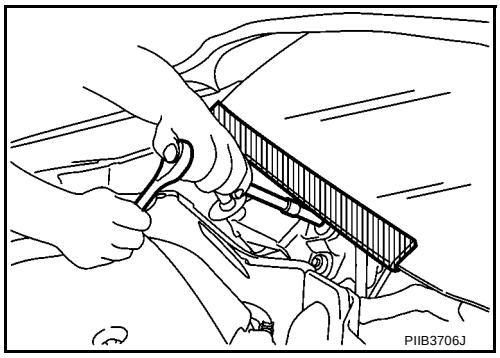
PRECAUTIONS

PFP:00001

Precautions for Procedures without Cowl Top Cover

EBS01J8N

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



Precautions for Draining Engine Coolant

EBS01J8P

Drain engine coolant when engine is cooled.

Precautions for Disconnecting Fuel Piping

EBS01J8Q

- 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

EBS01J8R

- When instructed to use special service tools, use the specified tools. Always be careful to work safely, avoid forceful or uninstructed operations.
- Exercise maximum care to avoid damage to mating or sliding surfaces.
- Cover openings of engine system with tape or the equivalent, if necessary, to seal out foreign materials.
- Mark and arrange disassembly parts in an organized way for easy troubleshooting and re-assembly.
- When loosening nuts and bolts, as a basic rule, start with the one furthest outside, then the one diagonally opposite, and so on. If the order of loosening is specified, do exactly as specified.

Precautions for Inspection, Repair and Replacement

EBS01J8S

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

Precautions for Assembly and Installation

EBS01J8T

- Use torque wrench to tighten bolts or nuts to specification.
- When tightening nuts and bolts, as a basic rule, equally tighten in several different steps starting with the ones in center, then ones on inside and outside diagonally in this order. If the order of tightening is specified, do exactly as specified.
- Replace with new gasket, packing, oil seal or O-ring.
- Thoroughly wash, clean, and air-blow each part. Carefully check the engine oil and engine coolant passages for any restriction and blockage.
- Avoid damaging the sliding or mating surfaces. Completely remove foreign materials such as cloth lint or dust. Before assembly, oil sliding surfaces well.
- Release air within route when refilling after draining coolant.
- Before starting engine, apply fuel pressure to fuel lines with turning ignition switch ON (with engine stopped). Then make sure there are no leaks at fuel line connections.
- After repairing, start engine and increase engine speed to check engine coolant, fuel, engine oil, and exhaust gas for leakage.

Parts Requiring Angle Tightening

EBS01J8U

- Use angle wrench (SST: KV10112100) for the final tightening of the following engine parts.

– Cylinder head bolts

- Main bearing cap bolts
- Connecting rod cap bolts
- Crankshaft pulley bolt (No angle wrench is required as the bolt flange is provided with notches for angle tightening)

- Do not use a torque value for final tightening.
- The torque value for these parts are for a preliminary step.
- Ensure thread and seat surfaces are clean and coated with engine oil.

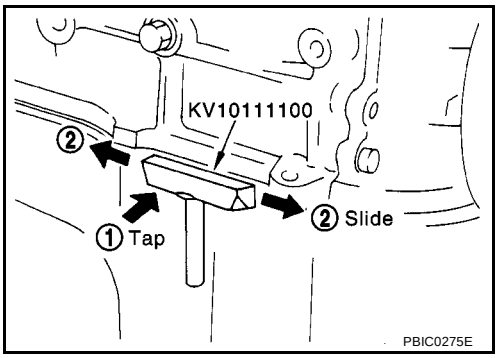
Precautions For Liquid Gasket

EBS01J8V

REMOVAL OF LIQUID GASKET

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

  CAUTION:
  Be careful not to damage the mating surfaces.

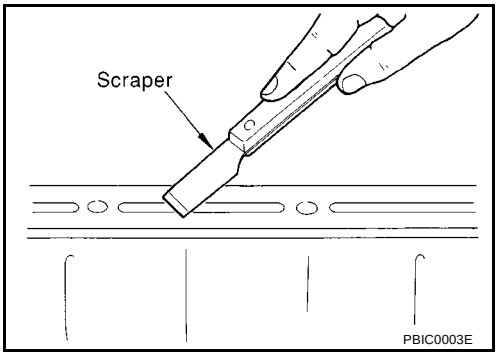


- Tap seal cutter to insert it (1), and then slide it (2) by tapping on the side as shown in the figure.
- In areas where seal cutter is difficult to use, use plastic hammer to lightly tap the parts, to remove it.

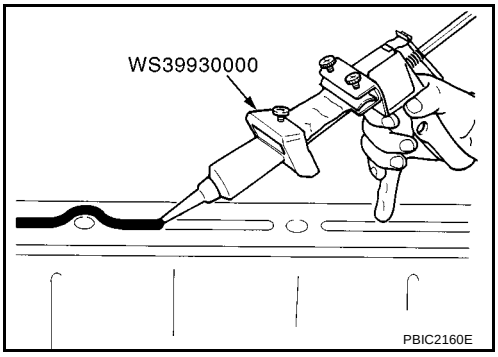
  CAUTION:
  If for some unavoidable reason tool such as screwdriver is used, be careful not to damage the mating surfaces.

LIQUID GASKET APPLICATION PROCEDURE

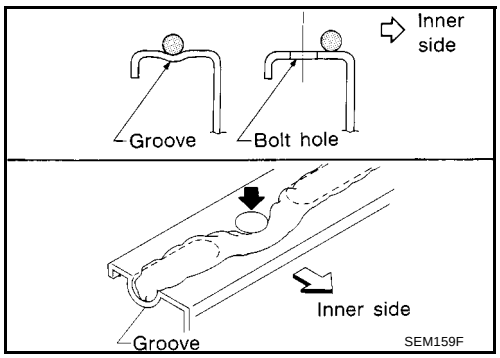
1. Using a scraper, remove the old liquid gasket adhering to the liquid gasket application surface and the mating surface.
   - Remove the liquid gasket completely from the groove of the liquid gasket application surface, mounting bolts and bolt holes.
2. Wipe the liquid gasket application surface and the mating surface with white gasoline (lighting and heating use) to remove adhering moisture, grease and foreign materials.



3. Attach liquid gasket tube to the tube presser (SST).
   Use Genuine Liquid Gasket or equivalent.
4. Apply the liquid gasket without breaks to the specified location with the specified dimensions.
   - If there is a groove for the liquid gasket application, apply the liquid gasket to the groove.



- As for the bolt holes, normally apply the liquid gasket inside the holes. Occasionally, it should be applied outside the holes. Make sure to read the text of service manual.
- Within 5 minutes of liquid gasket application, install the mating component.
- If the liquid gasket protrudes, wipe it off immediately.
- Do not retighten mounting bolts or nut after the installation.
- Wait 30 minutes or more after installation before refilling engine oil and engine coolant.



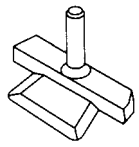
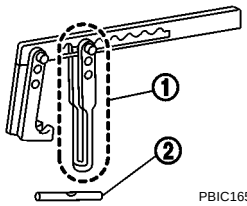
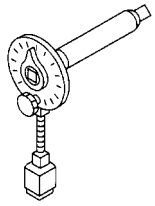
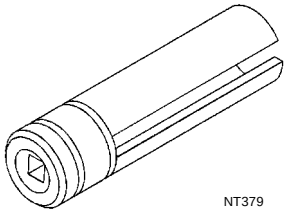
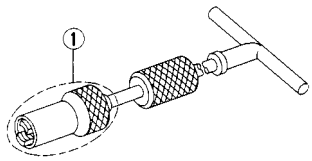
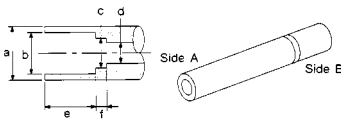
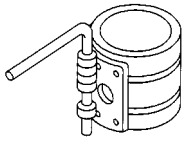
CAUTION:
If there are specific instructions in this manual, observe them.

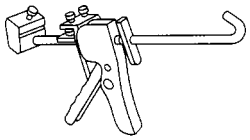
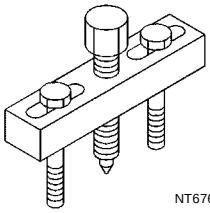
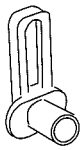
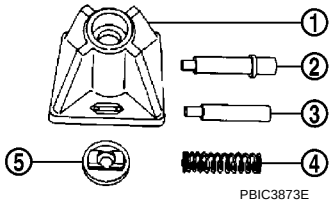
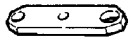
PREPARATION

PFP:00002

Special Service Tools

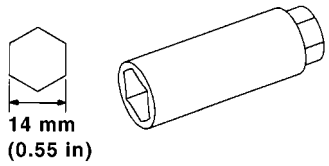
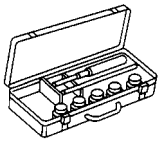
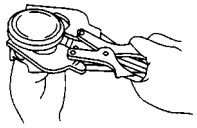
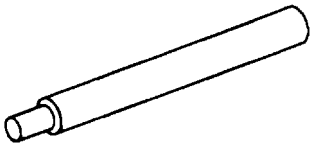
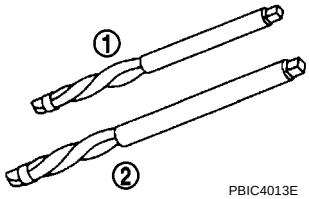
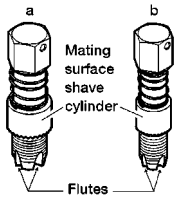
EBS01J8W

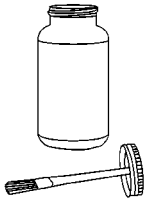
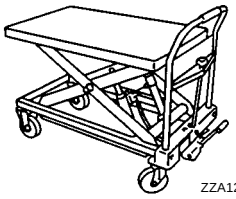
Tool number Tool name	Description
KV10111100 Seal cutter  S-NT046	Removing oil pan (lower and upper) etc.
KV10116200 Valve spring compressor 1. KV10115900 Attachment 2. KV10109220 Adapter  PBIC1650E	Disassembling and assembling valve mechanism Part (1) is a component of KV10116200, but Part (2) is not so.
KV10112100 Angle wrench  S-NT014	Tightening bolts for bearing cap, cylinder head, etc. in angle
KV10117100 Heated oxygen sensor wrench  NT379	Loosening or tightening heated oxygen sensor 1 **For 22 mm (0.87 in) width hexagon nut**
KV10107902 Valve oil seal puller 1. KV10116100 Valve oil seal puller adapter  S-NT605	Removing valve oil seal
KV10115600 Valve oil seal drift  S-NT603	Installing valve oil seal **Use side A.** **a: 20 (0.79) dia.** **d: 8 (0.31) dia.** **b: 13 (0.51) dia.** **e: 10.7 (0.421)** **c: 10.3 (0.406) dia.** **f: 5 (0.20)** Unit: mm (in)
EM03470000 Piston ring compressor  S-NT044	Installing piston assembly into cylinder bore

Tool number Tool name	Description
WS39930000 Tube presser  S-NT052	Pressing the tube of liquid gasket
KV11103000 Pulley puller  NT676	Removing crankshaft pulley
Quick connector release  PBIC0198E	Removing fuel tube quick connectors in engine room (Available in SEC. 164 of PARTS CATALOG: Part No. 16441 6N210)
1. Press stand: ST13030020 2. Center shaft: KV10114120 3. Drift: KV10109730 4. Spring: ST13030030 5. Center cap: KV10110310  PBIC3873E	Installing and removing piston pin
KV11105210 Stopper plate  ZZA0009D	Fixing flywheel

Commercial Service Tools

EBS01J8X

Tool name	Description
Spark plug wrench  PBIC3874E	Removing and installing spark plug
Valve seat cutter set  S-NT048	Finishing valve seat dimensions
Piston ring expander  S-NT030	Removing and installing piston ring
Valve guide drift  PBIC4012E	Removing and installing valve guide
Valve guide reamer  PBIC4013E	1: Reaming valve guide inner hole 2: Reaming hole for oversize valve guide
Oxygen sensor thread cleaner  AEM488	Reconditioning the exhaust system threads before installing a new heated oxygen sensor (Use with anti-seize lubricant shown below.) **a = 18 mm (0.71 in) dia. for zirconia heated oxygen sensor** **b = 12 mm (0.47 in) dia. for titania heated oxygen sensor**

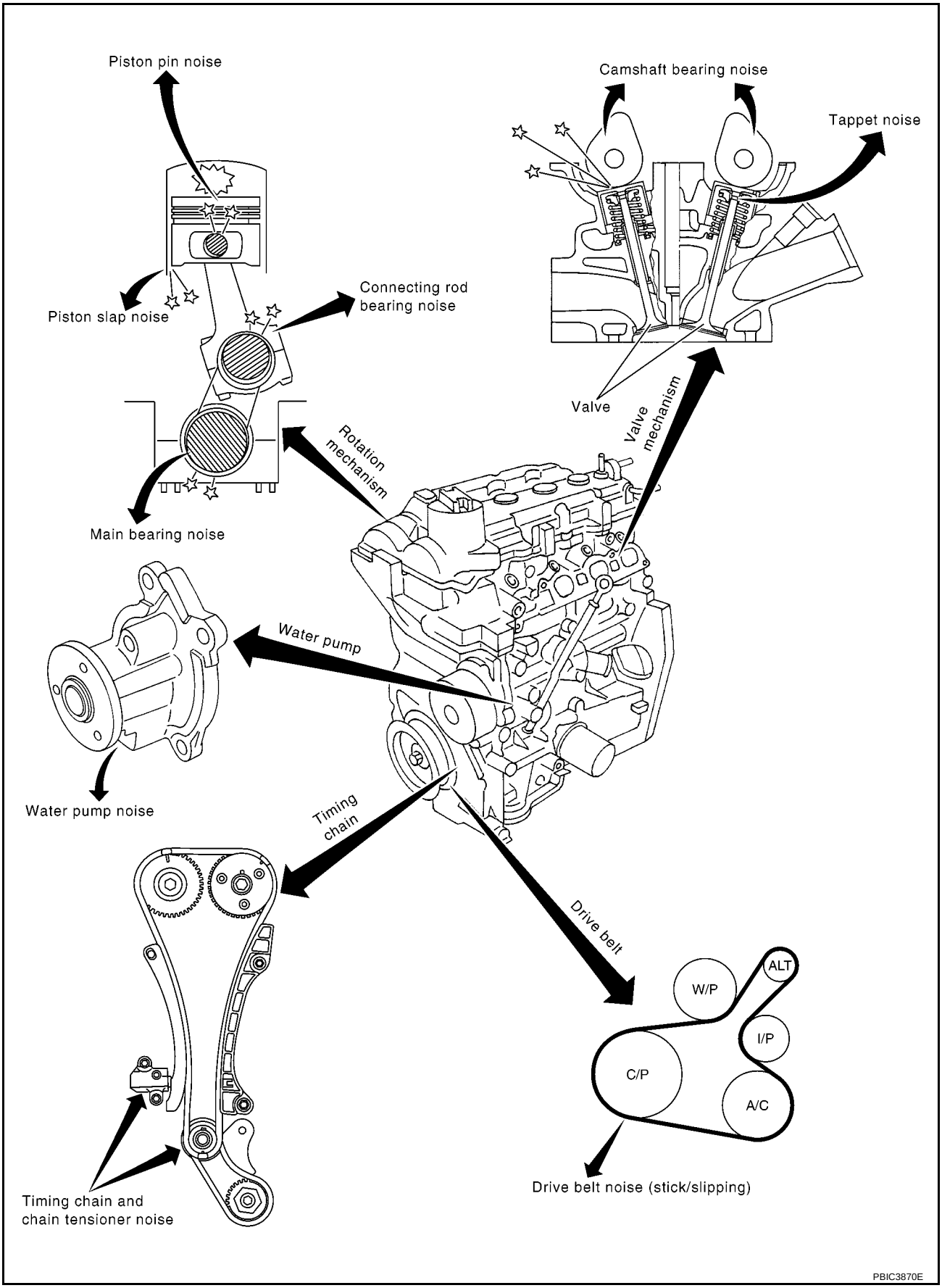
Tool name	Description
Anti-seize lubricant (Permatex 133AR or equivalent meeting MIL specification MIL-A-907)  AEM489	Lubricating oxygen sensor thread cleaning tool when reconditioning exhaust system threads
Manual lift table caddy  ZZA1210D	Removing and installing engine

NOISE, VIBRATION AND HARSHNESS (NVH) TROUBLESHOOTING

PFP:00003

NVH Troubleshooting — Engine Noise

EBS01J8Y



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

EBS01J8Z

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-167
	Rattle	C	A	—	A	B	C	Camshaft bearing noise	Camshaft journal oil clearance Camshaft runout	EM-159 EM-159
Crankshaft pulley Cylinder block (Side of engine) Oil pan	Slap or knock	—	A	—	B	B	—	Piston pin noise	Piston to piston pin oil clearance Connecting rod bushing oil clearance	EM-206 EM-208
	Slap or rap	A	—	—	B	B	A	Piston slap noise	Piston to cylinder bore clearance Piston ring side clearance Piston ring end gap Connecting rod bend and torsion	EM-210 EM-207 EM-207 EM-208
	Knock	A	B	C	B	B	B	Connecting rod bearing noise	Connecting rod bushing oil clearance Connecting rod bearing oil clearance	EM-208 EM-211
	Knock	A	B	—	A	B	C	Main bearing noise	Main bearing oil clearance Crankshaft runout	EM-212 EM-211
Front of engine Front cover	Tapping or ticking	A	A	—	B	B	B	Timing chain and chain tensioner noise	Timing chain cracks and wear Timing chain tensioner operation	EM-143
Front of engine	Squeaking or fizzing	A	B	—	B	—	C	Drive belt (Sticking or slipping)	Drive belt deflection	EM-115
	Creaking	A	B	A	B	A	B	Drive belt (Slipping)	Idler pulley bearing operation	
	Squall Creak	A	B	—	B	A	B	Water pump noise	Water pump operation	CO-48

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

DRIVE BELTS

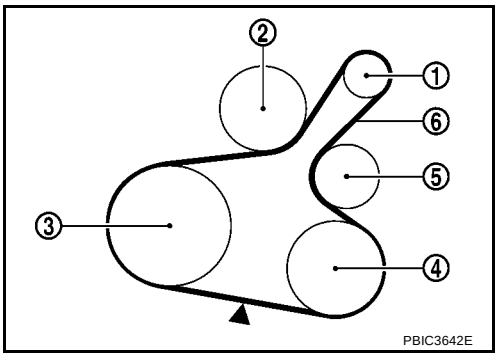
PFP:02117

Checking Drive Belts

EBS01J90

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

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



- Visually check belts for wear, damage, and cracks on inside and edges.
- Turn crankshaft pulley two time clockwise, and make sure tension on all pulleys is equal before doing the test.
- When measuring deflection, apply 98 N (10 kg, 22 lb) at the (▼) marked point.
- Measure the belt tension and frequency with acoustic tension gauge (commercial service tool) at the (▼) marked point.

CAUTION:

- **When the tension and frequency are measured, the acoustic tension gauge should be used.**
- **When checking immediately after installation, first adjust it to the specified value. Then, after turning crankshaft two turns or more, re-adjust to the specified value to avoid variation in deflection between pulleys.**

Belt Deflection (Hatchback Models):

Location		Deflection adjustment *		Unit: mm (in)
		Used belt		New belt
		Limit	After adjusted	
Drive belt	With A/C models	7.9 (0.31)	4.8 - 5.3 (0.19 - 0.21)	4.2 - 4.5 (0.17 - 0.18)
	Without A/C models	7.1 (0.28)	4.3 - 4.7 (0.17 - 0.19)	3.6 - 3.9 (0.14 - 0.15)
Applied pushing force	98 N (10 kg, 22lb)			

*: When engine is cold.

Belt Deflection (C+C Models):

Location		Deflection adjustment *		Unit: mm (in)
		Used belt		New belt
		Limit	After adjusted	
Drive belt	With A/C models	9.4 (0.37)	4.8 - 5.3 (0.19 - 0.21)	4.2 - 4.5 (0.17 - 0.18)
	Without A/C models	7.1 (0.28)	4.3 - 4.7 (0.17 - 0.19)	3.6 - 3.9 (0.14 - 0.15)
Applied pushing force	98 N (10 kg, 22lb)			

*: When engine is cold.

Tension Adjustment

EBS01J91

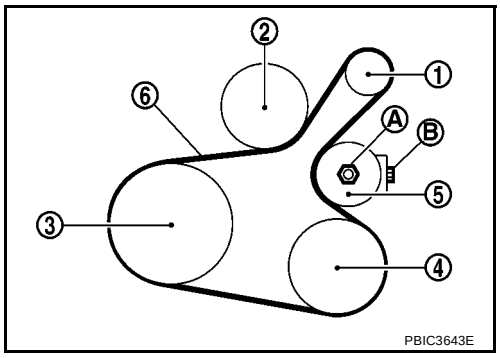
Location	Location of adjuster and tightening method
Drive belt	Adjusting bolt on idler pulley

CAUTION:

- **When belt is replaced with new one, adjust belt tension to the value for “New belt”, because new belt will not fully seat in the pulley groove.**
- **When tension of the belt being used exceeds “Limit”, adjust it to the value for “After adjusted”.**
- **When installing a belt, make sure it is correctly engaged with the pulley groove.**

- **Do not allow oil or engine coolant to get on the belt.**
- **Do not twist or bend the belt strongly.**

1. Remove front fender protector (RH). Refer to EI-14, "FENDER PROTECTOR" .
2. Loosen the idler pulley lock nut (A) from the tightening position with the specified torque by 45 degrees.



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

CAUTION:
- **When the lock nut is loosened excessively, the idler pulley tilts and the correct tension adjustment cannot be performed. Do not loosen it excessively (more than 45 degrees).**
- **Put a matching mark on the lock nut (A), and check turning angle with a protractor. Do not visually check the tightening angle.**

3. Adjust the belt tension by turning the adjusting bolt (B). Refer to EM-115, "Checking Drive Belts" .

CAUTION:
- **When checking immediately after installation, first adjust it to the specified value. Then, after turning crankshaft two turns or more, re-adjust to the specified value to avoid variation in deflection between pulleys.**
- **When the tension adjustment is performed, the lock nut should be in the condition at step“ 2”. If the tension adjustment is performed when the lock nut is loosened more than the standard, the idler pulley tilts and the correct tension adjustment cannot be performed.**

4. Tighten the lock nut (A).

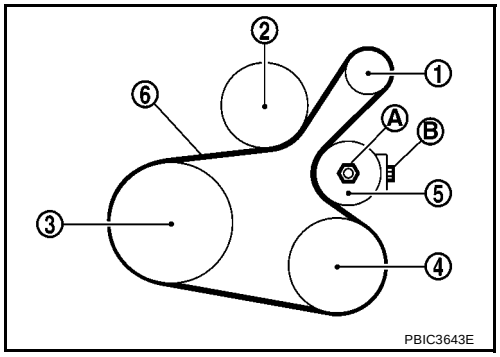
: 34.8 N·m (3.5 kg-m, 26 ft-lb)

Removal and Installation

EBS01J92

REMOVAL

1. Remove front fender protector (RH). Refer to EI-14, "FENDER PROTECTOR" .
2. Loosen the lock nut (A), and then adjust the belt tension by turning the adjusting bolt (B).

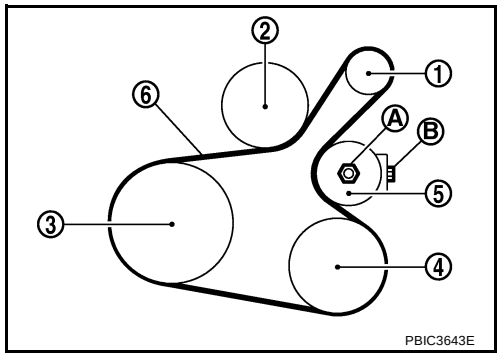


1 : Alternator
2 : Water pump
3 : Crankshaft pulley
4 : A/C compressor (with A/C models)
: Idler pulley (without A/C models)
5 : Idler pulley
6 : Drive belt

3. Remove drive belt.

INSTALLATION

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



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

: 4.4 N·m (0.45 kg-m, 39 in-lb)

NOTE:
Do not move the lock nut from the tightened position. Go to step “2”.

2. Install the drive belt to each pulley.

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

3. Adjust drive belt tension by turning the adjusting bolt (B). Refer to EM-115, "Tension Adjustment" .

CAUTION:
- **Perform the belt tension adjustment with the lock nut temporarily tightened at the step “1” so as not to tilt the idler pulley.**
- **When checking immediately after installation, first adjust it to the specified value. Then, after turning crankshaft two turns or more, re-adjust to the specified value to avoid variation in deflection between pulleys.**

4. Tighten the lock nut (A).

: 34.8 N·m (3.5 kg-m, 26 ft-lb)

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

Removal and Installation of Drive Belt Idler Pulley

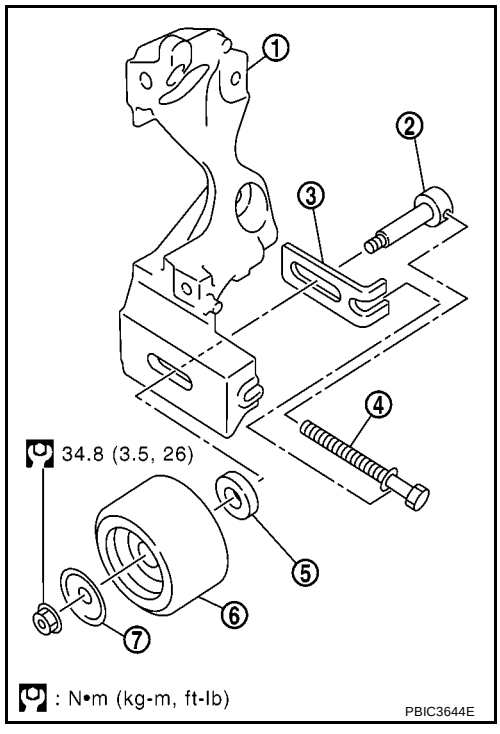
EBS01J93

REMOVAL

1. Remove drive belts. Refer to EM-116, "Removal and Installation" .
2. Remove the lock nut, and then remove the plate (7), idler pulley (6), and washer (5).

1 : Alternator bracket

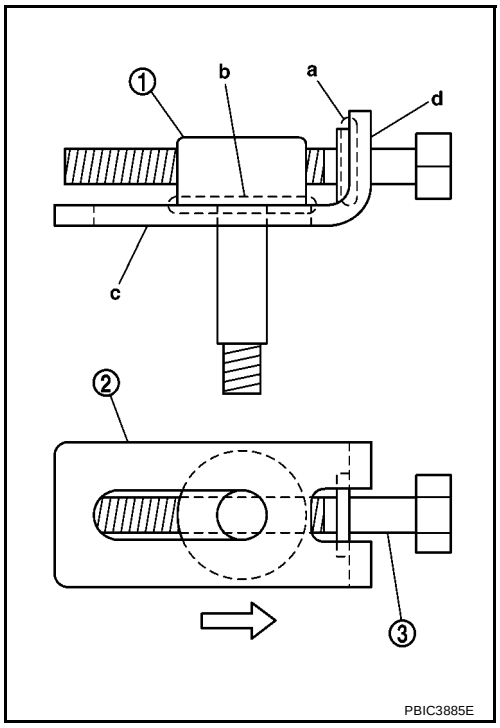
3. Remove the center shaft (2) together with the spacer (3) with inserting the adjusting bolt (4).



INSTALLATION

1. Insert the center shaft (1) into the slide groove of the spacer (2). Fully screw in the adjusting bolt (3) in the belt loosening direction (⇦).
   - At that time, place the flange (a) of the adjusting bolt and the seat (b) of the center shaft on the spacer.
2. Place each surface (c, d) of the spacer on the alternator bracket. Install the washer, idler pulley, and plate, and then temporarily tighten the lock nut.

   : 4.4 N·m (0.45 kg-m, 39 in-lb)



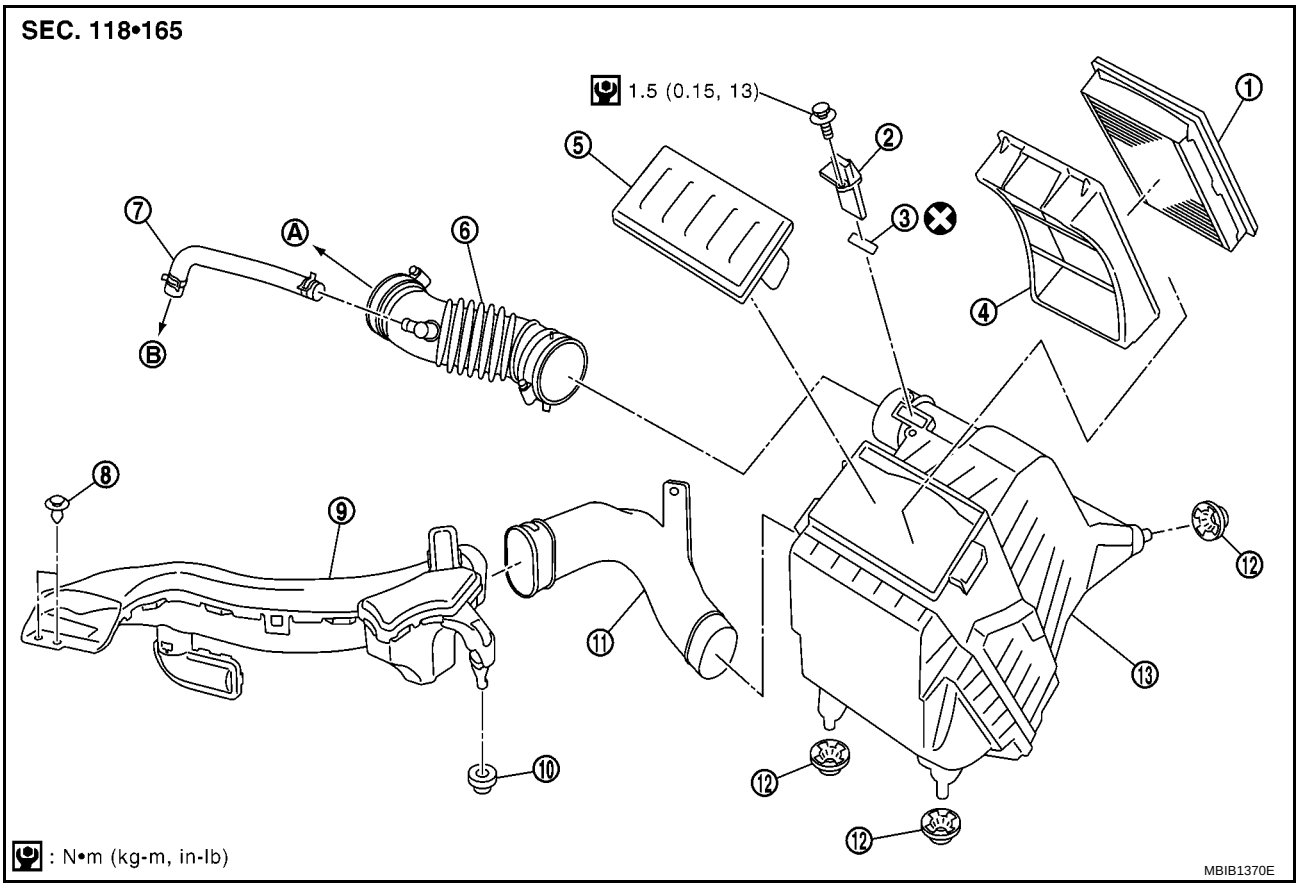
3. Install removed parts in the reverse order of removal.

AIR CLEANER AND AIR DUCT

PFP:16500

Components

EBS01J94



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

Refer to GI-9, "Components" for symbol marks in the figure.

Removal and Installation

EBS01J95

REMOVAL

1. Remove the air duct (inlet).
2. Remove the air cleaner filter from the air cleaner case. Refer to EM-120, "Changing Air Cleaner Filter" .
3. Remove the air duct [between air duct (inlet) and air cleaner case] from the air cleaner case.
4. Remove the PCV hose.
5. Remove the air duct (between air cleaner case and electric throttle control actuator).
   - Add marks as necessary for easier installation.
6. Remove air cleaner case with the following procedure.

a. Remove battery. Refer to SC-6, "BATTERY" .
b. Disconnect harness connector from mass air flow sensor.
c. Remove the air cleaner case.

7. Remove the mass air flow sensor from the air cleaner case, if necessary.

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

INSTALLATION

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

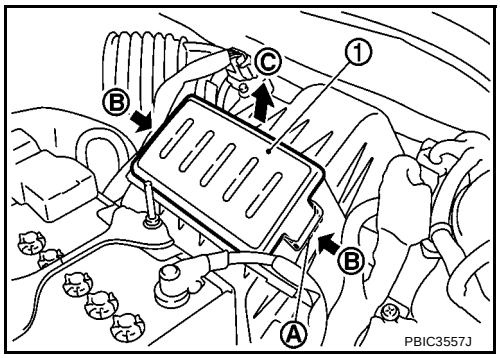
- Align marks. Attach each joint. Screw clamps firmly.

Changing Air Cleaner Filter

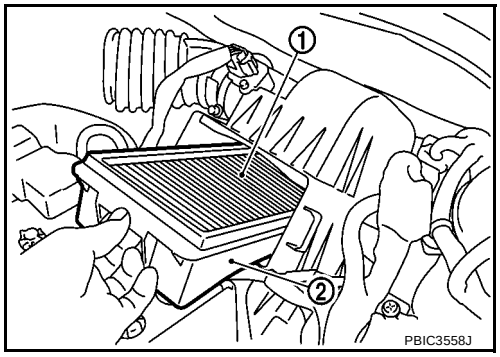
EBS01J96

REMOVAL

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



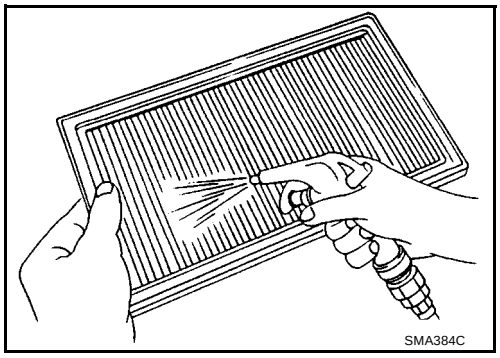
3. Remove the air cleaner filter (1) and holder (2) assembly from the air cleaner case.
4. Remove the air cleaner filter from the holder.



INSPECTION AFTER REMOVAL

It is necessary to clean air cleaner filter or replace it at the recommended intervals, more often under dusty driving conditions. Refer to MA-9, "PERIODIC MAINTENANCE" .

- Blow air into the back side of air cleaner filter until no any object sprays out.

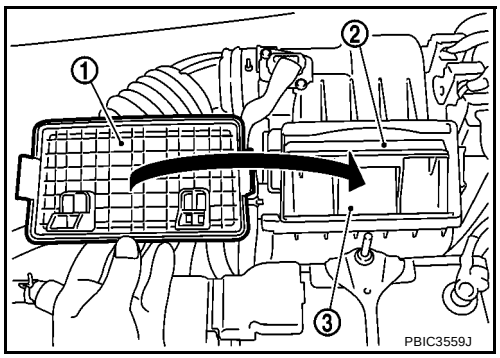


INSTALLATION

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

- Install the air cleaner cover (1) in the direction shown in the figure.

2 : Air cleaner filter
3 : Holder

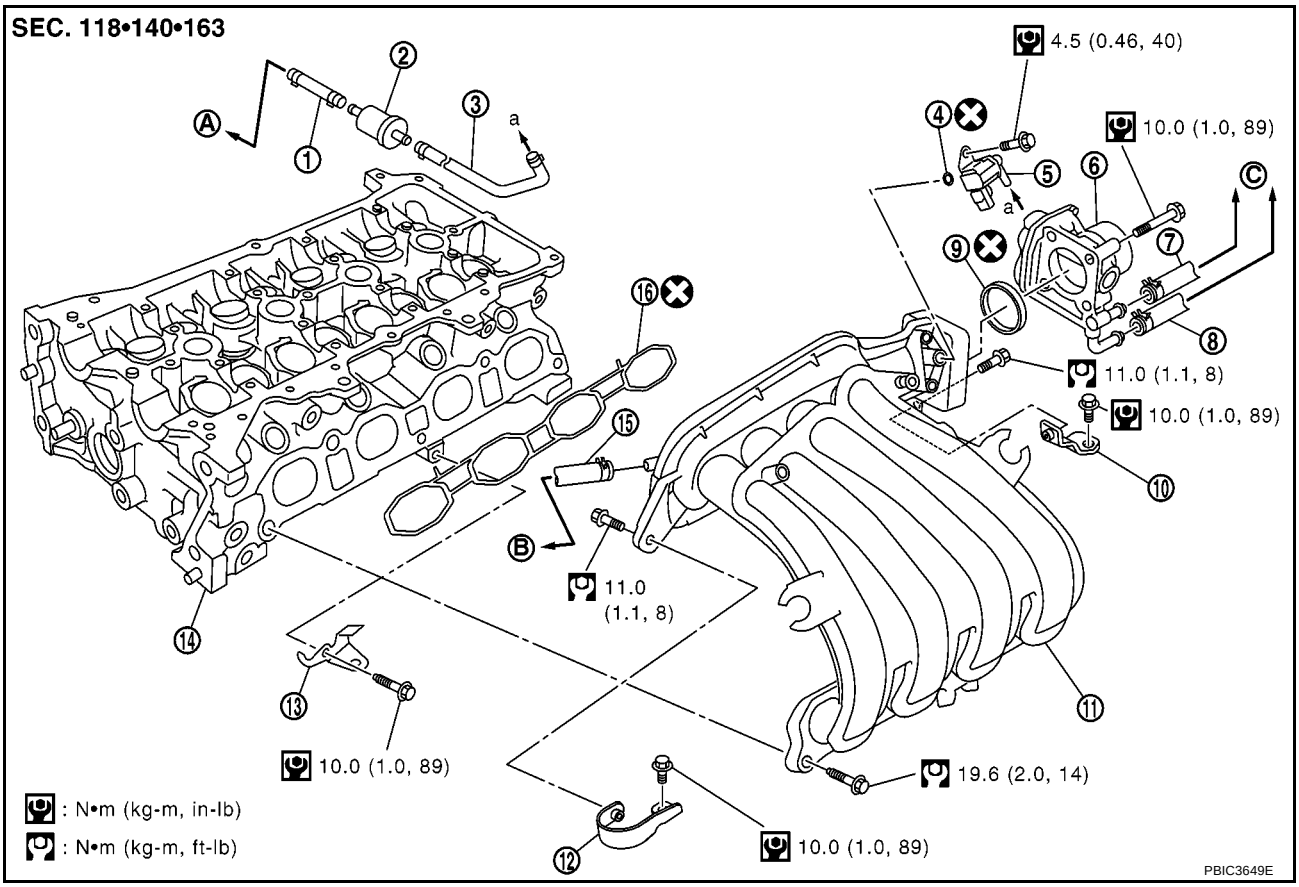


INTAKE MANIFOLD

PFP:14003

Components

EBS01J97



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

Refer to GI-9, "Components" for symbol marks in the figure.

Removal and Installation

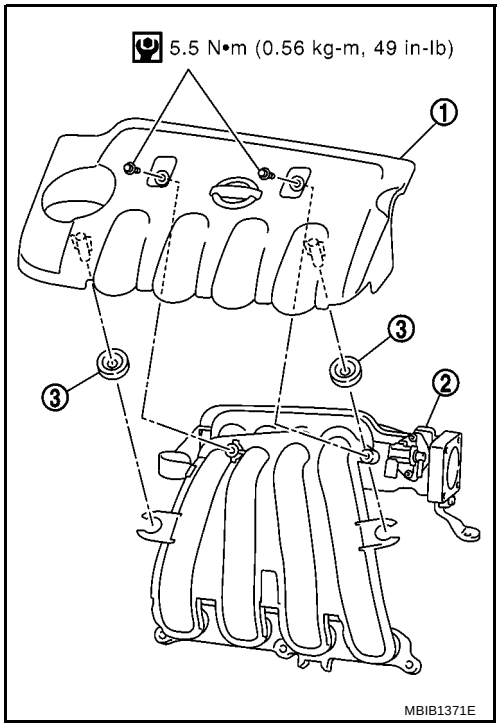
EBS01J98

REMOVAL

1. Remove engine cover (1).

2 : Intake manifold

3 : Grommet



2. Remove the air duct (inlet) and the air duct (between air cleaner case and electric throttle control actuator). Refer to EM-119, "AIR CLEANER AND AIR DUCT" .
3. Move the reservoir tank. Refer to CO-38, "RADIATOR" .
4. Disconnect water hoses from electric throttle control actuator, attach blind plug to prevent engine coolant leakage.

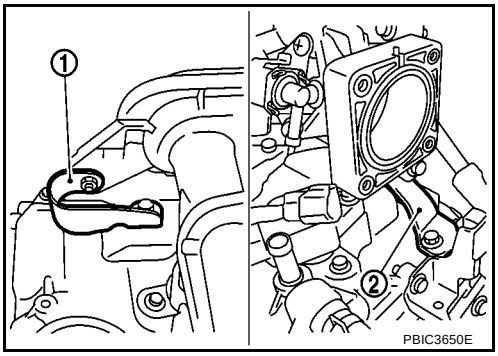
   CAUTION:
   - **Perform this step when the engine is cold.**
   - **Do not spill engine coolant on drive belts.**
5. Pull out oil level gauge.

   CAUTION:
   Cover the oil level gauge guide openings to avoid entry of foreign materials.
6. Remove electric throttle control actuator.

   CAUTION:
   - **Handle it carefully and avoid impacts.**
   - **Do not disassemble or adjust.**
7. Disconnect the harness connector and EVAP hose from the EVAP canister purge volume control solenoid valve.

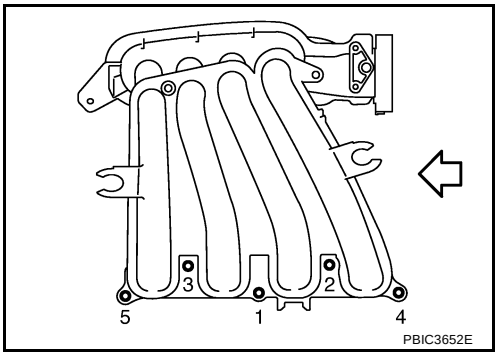
   CAUTION:
   Handle it carefully and avoid impacts.
8. Disconnect vacuum hose for brake booster from intake manifold.

9. Remove intake manifold support front (1) and rear (2).



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

    ⇦ : Engine front



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

    CAUTION:
    Handle it carefully and avoid impacts.

12. Remove intake manifold support (center) from cylinder head if necessary.

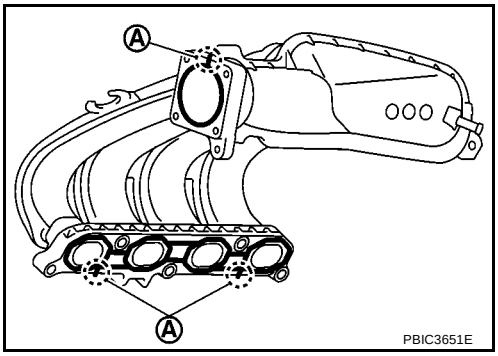
    NOTE:
    The intake manifold support (center) functions as the guide when the intake manifold is installed.

INSTALLATION

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

Intake Manifold

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

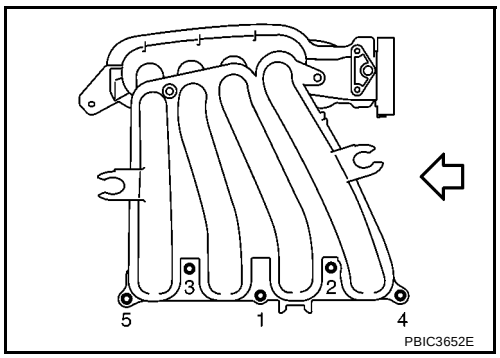


2. Place the intake manifold into the installation position.

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

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

⇦ : Engine front



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

Electric Throttle Control Actuator

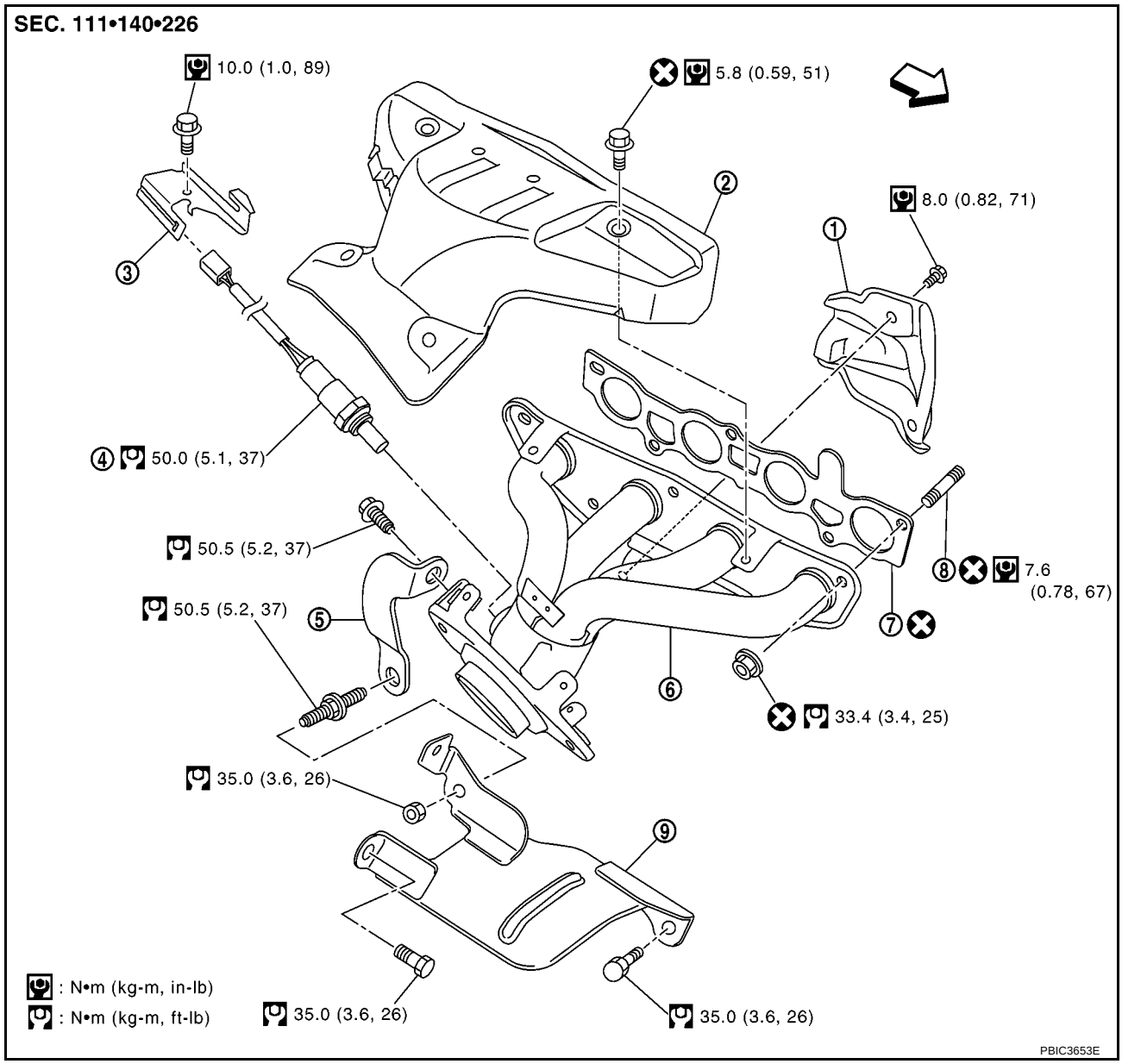
- Tighten bolts of electric throttle control actuator equally and diagonally in several steps.
- Perform “Throttle Valve Closed Position Learning” after repair when removing harness connector of the electric throttle control actuator. Refer to EC-858, "Throttle Valve Closed Position Learning" (with EURO-OBD) or EC-1284, "Throttle Valve Closed Position Learning" (without EURO-OBD).
- Perform “Throttle Valve Closed Position Learning” and “Idle Air Volume Learning” after repair when replacing electric throttle control actuator. Refer toEC-859, "Idle Air Volume Learning" (with EURO-OBD) or EC-1284, "Idle Air Volume Learning" (without EURO-OBD).

EXHAUST MANIFOLD

PFP:14004

Components

EBS01J99



1. Exhaust manifold cover
2. Exhaust manifold cover
3. Harness bracket
4. Heated oxygen sensor 1
5. Exhaust manifold stay
6. Exhaust manifold
7. Gasket
8. Stud bolt
9. Heat insulator

⇦ Engine front

Refer to GI-9, "Components" for symbol marks in the figure.

Removal and Installation

EBS01J9A

REMOVAL

1. Remove exhaust front tube. Refer to EX-4, "EXHAUST SYSTEM" .
2. Remove intake manifold. Refer to EM-121, "INTAKE MANIFOLD" .
3. Remove the harness bracket of heated oxygen sensor 1 from the cylinder head.
4. Remove exhaust manifold cover.
5. Remove the heated oxygen sensor 1.

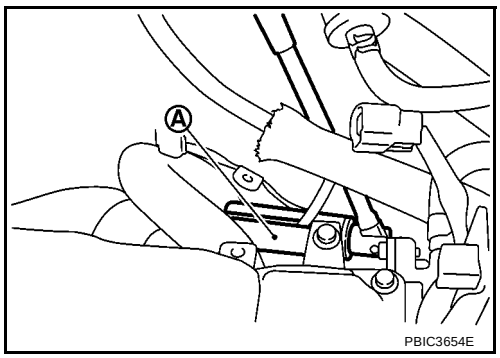
- Using heated oxygen sensor wrench (SST: KV10117100) (A), remove heated oxygen sensor 1.

CAUTION:

Handle it carefully and avoid impacts.

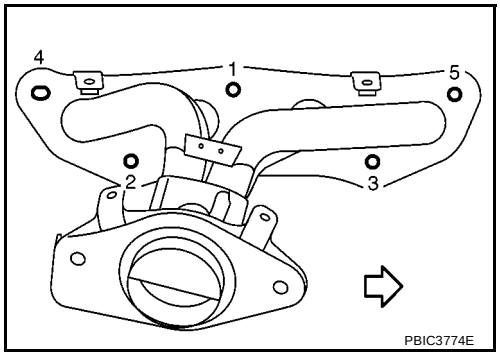
NOTE:

The exhaust manifold can be removed and installed without removing the heated oxygen sensor 1 (Disassembly of harness connector is necessary)



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

⇦ : Engine front



8. Remove gasket.

CAUTION:

Cover engine openings to avoid entry of foreign materials.

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

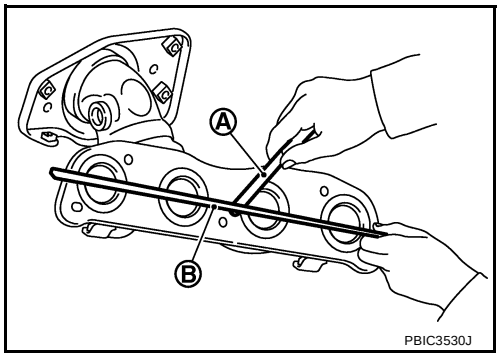
INSPECTION AFTER REMOVAL

Mounting Surface Distortion

- Using a straightedge (B) and feeler gauge (A), check distortion of exhaust manifold mounting surface.

Limit : 0.3 mm (0.012 in)

- Replace exhaust manifold if outside the limit.



INSTALLATION

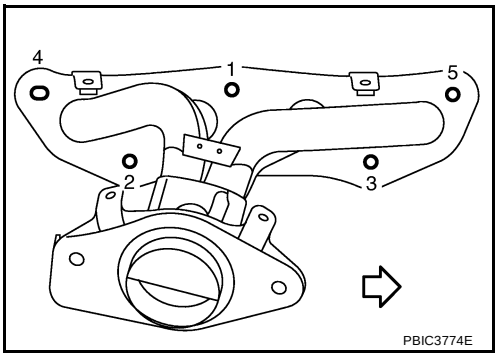
Note the following, and install in the reverse order of removal.

Exhaust Manifold

1. Tighten nuts in numerical order shown in the figure.

   ⇦ : Engine front

2. Tighten to the specified torque again.

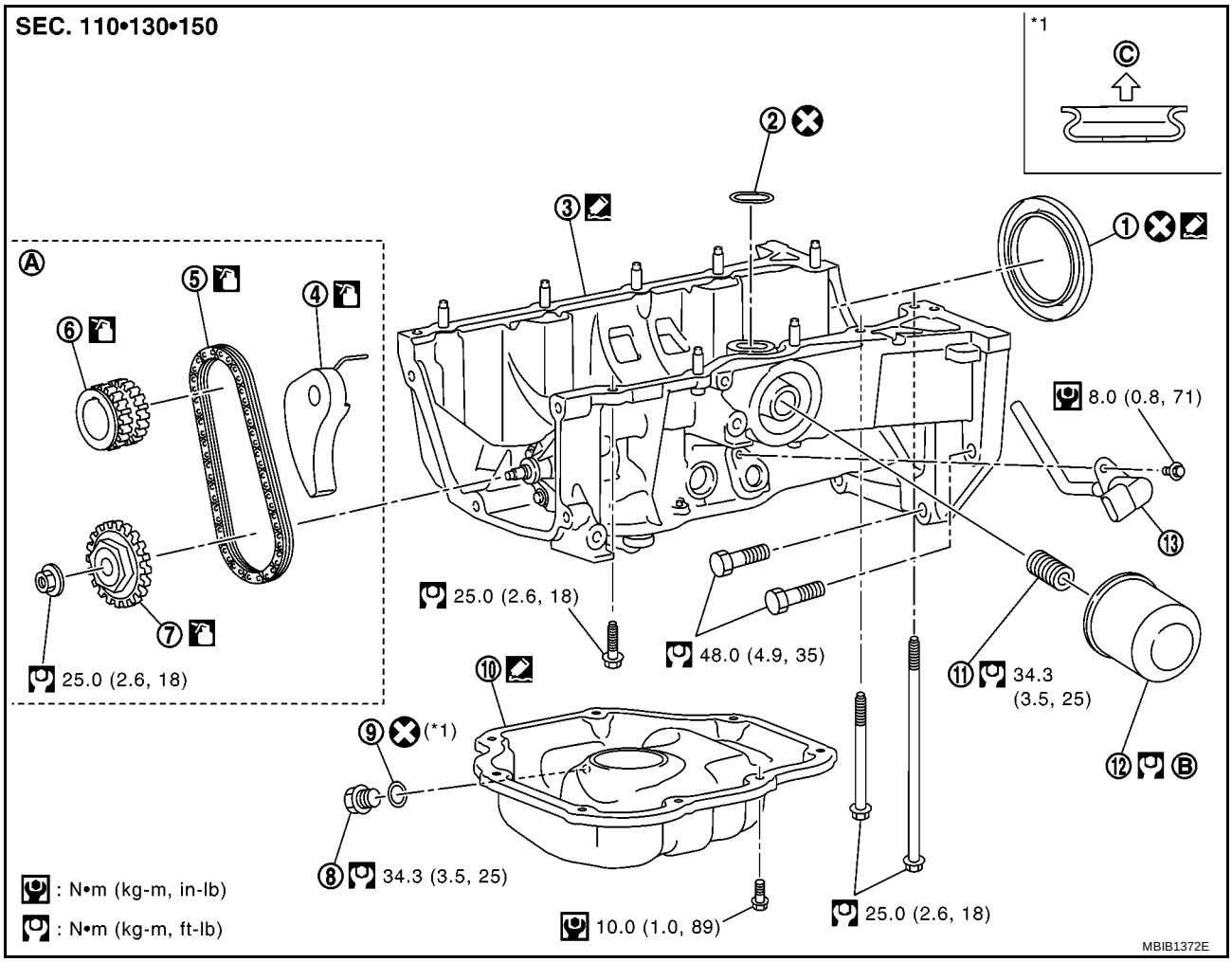


OIL PAN AND OIL STRAINER

PFP:11110

Components

EBS01J9B



1.	Rear oil seal	2.	O-ring	3.	Oil pan (upper)
4.	Chain tensioner	5.	Oil pump drive chain	6.	Crankshaft sprocket
7.	Oil pump sprocket	8.	Oil pan drain plug	9.	Washer
10.	Oil pan (lower)	11.	Oil filter stud bolt	12.	Oil filter
13.	Oil level sensor				
A.	Refer to EM-143	B.	Refer to LU-19	C.	Oil pan side

Refer to GI-9, "Components" for symbol marks in the figure.

Removal and Installation

EBS01J9C

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

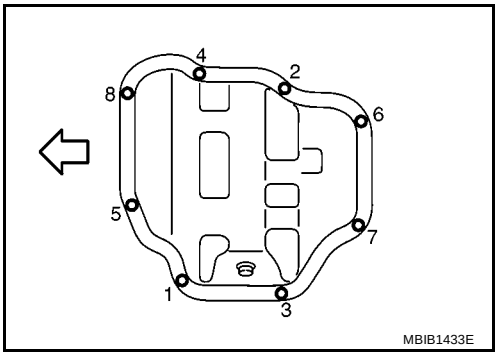
REMOVAL

NOTE:
When removing oil pan (lower) only, steps “2” and “3” are not necessary. Perform step “5” after completing step “4”.

1. Remove engine undercover.
2. Remove engine and transaxle assembly from the vehicle, and then separate engine and transaxle. Refer to EM-185, "ENGINE ASSEMBLY" .
3. Install engine assembly to widely use engine stand. Refer to EM-190, "CYLINDER BLOCK" .
4. Drain engine oil. Refer to LU-16, "ENGINE OIL" .
5. Remove the oil pan (lower) with the following procedure.

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

⇦ : Engine front



b. Insert the seal cutter (SST: KV10111100) between oil pan (upper) and oil pan (lower).

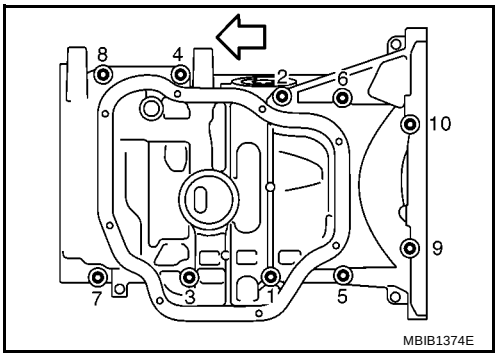
CAUTION:

- **Be careful not to damage the mating surface.**
- **A more adhesive liquid gasket is applied compared to previous types when shipped, so it should not be forced off using a flat- bladed screwdriver, etc.**

6. Remove front cover and timing chain. Refer to EM-143, "TIMING CHAIN" .
7. Remove oil pump sprocket and crankshaft sprocket together with oil pump drive chain. Refer to EM-143, "TIMING CHAIN" .
8. Remove oil pan (upper) with the following procedure.

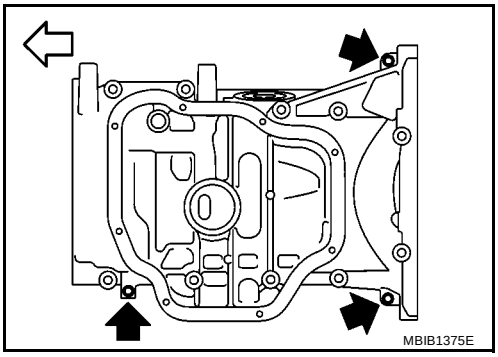
a. Loosen oil pan (upper) mounting bolts in the reverse of the order shown in the figure.

⇦ : Engine front



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

⇦ : Engine front



c. Insert the seal cutter (SST: KV10111100) between remove the oil pan (upper) and cylinder block.Slide seal cutter by tapping on the side of tool with a hammer.

CAUTION:

- **Be careful not to damage the mating surface.**
- **A more adhesive liquid gasket is applied compared to previous types when shipped, so it should not be forced off using a screwdriver, etc. outside the indicated location.**
- **Do not remove oil pump and oil strainer from oil pan (upper).**

9. Remove rear oil seal from crankshaft.

INSTALLATION

1. Install the oil pan (upper) in the following procedure.

a. Use scraper to remove old liquid gasket from mating surfaces.

- Also remove the old liquid gasket from mating surface of cylinder block.
- Remove old liquid gasket from the bolt holes and threads.

CAUTION:

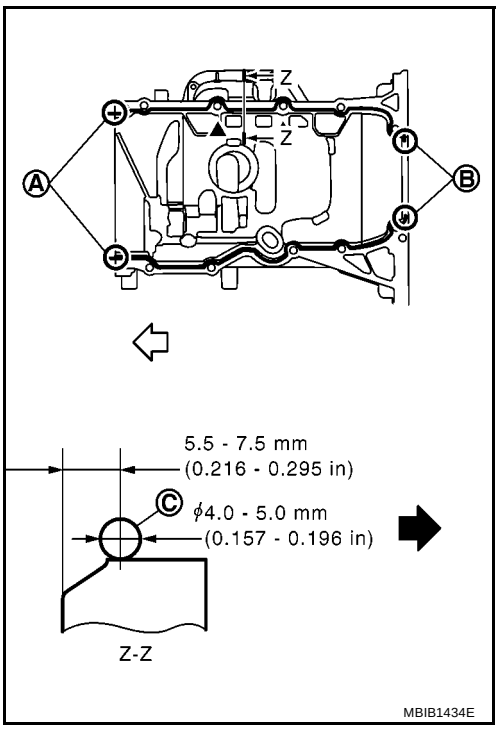
Do not scratch or damage the mating surfaces when cleaning off old liquid gasket.

b. Install O-ring to the cylinder block.

c. Apply a continuous bead of liquid gasket (C) with the tube presser (SST: WS39930000) to areas shown in the figure.
Use Genuine Liquid Gasket or equivalent.

A : 2 mm (0.07 in) protruded to outside
B : 2 mm (0.07 in) protruded to rear oil seal mounting side
⇦ : Engine front
⬅ : Oil pan out side

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



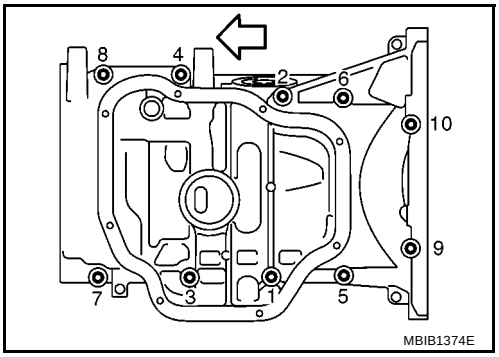
d. Tighten bolts in the numerical order shown in the figure.

⇦ : Engine front

CAUTION:
Install avoiding misalignment of both oil pan gasket and O-ring.

- The bolts are different according to the installation position. Refer to the numbers shown in the figure.

M8 × 180 mm (7.09 in) : No. 9, 10
M8 × 25 mm (0.98 in) : No. 3, 4, 7, 8
M8 × 90 mm (3.54 in) : No. 1, 2, 5, 6



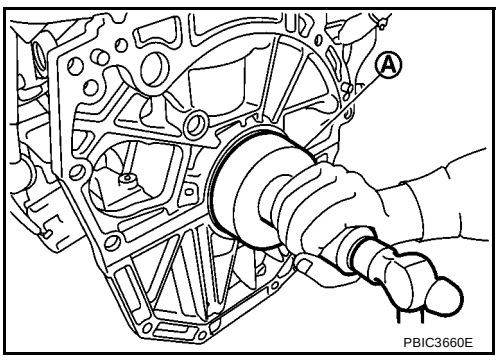
2. Install rear oil seal with the following procedure:

CAUTION:
- **The installation of rear oil seal should be completed within 5 minutes after installing oil pan (upper).**
- **Do not touch oil seal lip.**

a. Wipe off any liquid gasket protruding to the rear oil seal mounting part of oil pan (upper) and cylinder block using a spatula.

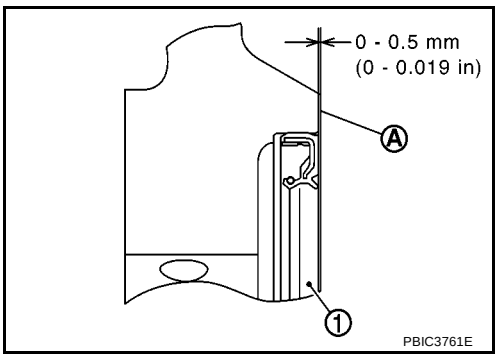
b. Apply the liquid gasket lightly to entire outside area of new rear oil seal.
Use Genuine Liquid Gasket or equivalent.

c. Press-fit the rear oil seal using a drift with outer diameter 113 mm (4.45 in) and inner diameter 90 mm (3.54 in) (commercial service tool) (A).



- Press-fit to the dimensions specified in the figure.

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



CAUTION:
- **Do not touch the grease applied to the oil seal lip.**
- **Be careful not to damage the rear oil seal mounting part of oil pan (upper) and cylinder block or the crankshaft.**
- **Press-fit straight make sure that oil seal does not curl or tilt.**

d. After press-fitting the rear oil seal, completely wipe off any liquid gasket protruding to rear end surface side.

3. Install crankshaft sprocket, oil pump sprocket, oil pump drive chain, and chain tensioner. Refer to EM-143, "TIMING CHAIN" .
4. Install timing chain and related parts. Refer to EM-143, "TIMING CHAIN" .
5. Install front cover and related parts. Refer to EM-143, "TIMING CHAIN" .
6. Install oil pan (lower) with the following procedure.

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

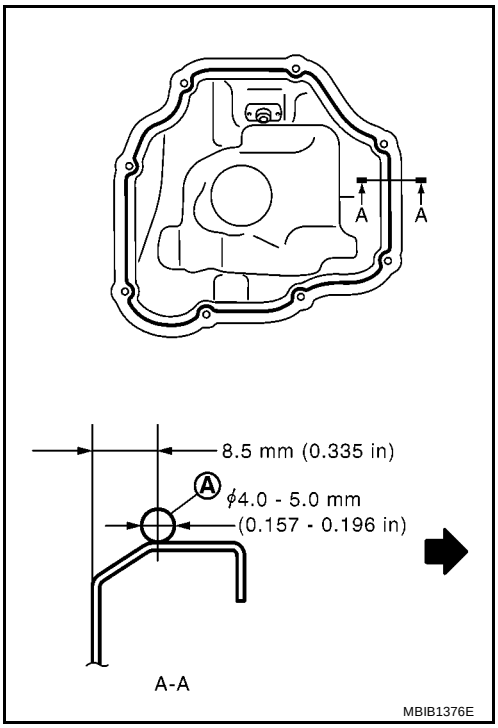
CAUTION:
Do not scratch or damage the mating surfaces when cleaning off old liquid gasket.

b. Apply a continuous bead of liquid gasket (A) with the tube presser (SST: WS39930000) to areas shown in the figure.

⬅ : Engine out side

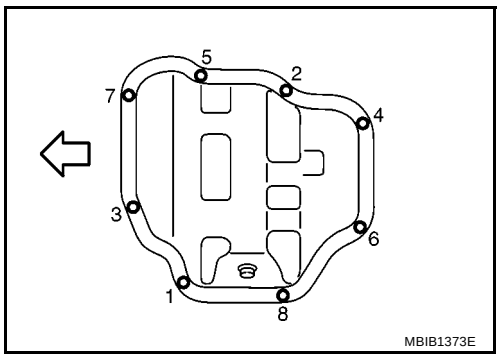
Use Genuine Liquid Gasket or equivalent.

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



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

⇦ : Engine front



7. Install oil pan drain plug.
   - For installation direction of washer. Refer to EM-128, "Components" .
8. Install in the reverse order of removal.

CAUTION:

Pour engine oil at least 30 minutes after oil pan is installed.

INSPECTION AFTER INSTALLATION

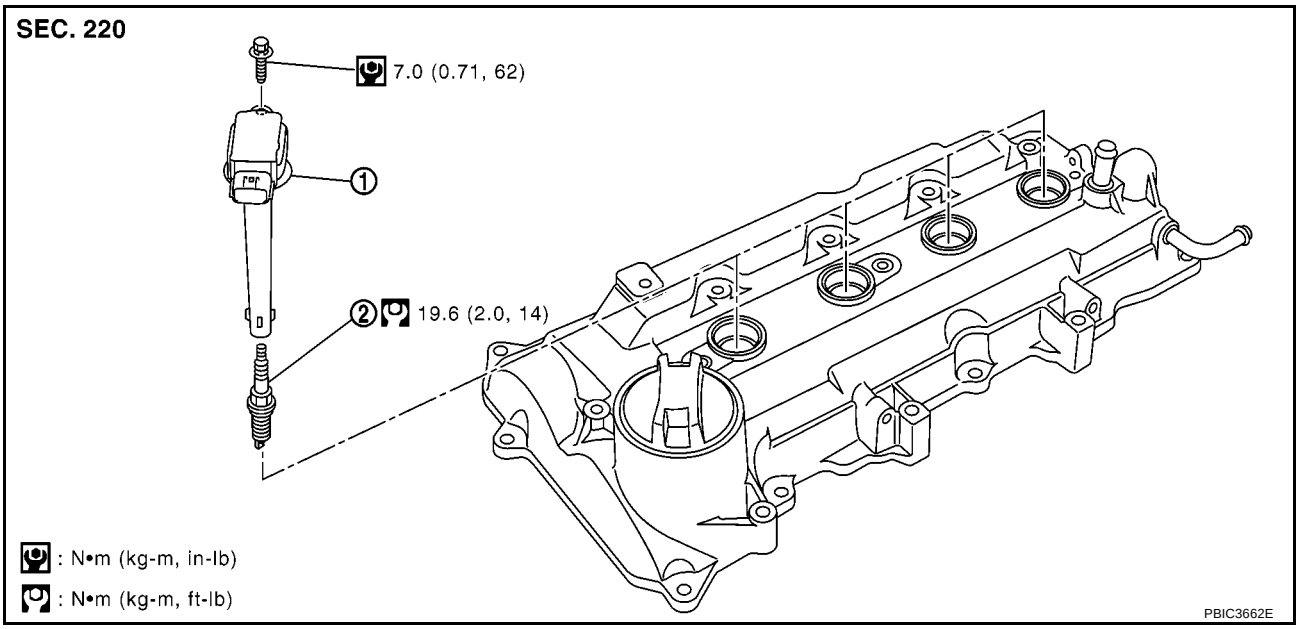
1. Check engine oil level and adjust engine oil. Refer to LU-16, "ENGINE OIL" .
2. Check for leakage of engine oil when engine is warmed.
3. Stop engine and wait for 10 minutes.
4. Check engine oil level again. Refer to LU-16, "ENGINE OIL" .

IGNITION COIL

PFP:22448

Components

EBS01J9D



1. Ignition coil
2. Spark plug

Removal and Installation

EBS01J9E

REMOVAL

1. Remove intake manifold. Refer to EM-121, "INTAKE MANIFOLD" .
2. Disconnect harness connector from the ignition coil.
3. Remove ignition coil.

CAUTION:

- **Handle it carefully and avoid impacts.**
- **Do not disassemble.**

INSTALLATION

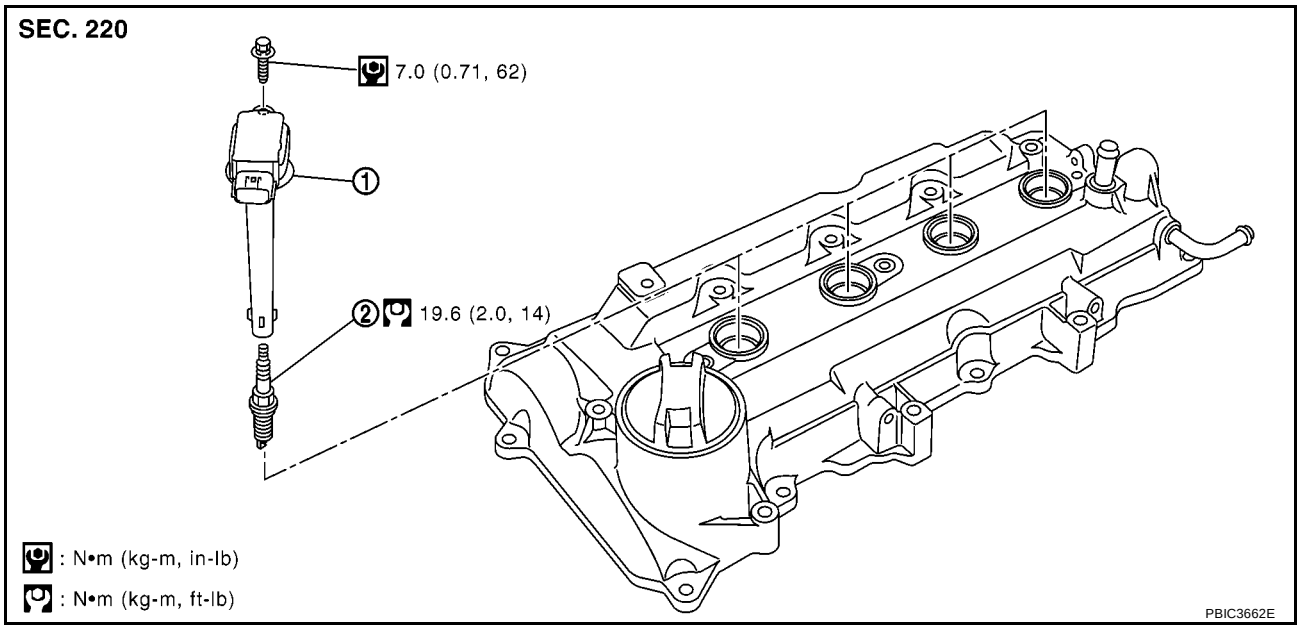
Installation is the reverse order of removal.

SPARK PLUG (PLATINUM-TIPPED TYPE)

PFP:22401

Components

EBS01J9F



1. Ignition coil
2. Spark plug

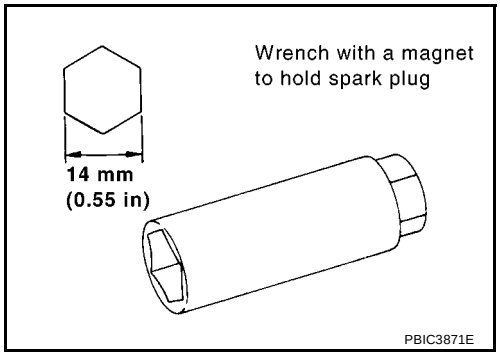
Removal and Installation

EBS01J9G

REMOVAL

1. Remove intake manifold. Refer to EM-121, "INTAKE MANIFOLD" .
2. Remove ignition coil. Refer to EM-133, "IGNITION COIL" .
3. Remove spark plug using spark plug wrench (commercial service tool).

   CAUTION:
   Do not drop or shock it.



INSPECTION AFTER REMOVAL

Use standard type spark plug for normal condition.

Hot type spark plug is suitable when fouling occurs with standard type spark plug under conditions such as:

- Frequent engine starts
- Low ambient temperatures

Cold type spark plug is suitable when spark plug knock occurs with standard type spark plug under conditions such as:

- Extended highway driving
- Frequent high engine revolution

Make	NGK
Standard type	PLZKAR6A-11
Hot type	PLZKAR5A-11
Cold type	PLZKAR7A-11

Gap (Nominal) : 1.1 mm (0.043 in)

CAUTION:

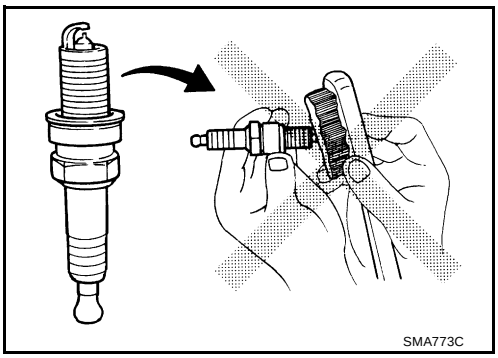
- **Do not drop or shock spark plug.**
- **Do not use wire brush for cleaning.**
- **If plug tip is covered with carbon, spark plug cleaner may be used.**

Cleaner air pressure:

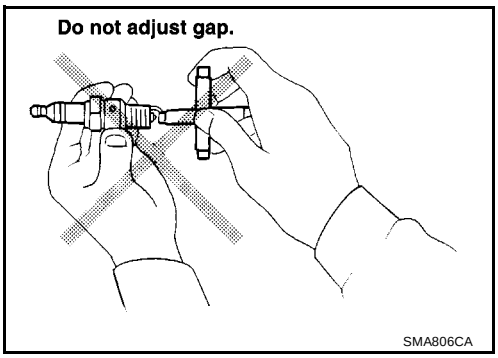
Less than 588 kPa (5.88 bar, 6 kg/cm^2 , 85 psi)

Cleaning time:

Less than 20 seconds



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



INSTALLATION

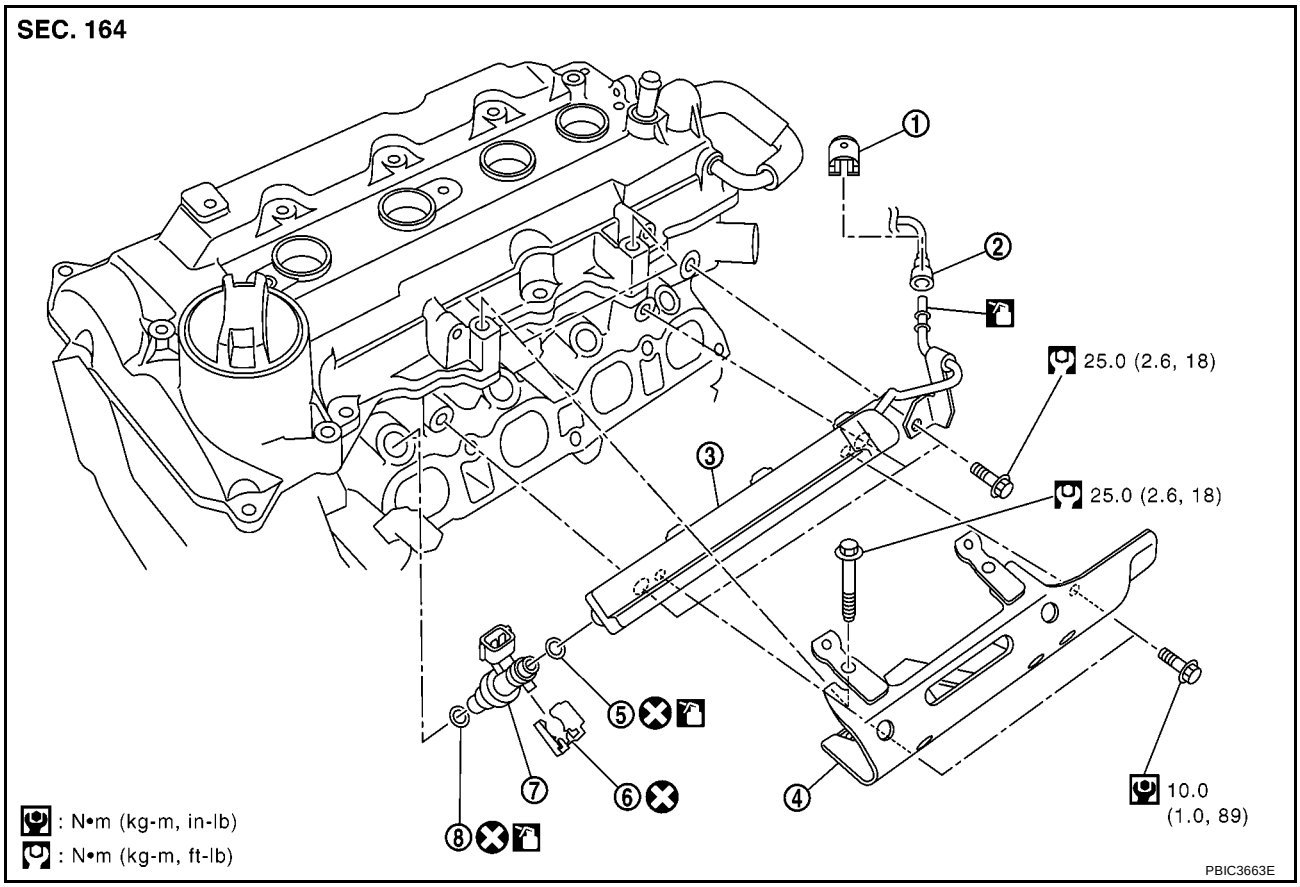
Installation is the reverse order of removal.

FUEL INJECTOR AND FUEL TUBE

PFP:16600

Components

EBS01J9H



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

CAUTION:

Do not remove or disassemble parts unless instructed as shown in the figure.

Refer to GI-9, "Components" for symbol marks in the figure.

Removal and Installation

EBS01J9I

WARNING:

- **Put a “CAUTION: INFLAMMABLE” sign in the workshop.**
- **Be sure to work in a well ventilated area and furnish workshop with a CO_2 fire extinguisher.**
- **Do not smoke while servicing fuel system. Keep open flames and sparks away from the work area.**

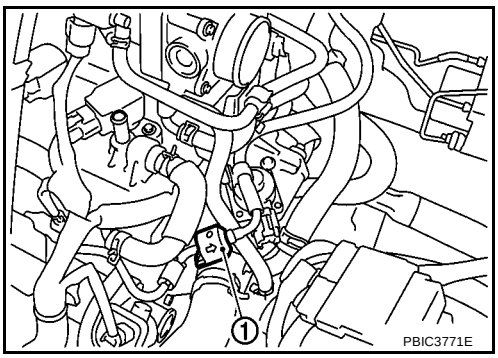
REMOVAL

1. Release the fuel pressure. Refer to EC-861, "FUEL PRESSURE RELEASE" (with EURO-OBD) or EC-1286, "FUEL PRESSURE RELEASE" (without EURO-OBD).
2. Remove intake manifold. Refer to EM-121, "INTAKE MANIFOLD" .

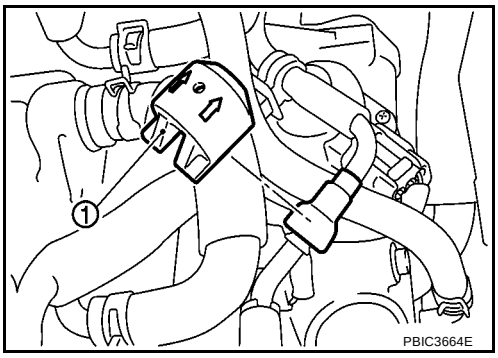
3. Disconnect quick connector with the following procedure. Disconnect fuel feed hose from fuel tube.

1 : Quick connector cap

NOTE:
There is no fuel return path.

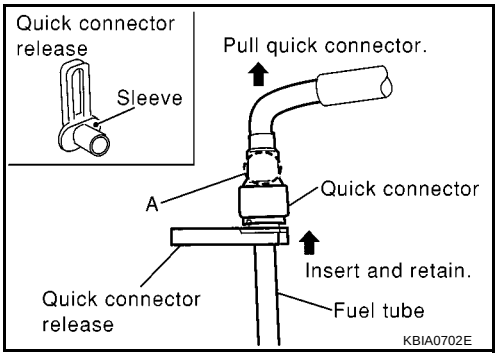


a. Remove quick connector cap (1) from quick connector connection.
b. Disconnect fuel feed hose from hose clamp.



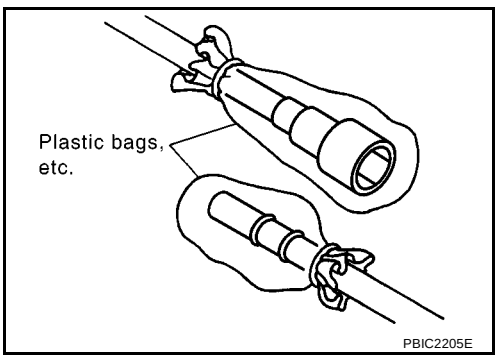
c. With the sleeve side of quick connector release facing quick connector, install quick connector release onto fuel tube.
d. Insert quick connector release into quick connector until sleeve contacts and goes no further. Hold quick connector release on that position.

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



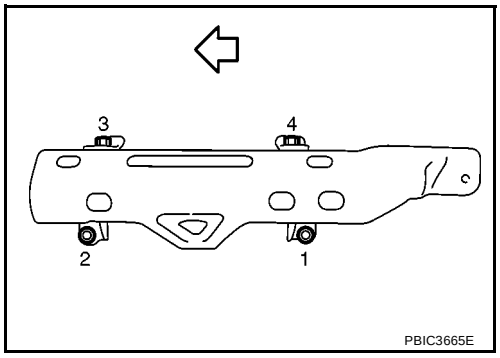
e. Draw and pull out quick connector straight from fuel tube.

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



4. Disconnect harness connector from fuel injector.
5. Remove fuel tube protector.
   - Loosen bolts in the reverse of the order shown in the figure.

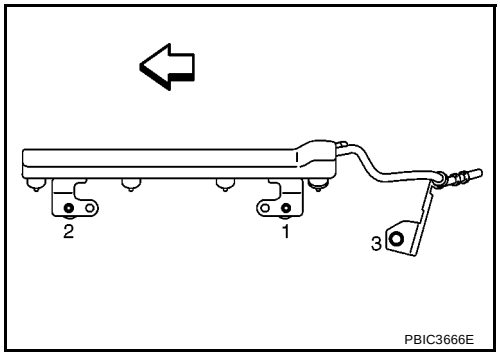
⇦ : Engine front



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

⇦ : Engine front

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

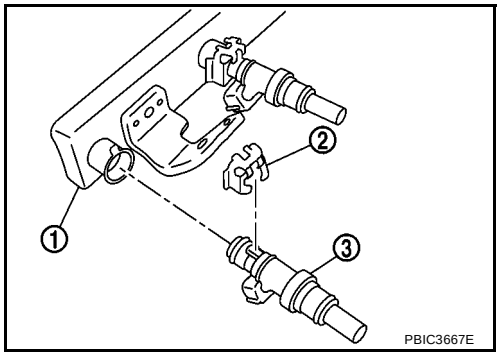


7. Remove the fuel injector (3) from the fuel tube (1) with the following procedure.

a. Open and remove the clip (2).

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

CAUTION:
- **Be careful about fuel leakage remaining in fuel tube.**
- **Be careful not to damage the nozzle of fuel injector.**
- **Do not subject it to impact by dropping or hitting.**
- **Do not disassemble.**



INSTALLATION

1. Install new the O-ring to the fuel injector, paying attention to the following.

CAUTION:
- **The upper and lower O-rings are different. Be careful not to confuse them.**

Fuel tube side : Black
Nozzle side : Green

- **Handle O-ring with bare hands. (Do not wear gloves.)**
- **Lubricate O-ring with engine oil.**
- **Do not clean O-ring with solvent.**
- **Make sure that the O-ring and its mating part are free of foreign material.**
- **Be careful not to scratch O-ring with tool or fingernails when installing it. Also be careful not to twist or stretch O-ring. If O-ring was stretched while it was being attached, do not insert it into fuel tube immediately.**
- **Insert O-ring straight into fuel tube. Do not decenter or twist it.**

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

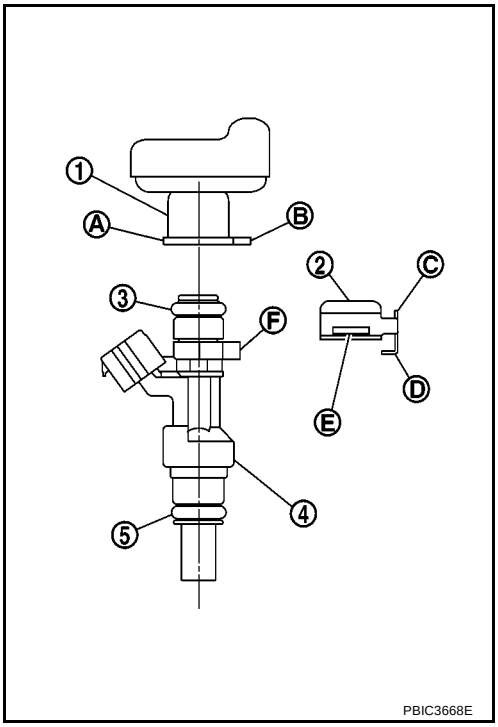
3 : O-ring (Black)
5 : O-ring (Green)

a. Insert the clips (2) into the clip mounting grooves on the fuel injector.
- Insert clip cut-out (D) into fuel injector protrusion (F).

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

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

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

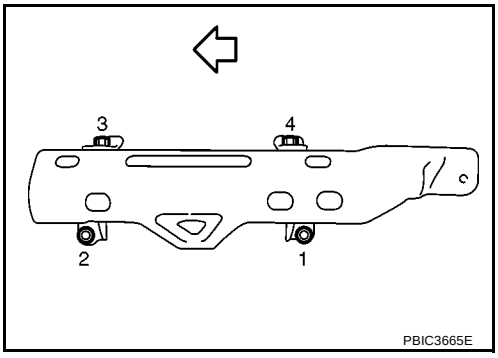


PBIC3668E

3. Install fuel tube and fuel injector assembly onto cylinder head.
- Tighten bolts in the numerical order shown in the figure.

⇦ : Engine front

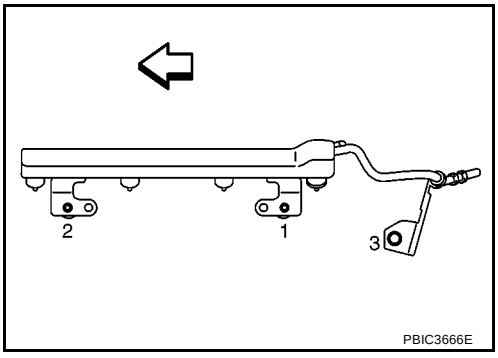
CAUTION:
Be careful not to let tip of fuel injector nozzle come in contact with other parts.



PBIC3665E

4. Install fuel tube protector.
- Tighten bolts in the numerical order shown in the figure.

⇦ : Engine front

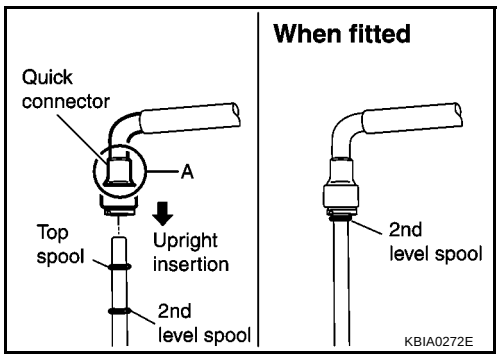


PBIC3666E

5. Connect harness connector to fuel injector.
6. Connect fuel feed hose with the following procedure.
a. Check for damage or foreign material on the fuel tube and quick connector.
b. Apply new engine oil lightly to area around the top of fuel tube.

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

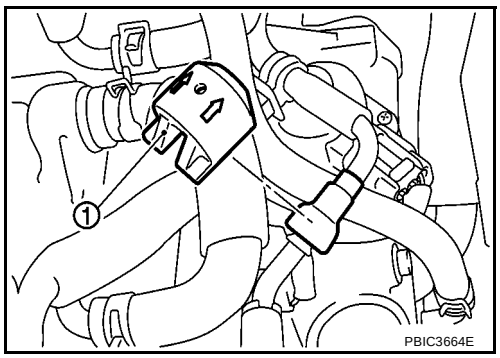
     CAUTION:
     - **Hold "A" position in the figure when inserting fuel tube into quick connector.**
     - **Carefully align center to avoid inclined insertion to prevent damage to O-ring inside quick connector.**
     - **Insert until you hear a "click" sound and actually feel the engagement.**
    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



d. Before clamping fuel feed hose with hose clamp, pull quick connector hard by hand holding "A" position. Make sure it is completely engaged (connected) so that it does not come out from fuel tube.

e. Install quick connector cap (1) to quick connector connection.
   - Install quick connector cap with the side arrow facing quick connector side (fuel feed hose side).

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



f. Install fuel feed hose to hose clamp.

7. Install in the reverse order of removal.

INSPECTION AFTER INSTALLATION

Check on Fuel Leaks

1. Apply fuel pressure to fuel lines with turning ignition switch ON (with engine stopped). Then make sure there are no fuel leaks at connections.

   NOTE:
   Use mirrors for checking on invisible points.

2. Start engine. With engine speed increased, make sure again there are no fuel leaks at connections.

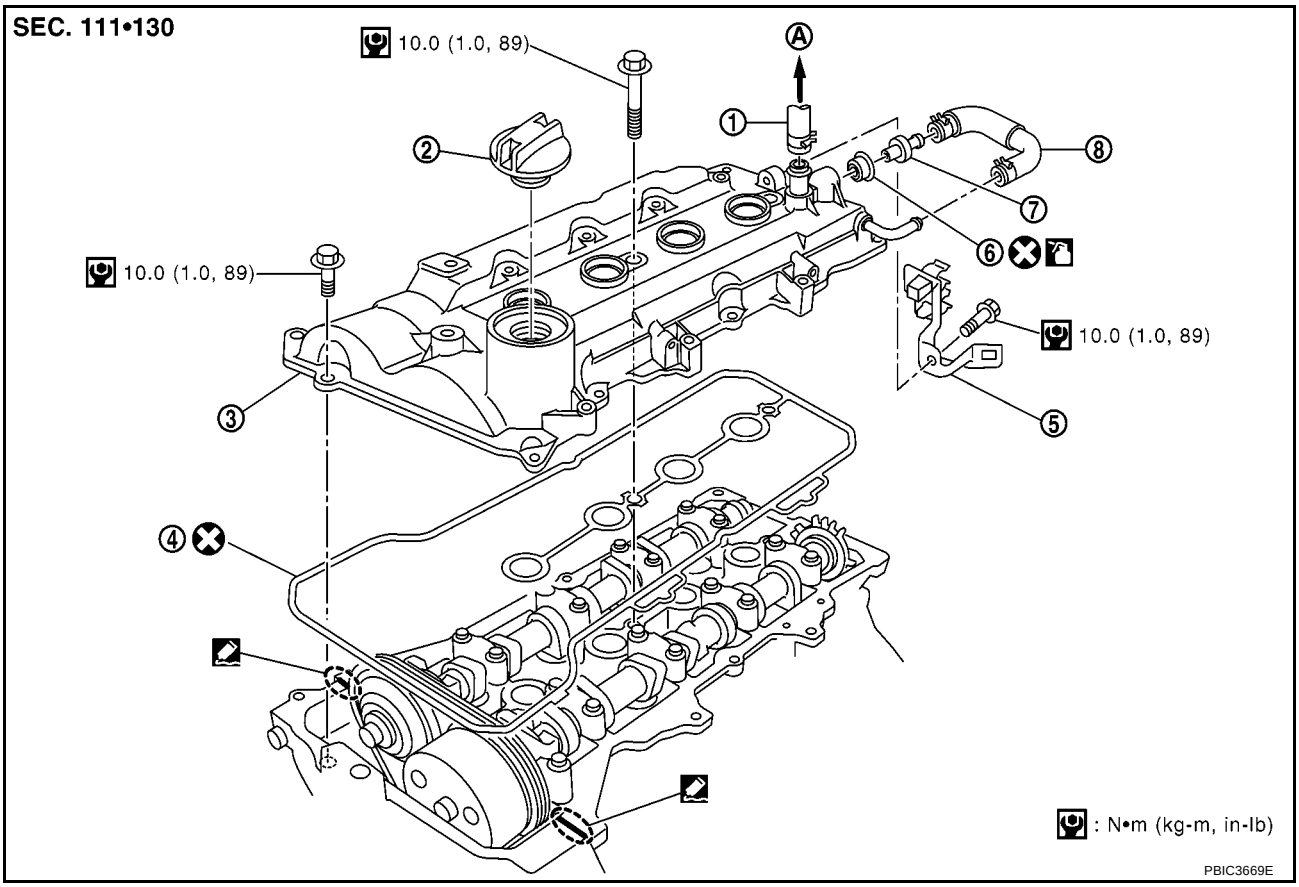
   CAUTION:
   Do not touch engine immediately after stopped as engine becomes extremely hot.

ROCKER COVER

PFP:13264

Components

EBS01J9J



1. PCV hose	2. Oil filler cap	3. Rocker cover
4. Gasket	5. Bracket	6. Grommet
7. PCV valve	8. PCV hose	
A. To air duct		

Refer to GI-9, "Components" for symbol marks in the figure.

Removal and Installation

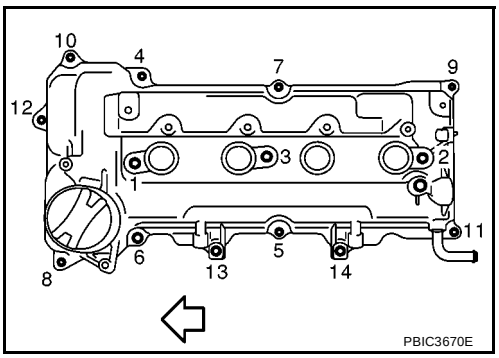
EBS01J9K

REMOVAL

1. Remove intake manifold. Refer to EM-121, "INTAKE MANIFOLD" .
2. Remove ignition coil. Refer to EM-133, "IGNITION COIL" .
3. Remove engine mounting stay (RH). Refer to EM-185, "ENGINE ASSEMBLY" .

   NOTE:
   For supporting engine load, it is not necessary that only the engine mounting stay (RH) is removed.
4. Remove fuel tube protector. Refer to EM-136, "FUEL INJECTOR AND FUEL TUBE" .
5. Remove the PCV hose from rocker cover.
6. Remove PCV valve if necessary.

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



⇦ : Engine front

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

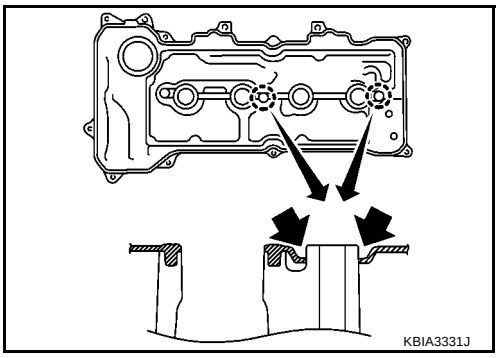
8. Remove gasket from rocker cover.
9. Remove all traces of liquid gasket from cylinder head and front cover.

INSTALLATION

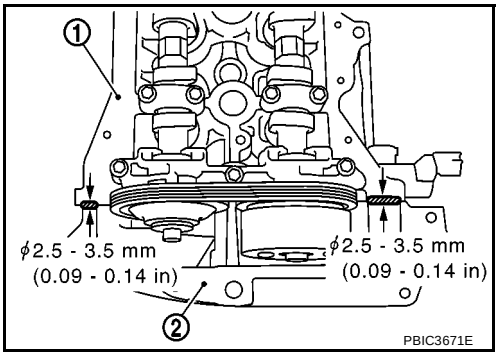
1. Install the rocker cover with the following procedure.

a. Install the gasket to the rocker cover.

- Check for damage or foreign material.
- Make sure that it is securely inserted in the mounting groove of rocker cover.
- For the 2 bolt holes shown in the figure, push the gasket into the boss for the rocker cover bolt hole to prevent it from falling.



b. Apply liquid gasket to the position shown in the figure.



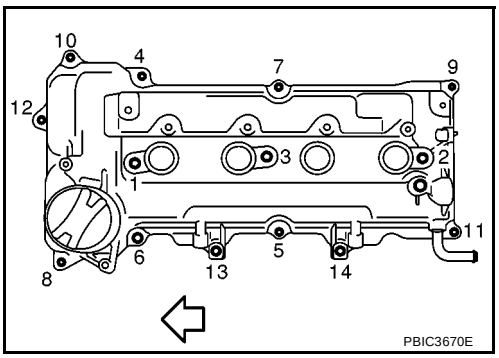
1 : Cylinder head
2 : Front cover

Use Genuine Liquid Gasket or equivalent.

c. Install the rocker cover to the cylinder head.

CAUTION:
Make sure the gasket is not dropped.

d. Tighten bolts in two steps in numerical order as shown in the figure.



⇦ : Engine front

NOTE:
13 and 14 shown in the figure tighten together with the fuel tube protector. Refer to EM-136, "Components" .

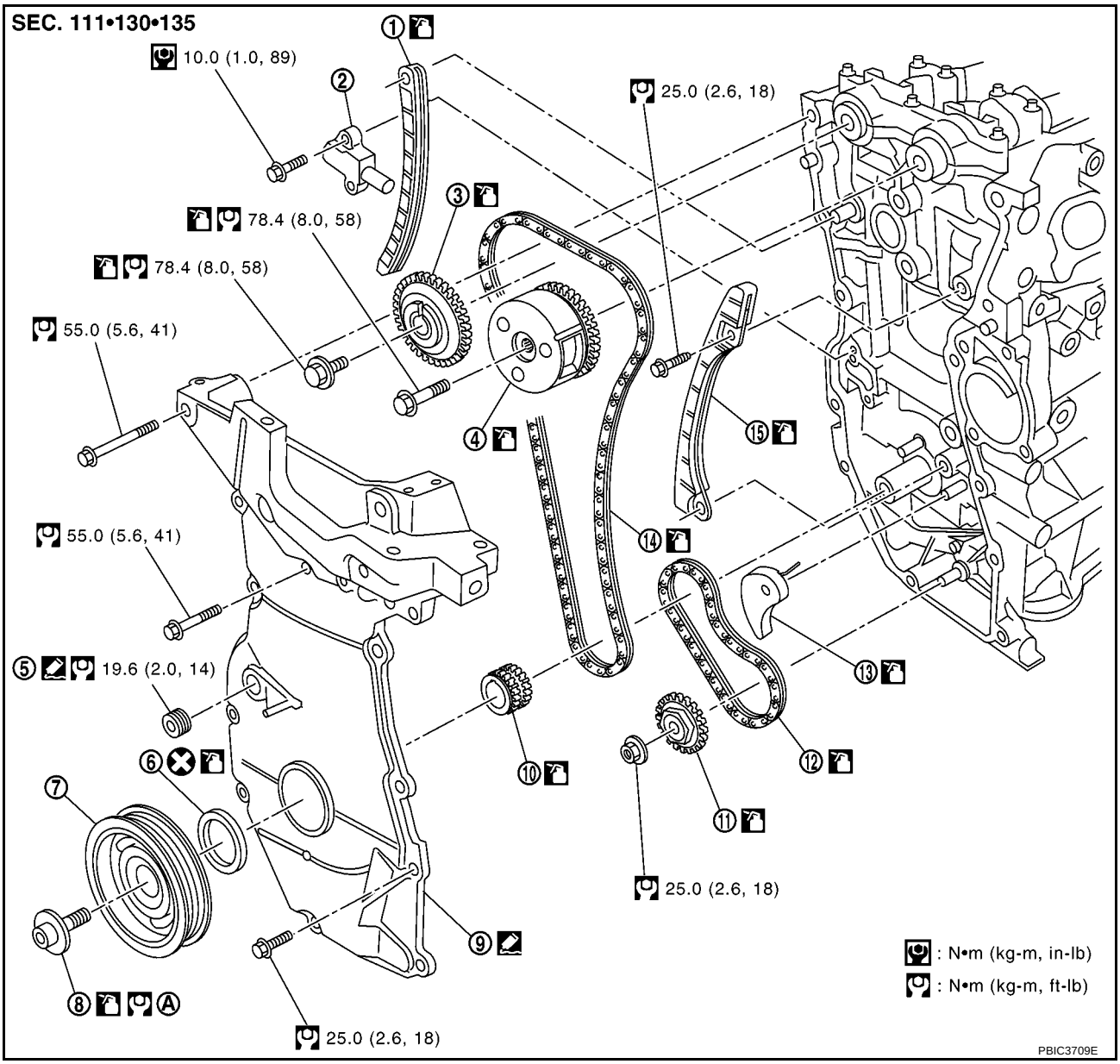
2. Install in the reverse order of removal.

TIMING CHAIN

PFP:13028

Components

EBS01J9L



1.	Timing chain slack guide	2.	Chain tensioner (For timing chain)	3.	Camshaft sprocket (EXH)
4.	Camshaft sprocket (INT)	5.	Plug	6.	Front oil seal
7.	Crankshaft pulley	8.	Crankshaft pulley bolt	9.	Front cover
10.	Crankshaft sprocket	11.	Oil pump sprocket	12.	Oil pump drive chain
13.	Chain tensioner (For oil pump drive chain)	14.	Timing chain	15.	Timing chain tension guide
A.	Refer to EM-147				

Refer to GI-9, "Components" for symbol marks in the figure.

Removal and Installation

EBS01J9M

CAUTION:

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

REMOVAL

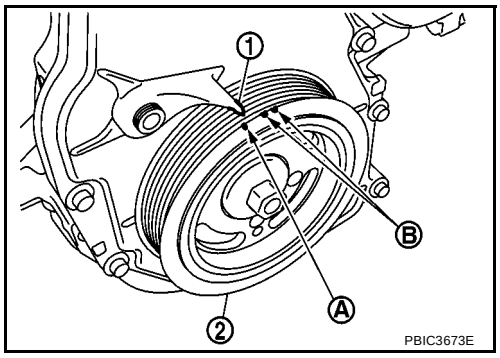
1. Remove front RH wheel. Refer to WT-5, "ROAD WHEEL AND TYRE ASSEMBLY" .
2. Remove front fender protector (RH). Refer to EI-14, "FENDER PROTECTOR" .
3. Drain engine oil. Refer to LU-16, "ENGINE OIL" .

   NOTE:

   Perform this step when engine is cold.
4. Remove the following parts.
   - Rocker cover: Refer to EM-141, "ROCKER COVER" .
   - Drive belt: Refer to EM-115, "DRIVE BELTS" .
   - Water pump pulley: Refer to CO-48, "WATER PUMP" .
   - Ground cable (between engine mounting bracket (RH) and radiator core support)
5. Support the bottom surface of engine using a transmission jack, and then remove the engine mounting bracket and insulator (RH). Refer to EM-185, "ENGINE ASSEMBLY" .
6. Set No. 1 cylinder at TDC of its compression stroke with the following procedure:

a. Rotate crankshaft pulley (2) clockwise and align TDC mark (without paint mark) (A) to timing indicator (1) on front cover.

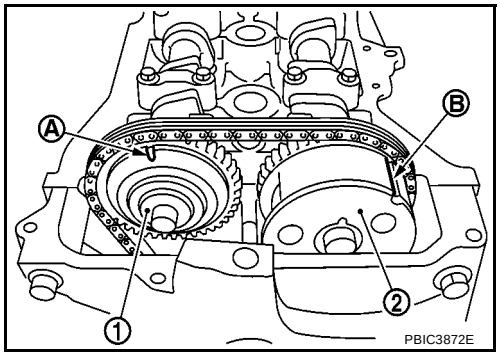
   B : White paint mark (Not use for service)



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

   1 : Camshaft sprocket (EXH)
   2 : Camshaft sprocket (INT)
   A : Matching mark (stamp)
   B : Matching mark (peripheral stamp line)

   - If not, rotate crankshaft pulley one more turn to align matching marks to the positions in the figure.



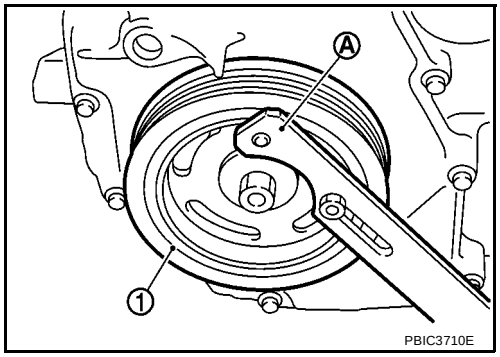
7. Remove crankshaft pulley with the following procedure:

a. Secure crankshaft pulley (1) using a pulley holder (commercial service tool) (A).

b. Loosen and pull out crankshaft pulley bolts.

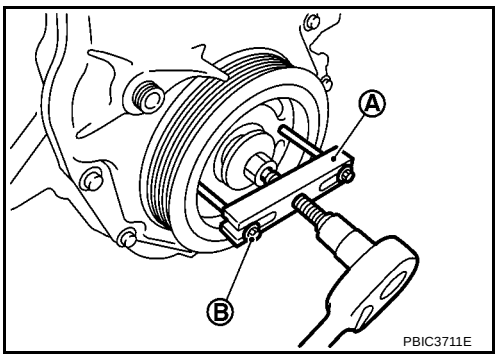
   CAUTION:

   Do not remove the mounting bolts as they will be used as a supporting point for the pulley puller (SST: KV11103000).



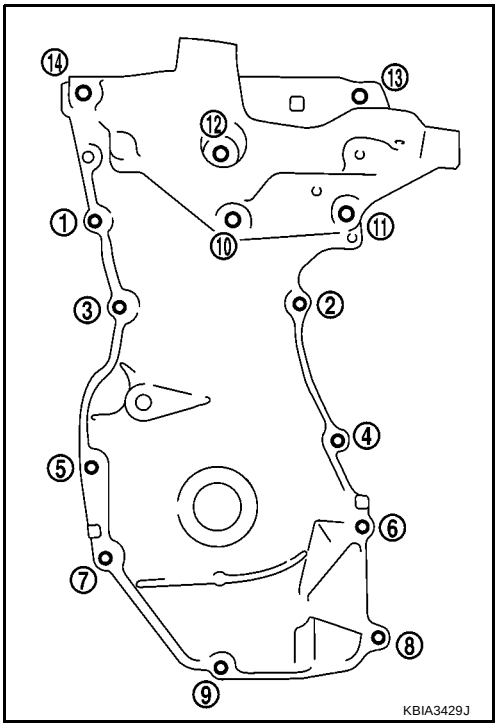
c. Attach a pulley puller (SST: KV11103000) (A) in the M 6 thread hole on crankshaft pulley, and remove crankshaft pulley.

B : M6 bolt

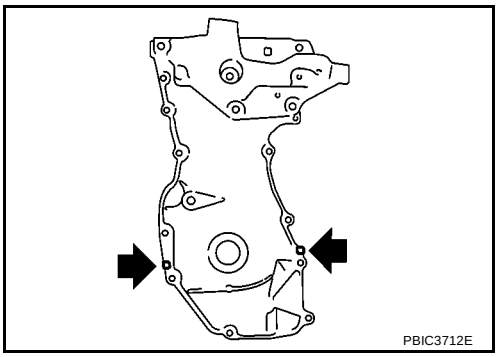


8. Remove front cover with the following procedure:

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



b. Cut liquid gasket by prying the position (⬅) shown in the figure, and then remove the front cover.



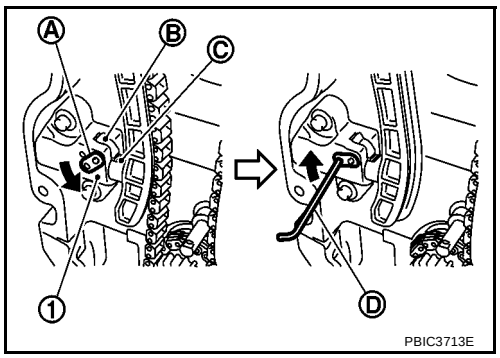
9. Remove front oil seal from front cover.

- Remove by lifting it up using a suitable tool.

CAUTION:

Be careful not to damage the front cover.

10. Remove chain tensioner (1) with the following procedure.



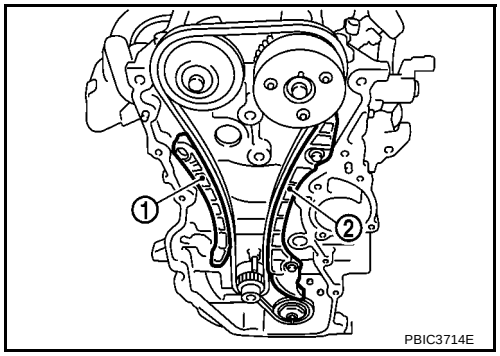
a. Fully push down the chain tensioner lever (A), and then push the plunger (C) into the inside of tensioner.
   - The tab (B) is released by fully pushing the lever down. As a result, the plunger can be moved.

b. Pull up the lever to align its hole position with the body hole position.
   - When the lever hole is aligned with the body hole position, the plunger is fixed.
   - When the protrusion parts of the plunger ratchet and the tab face each other, both hole positions are not aligned. At that time, correctly engage them and align these hole positions by slightly moving the plunger.

c. Insert the stopper pin (D) into the body hole through the lever hole, and then fix the lever at the upper position.
   - Figure shows the example that a hexagonal wrench for 2.5 mm (0.098 in) is used.

d. Remove chain tensioner.

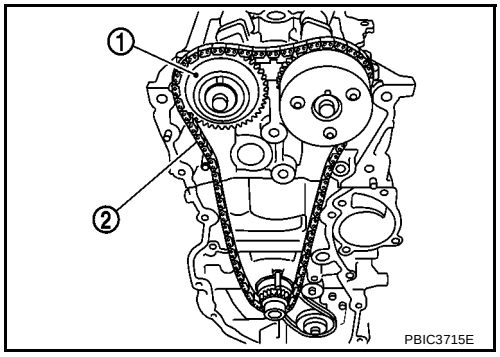
11. Remove the timing chain tension guide (2) and the timing chain slack guide (1).



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

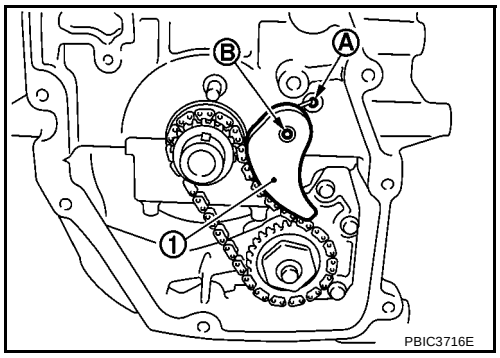
    CAUTION:

    Do not rotate crankshaft or camshaft while timing chain is removed. It causes interference between valve and piston.



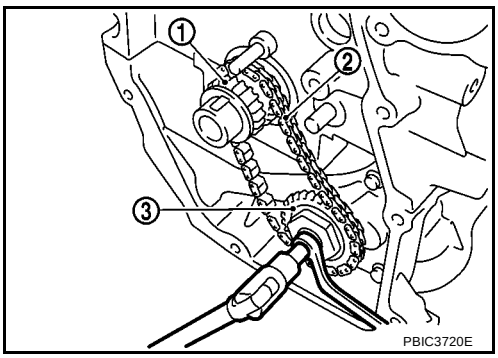
13. Remove the crankshaft sprocket and the oil pump drive related parts with the following procedure.

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



b. Hold the top of the oil pump shaft using the TORX socket (size: E8), and then loosen the oil pump sprocket nuts and remove them.

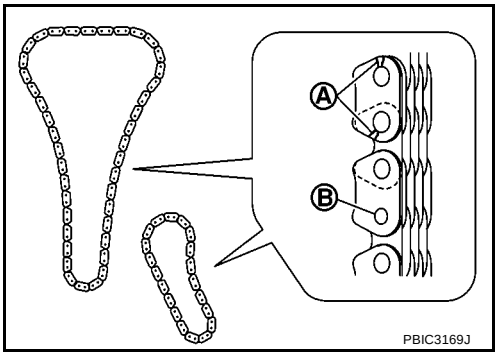
c. Remove the crankshaft sprocket (1), the oil pump drive chain (2), and the oil pump sprocket (3) at the same time.



INSPECTION AFTER REMOVAL

Timing Chain

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

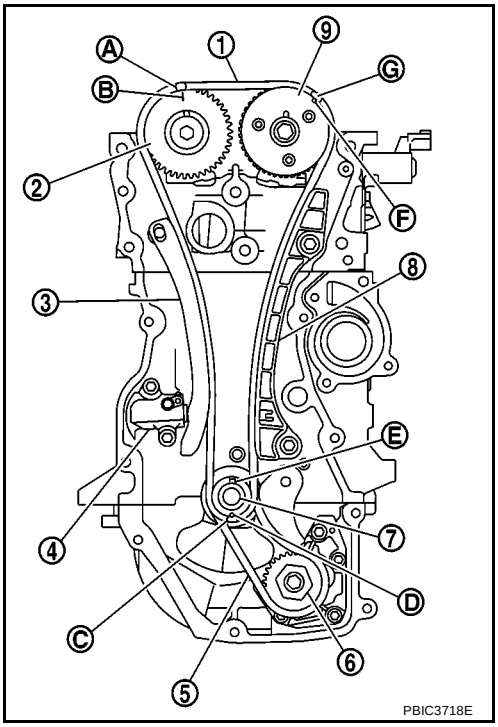


INSTALLATION

NOTE:

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

1 : Timing chain
2 : Camshaft sprocket (EXH)
3 : Timing chain slack guide
4 : Chain tensioner
5 : Oil pump drive chain
6 : Oil pump sprocket
7 : Crankshaft sprocket
8 : Timing chain tension guide
9 : Camshaft sprocket (INT)
A : Yellow link
B : Matching mark (stamp)
C : Orange link
D : Matching mark (stamp)
E : Crankshaft key (point straight up)
F : Matching mark (peripheral stamp line)
G : Yellow link



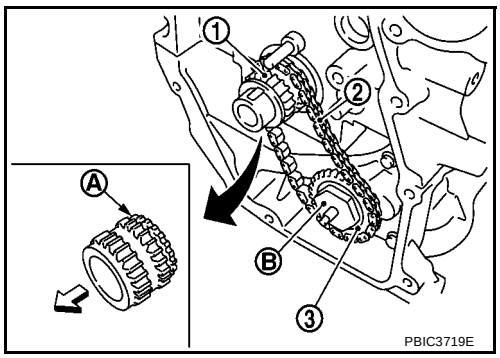
1. Install the crankshaft sprocket and the oil pump drive related parts with the following procedure:

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

⇦ : Engine front

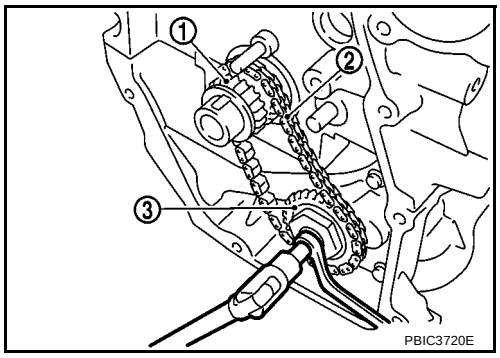
- Install the crankshaft sprocket so that its invalid gear area (A) is towards the back of the engine.
- Install the oil pump sprocket so that its hexagonal surface faces (B) the front of engine.

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



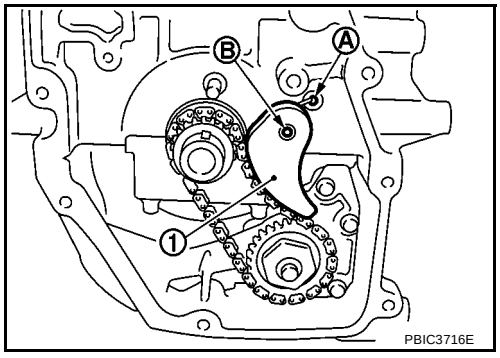
b. Hold the top of the oil pump shaft using the TORX socket (size: E8), and then tighten the oil pump sprocket nuts.

1 : Crankshaft sprocket
2 : Oil pump drive chain
3 : Oil pump sprocket



c. Install chain tensioner (1).

- Insert the body into the shaft (B) while inserting the spring into the fixing hole (A) of cylinder block front surface.
- Make sure that the tension is applied to the oil pump drive chain after installing.



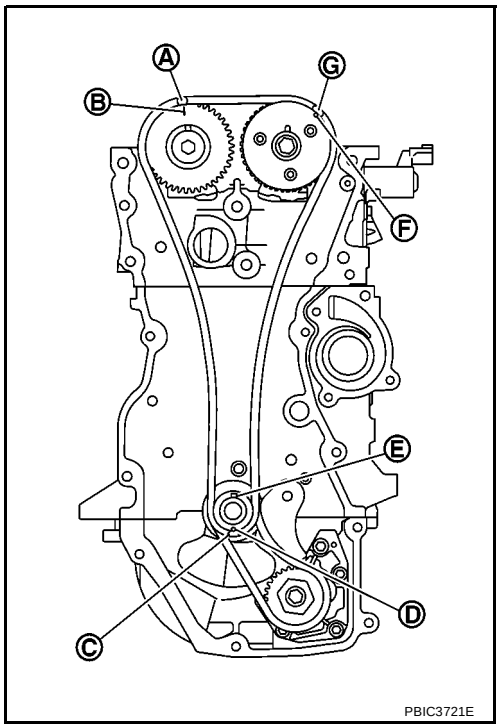
2. Install timing chain with the following procedure.

A : Yellow link
B : Matching mark (stamp)
C : Orange link
D : Matching mark (stamp)
E : Crankshaft key (point straight up)
F : Matching mark (peripheral stamp line)
G : Yellow link

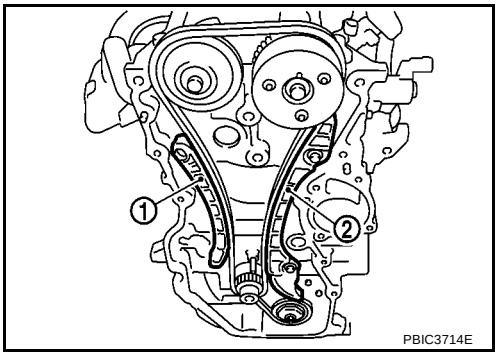
- Install by aligning matching marks on each sprocket and timing chain.
- If these matching marks are not aligned, rotate the camshaft slightly to correct the position.

CAUTION:

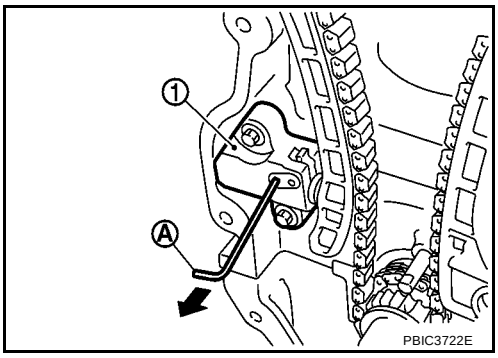
- **For the following note, after the matching marks are aligned, keep them aligned by holding them with a hand.**
- **To avoid skipped teeth, do not rotate crankshaft and camshaft until front cover is installed.**



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



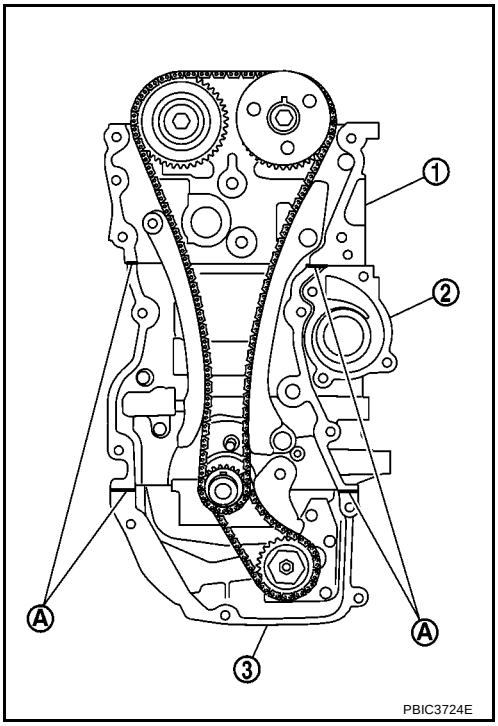
4. Install chain tensioner (1).
   - Fix the plunger at the most compressed position using a stopper pin (A), and then install it.
   - Securely pull out the stopper pin after installing the chain tensioner.



5. Check matching mark position of timing chain and each sprocket again.
6. Install the front oil seal to the front cover. Refer to EM-172, "Removal and Installation of Front Oil Seal"
7. Install front cover with the following procedure:

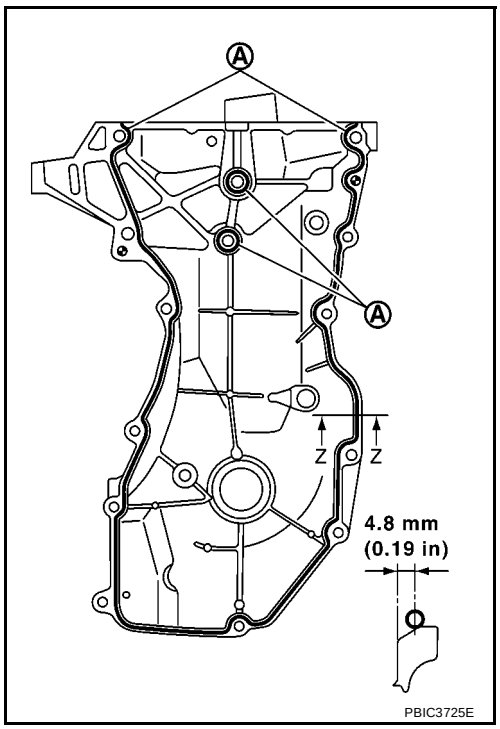
a. Apply a continuous bead of liquid gasket with tube presser (SST: WS39930000) to front cover as shown in the figure.
Use Genuine Liquid Gasket or equivalent.

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



b. Apply a continuous bead of liquid gasket with tube presser (SST: WS39930000) to front cover as shown in the figure.
Use Genuine Liquid Gasket or equivalent.

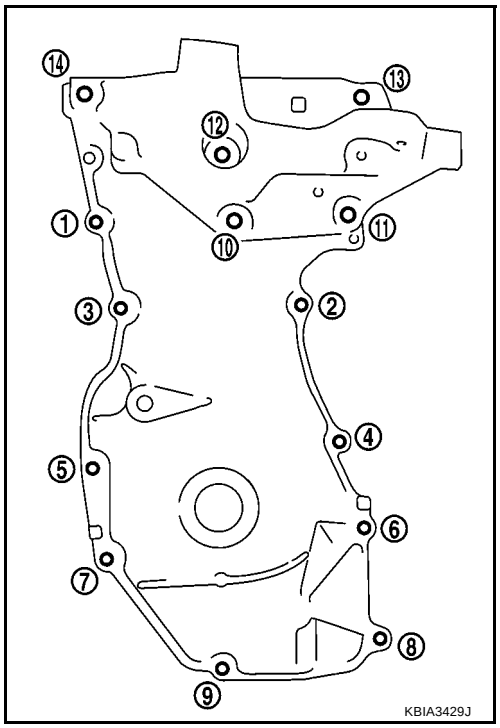
A : Liquid gasket application area
ϕ 3.0 - 4.0 mm (0.12 - 0.16 in)



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

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

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



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

   CAUTION:
   Install protecting front oil seal lip section from any damage.
9. Tighten crankshaft pulley bolt with the following procedure:
   - Secure crankshaft pulley with a pulley holder (commercial service tool), and tighten crankshaft pulley bolt.

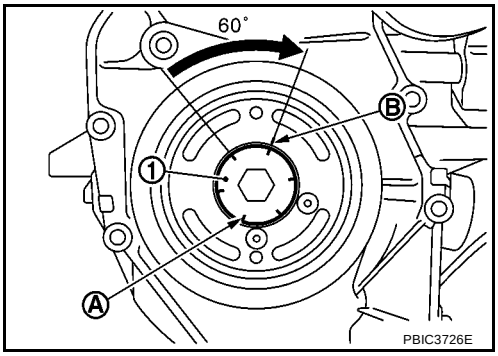
a. Apply new engine oil to thread and seat surfaces of crankshaft pulley bolt.

b. Tighten crankshaft pulley bolt.

: 35.0 N·m (3.6 kg-m, 26 ft-lb)

c. Put a paint mark (B) on crankshaft pulley, mating with any one of six easy to recognize angle marks (A) on crankshaft bolt flange (1).

d. Turn another 60 degrees clockwise (angle tightening).
   - Check the tightening angle with movement of one angle mark.



10. Make sure that crankshaft turns smoothly by rotating by hand clockwise.
11. Install in the reverse order of removal.

INSPECTION AFTER INSTALLATION

Inspection for Leaks

The following are procedures for checking fluids leak, lubricates leak and exhaust gases leak.

- Before starting engine, check oil/fluid levels including engine coolant and engine oil. If less than required quantity, fill to the specified level. Refer to MA-35, "RECOMMENDED FLUIDS AND LUBRICANTS" .
- Use procedure below to check for fuel leakage.
  - Turn ignition switch “ON” (with engine stopped). With fuel pressure applied to fuel piping, check for fuel leakage at connection points.
  - Start engine. With engine speed increased, check again for fuel leakage at connection points.
- Run engine to check for unusual noise and vibration.

  NOTE:
  If hydraulic pressure inside timing chain tensioner drops after removal/installation, slack in the guide may generate a pounding noise during and just after engine start. However, this is normal. Noise will stop after hydraulic pressure rises.
- Warm up engine thoroughly to make sure there is no leakage of fuel, exhaust gases, or any oil/fluids including engine oil and engine coolant.
- Bleed air from lines and hoses of applicable lines, such as in cooling system.
- After cooling down engine, again check oil/fluid levels including engine oil and engine coolant. Refill to the specified level, if necessary.

Summary of the inspection items:

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

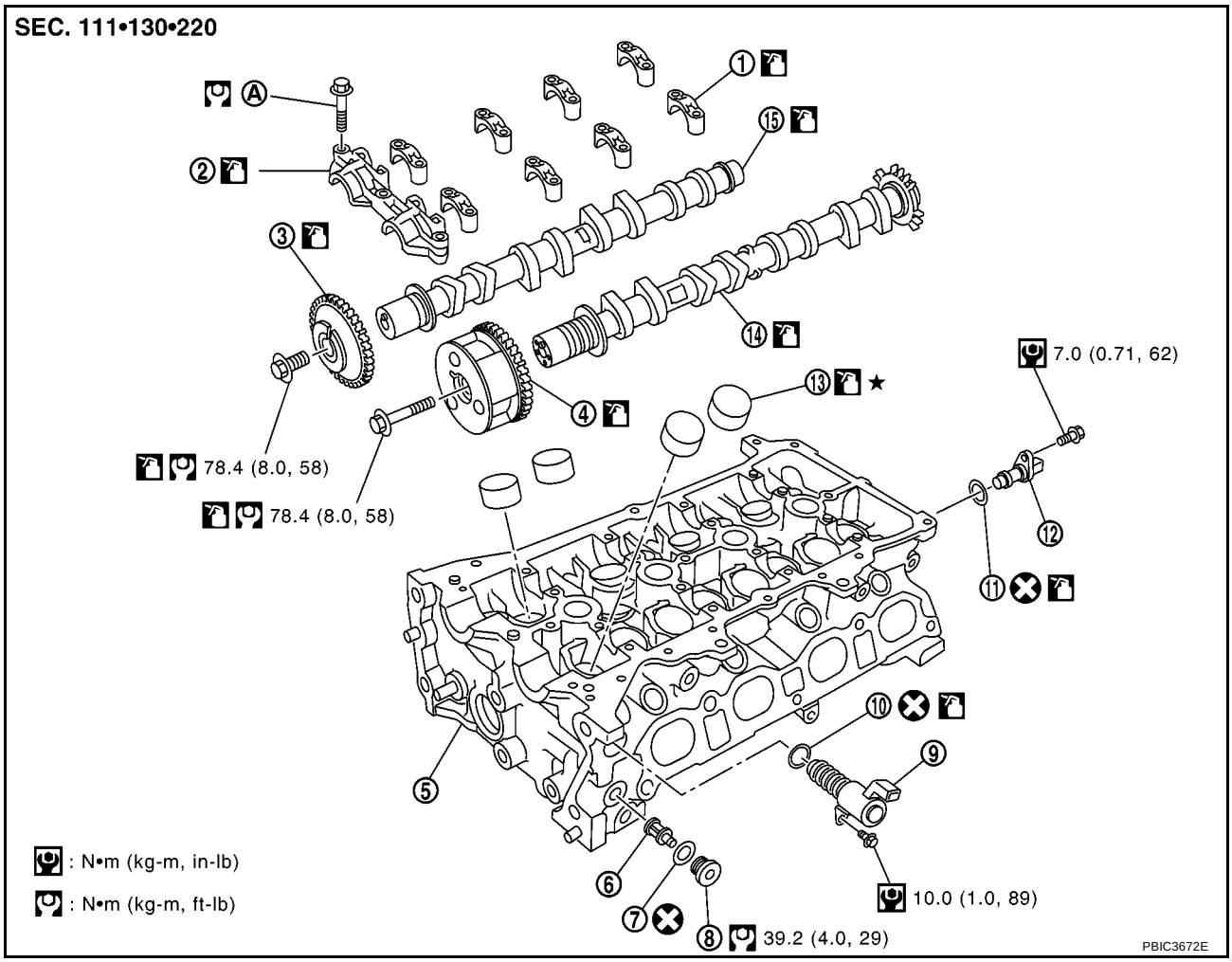
* Transmission/transaxle fluid, power steering fluid, brake fluid, etc.

CAMSHAFT

PFP:13001

Components

EBS01J9N



1. Camshaft bracket (No. 2 to 5)
2. Camshaft bracket (No. 1)
3. Camshaft sprocket (EXH)
4. Camshaft sprocket (INT)
5. Cylinder head
6. Oil filter (for intake valve timing control)
7. Washer
8. Plug
9. Intake valve timing control solenoid valve
10. O-ring
11. O-ring
12. Camshaft position sensor (PHASE)
13. Valve lifter
14. Camshaft (INT)
15. Camshaft (EXH)

A. Refer to EM-162

Refer to GI-9, "Components" for symbol marks in the figure.

Removal and Installation

EBS01J9O

CAUTION:

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

REMOVAL

NOTE:

This section describes the procedure for removal and installation of camshaft with front cover. If the front cover is removed first, change the following procedure.

- **Step 8 : After camshaft sprocket is removed, remove the camshaft brackets (No. 2 to 5).**
- **Step 9 : The camshaft (EXH) can be removed simultaneously with the camshaft (INT).**
- **Step 10 : When the camshaft sprocket (INT) mounting bolt is removed, the lifting up of camshaft is not necessary.**

1. Support the bottom surface of engine using a transmission jack, and then remove the engine mounting bracket and insulator (RH). Refer to EM-185, "ENGINE ASSEMBLY" .

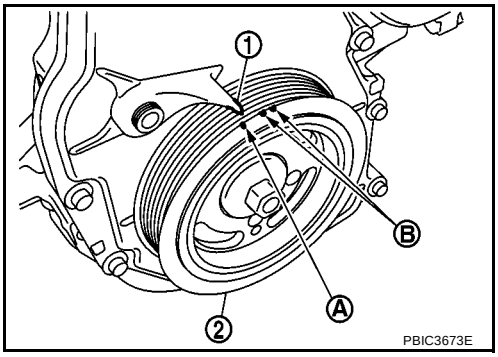
2. Remove rocker cover. Refer to EM-141, "ROCKER COVER" .
3. Remove camshaft position sensor (PHASE) from rear end of cylinder head.

CAUTION:
Handle it carefully and avoid impacts.

4. Place cylinder No. 1 at TDC of its compression stroke with the following procedure.

a. Rotate crankshaft pulley (2) clockwise and align TDC mark (without paint mark) (A) to timing indicator (1) on front cover.

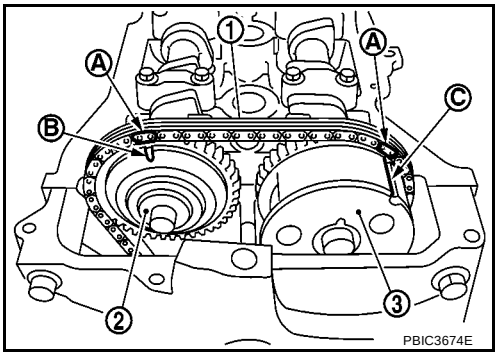
B : White paint mark (Not use for service)



b. Make sure that the matching marks on each the camshaft sprockets are in the position shown in the figure.

1. : Timing chain
2. : Camshaft sprocket (EXH)
3. : Camshaft sprocket (INT)

A : Matching mark (Paint)
B : Matching mark (Stamp)
C : Matching mark (Peripheral stamp line)

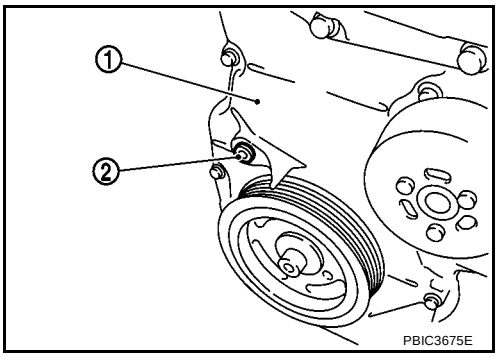


- If not, rotate crankshaft pulley one more turn to align matching marks to the positions in the figure.

c. Paint matching marks (A) on the timing chain links

5. Secure the plunger of chain tensioner in the fully compressed position with the following procedure. And then, loosen the timing chain tension.

a. Remove the plug (2) from the front cover (1).



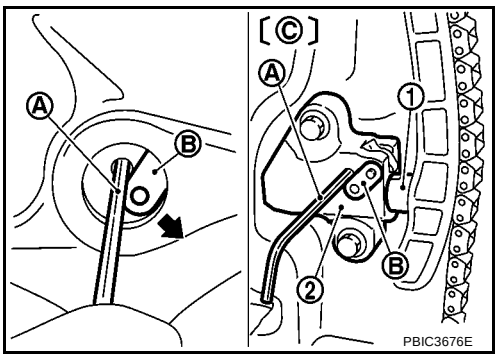
b. Fully push down the lever (B) of chain tensioner (2) from the plug hole, and then insert the stopper pin (A) into the body side hole and secure the lever at the lowest position.

C : Front cover has been omitted

- The tab is released by fully pushing the lever down. As a result, the plunger (1) can be moved.

NOTE:
Hexagonal wrench [2.5 mm (0.098 in)] is used for a stopper pin as an example.

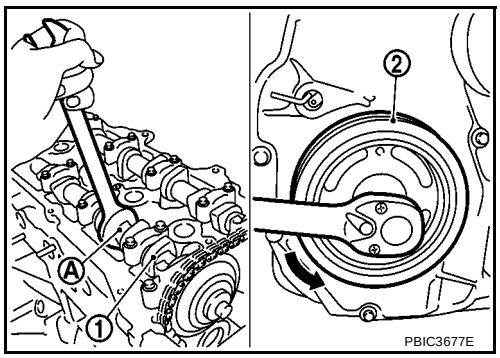
CAUTION:
The stopper pin must use a shape that cannot fall in the front cover when dropping out.



c. Turn the crankshaft pulley (2) counterclockwise with the camshaft (EXH) (1) fixing. Apply the tension to the timing chain, and then push the plunger of into the inside of chain tensioner.

CAUTION:

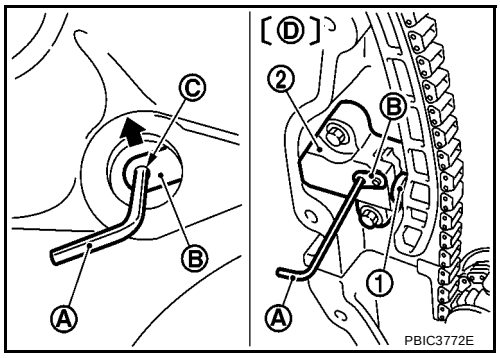
Hold the camshaft hexagonal part (A), and then secure the camshaft.



d. Pull out the stopper pin (A) of chain tensioner (2) side from plug hole. Lift the lever (B) up to align its hole position with the hole of the body.

D : Front cover has been omitted

- When the lever hole (C) is aligned with the body hole position, the plunger (1) is fixed.
- When the protrusion parts of the plunger ratchet and the tab face each other, both hole positions are not aligned. At that time, correctly engage them and align these hole positions by slightly moving the plunger.

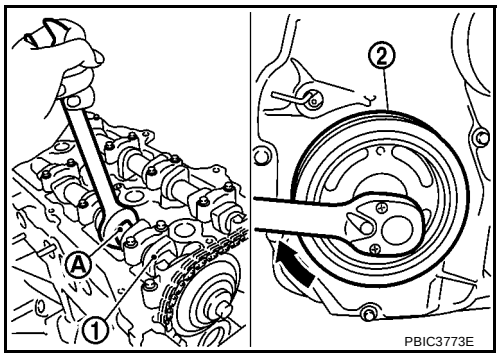


e. Insert the stopper pin into the body hole through the lever hole, and then fix the lever at the upper position.

f. Slightly rotate the crankshaft pulley (2) clockwise to loosen the timing chain on camshaft sprocket (EXH) (1) side.

CAUTION:

Hold the camshaft hexagonal part (A), and then secure the camshaft.



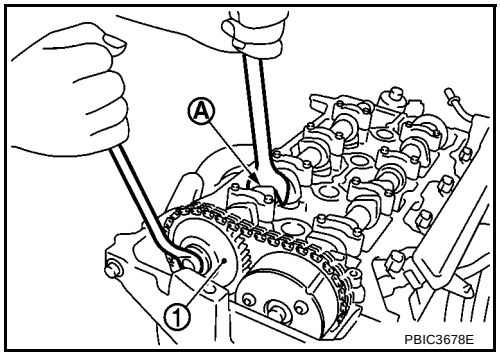
6. Remove camshaft sprocket (EXH) (1).

CAUTION:

- **Hold the camshaft hexagonal part (A), and then secure the camshaft.**
- **Do not rotate crankshaft and camshaft separately, so as not to contact valve with piston in the following steps.**

NOTE:

The timing chain with the front cover installed is not disengaged from the crankshaft sprocket and it is not dropped into the front cover. Therefore, the timing chain tension holding device is not necessary.

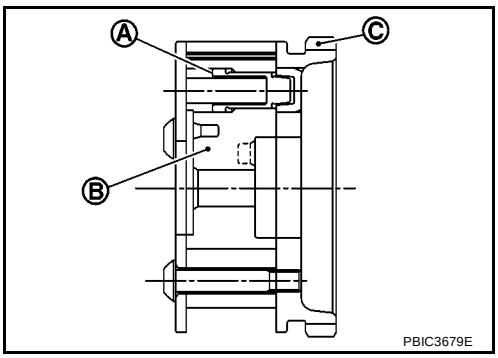


7. Turn the camshaft sprocket (INT) to the most advanced position.

CAUTION:

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

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

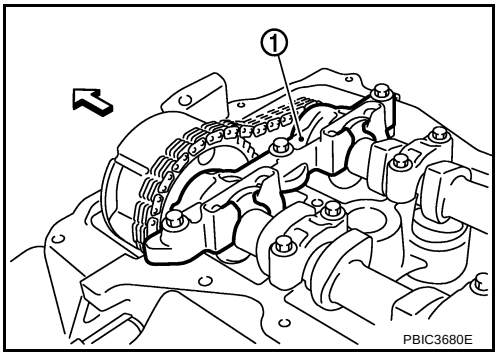


- Put the camshaft sprocket (INT) in the most advance position with the following procedure.

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

⇦ : Engine front

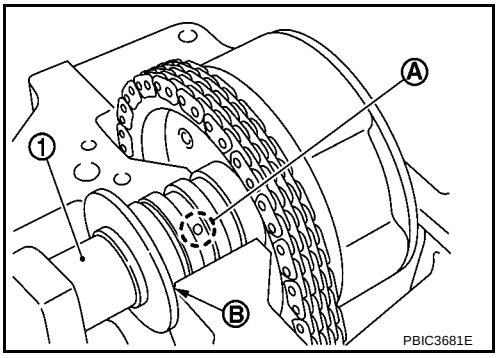
- Loosen the bolts in several steps, and then remove them.



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

Pressure : 300 kPa (3.0 bar, 3.1 kg/cm^2 , 44psi) or more

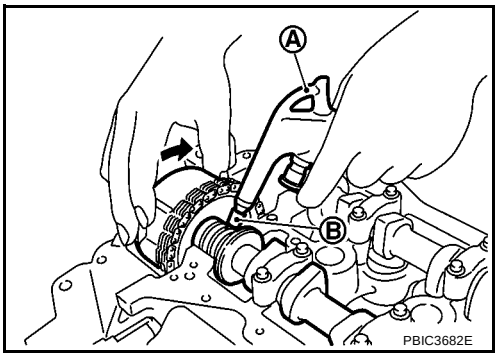
- Apply the air pressure into the oil hole on the second groove from the front of camshaft thrust (B).
- Proceed all the way through step “e” with the air pressure on.



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

CAUTION:

- **There are other oil holes in the side grooves. Do not use the incorrect oil holes.**
- **Be sure not to damage the oil path with the tip of the air gun.**
- **Wipe all the oil off the air gun to prevent oil from being blown all over along with the air, and the area around the air gun should be wiped with a rag when applying air pressure. Eye protection should be worn as needed.**

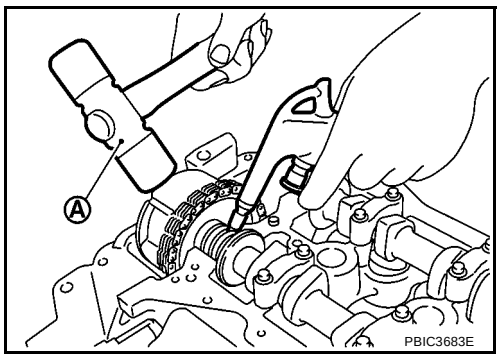


NOTE:
The air pressure is used to move the lock pin into the disengage position.

c. Hold the camshaft sprocket (INT) with hands, and then apply the power counterclockwise/clockwise alternatively.

- Finally rotate the sprocket of the camshaft sprocket (INT) counterclockwise [the direction shown by the arrow (⬅)].
- Perform the work while applying the air pressure to the oil hole.

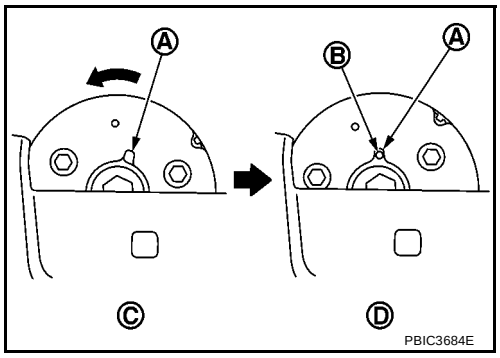
- If the lock pin is not released by hands, tap the camshaft sprocket (INT) lightly with a plastic hammer (A).
- If the camshaft sprocket (INT) is not rotated counterclockwise even if the above procedures are performed, check the air pressure and the oil hole position.



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

C : Lock pin engaged

D : Most advanced angle



- Keep the air pressure on.
- If there is no click, as soon as the vane-side (camshaft side) starts moving independently of the sprocket, the lock pin has become disengaged.
- Make sure that it is in the most advanced angle position by seeing if the stopper pin groove (A) and the stopper pin hole (B) are matched up as shown in the figure.

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

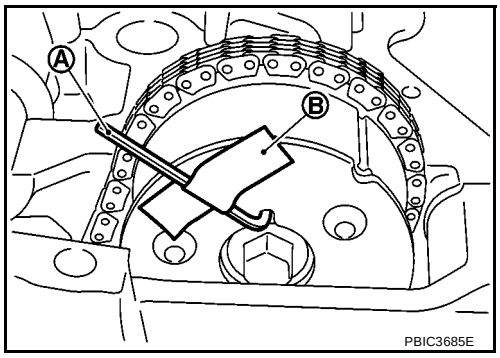
f. Insert the stopper pin (A) into the stopper pin holes in the camshaft sprocket (INT) and lock in the most advanced angle position.

CAUTION:

No load is exerted on the stopper pin (spring reaction, etc.). Since it comes out easily, secure it with tape (B) to prevent it from coming out.

NOTE:

The stopper pin in the figure shows one example of a hexagonal wrench for 2.5 mm (0.098 in) [length of inserted section: approximately15 mm (0.59 in)].



8. Remove camshaft brackets (No. 2 to 5).

- Loosen bolts in several steps in the reverse of the order shown in the figure.

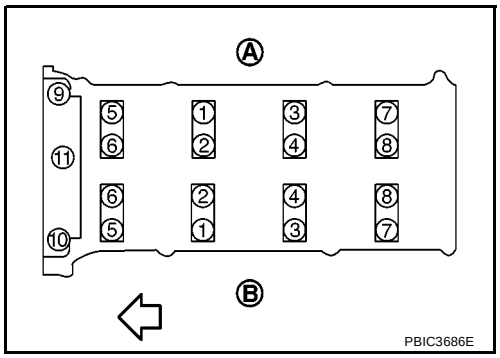
A : EXH side

B : INT side

⇦ : Engine front

NOTE:

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

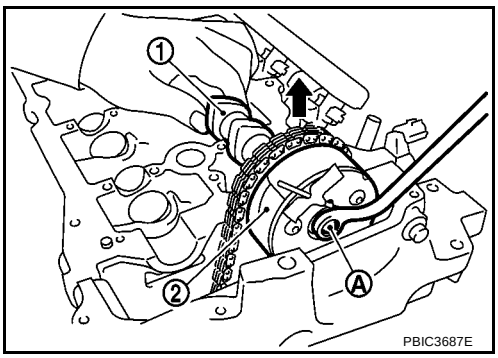


9. Remove camshaft (EXH).

10. Remove the camshaft (INT) (1) and the camshaft sprocket (INT) (2) with the following procedure.

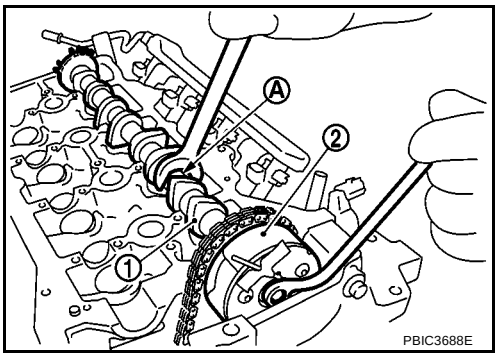
a. Lift up the camshaft sprocket (INT), and then set the thin tools (a box wrench, etc.) to the mounting bolt (A).

b. Return the camshaft (INT) to the cylinder head journal quietly.

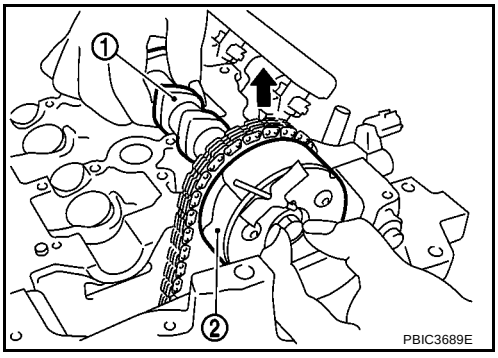


c. Keeping the camshaft hexagonal part (A) still with the wrench, loosen mounting the bolts for the camshaft sprocket (INT) (2).

1. Camshaft (INT)



d. Lift up the camshaft (INT) (1), and then disassemble the camshaft from the camshaft sprocket (INT) (2).

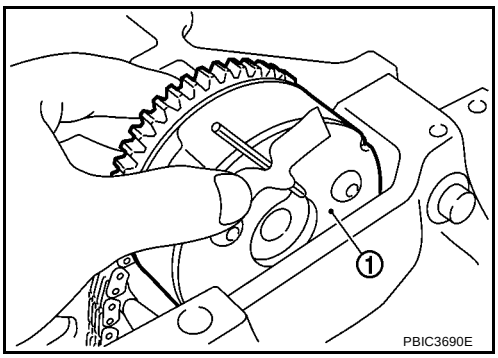


e. Remove camshaft (INT) rearward.

CAUTION:
Do not damage the signal plate of rear end.

f. Remove camshaft sprocket (INT) (1).

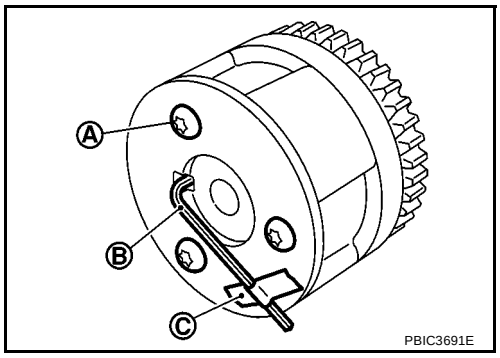
CAUTION:
Do not drop stopper pin.



CAUTION:

- **Tape (C) the stopper pin (B) so it does not come out.**
- **Do not subject it to impact by dropping.**
- **Do not disassemble. [Do not loosen the three mounting bolts (A)].**

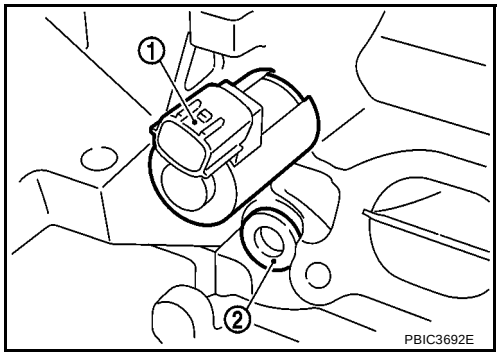
NOTE:
While removing the camshaft sprocket (INT), if you have taken out the stopper pin and the lock pin has been rejoined in the most retarded angle, do the following to restore it.



i. Install the camshaft (INT) and tighten the mounting bolts enough to prevent air from leaking out.

CAUTION:
The internal lock pin will get damaged, so keep the torque on the mounting bolts to the minimum required to prevent air from escaping.

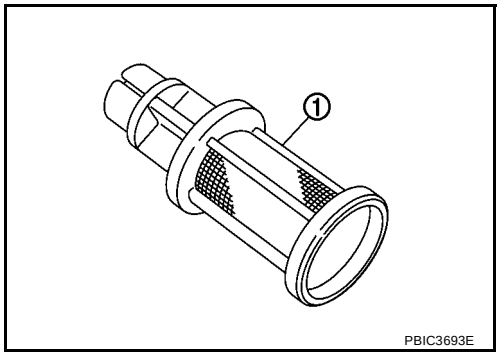
ii. Apply the air pressure, disengage the lock pin, and turn the vane to the most advanced angle position.
iii. Insert the stopper pin.
iv. Remove camshaft sprocket (INT) from the camshaft.
11. Remove valve lifter.
    - Identify installation positions, and store them without mixing them up.
12. Remove intake valve timing control solenoid valve (1).
13. Remove the alternator and bracket, remove the plug (2), and then remove the oil filter.
    Refer to EM-116, "Removal and Installation" .



INSPECTION AFTER REMOVAL

Oil Filter

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



Camshaft Runout

1. Put V-block on a precise flat table, and support No. 2 and 5 journals of camshaft.

   CAUTION:
   Do not support No. 1 journal (on the side of camshaft sprocket) because it has a different diameter from the other four locations.

2. Set a dial indicator vertically to No. 3 journal.
3. Turn camshaft to one direction with hands, and measure the camshaft runout on the dial indicator. (Total indicator reading)

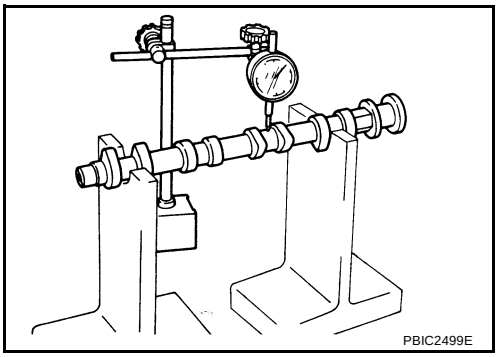
   Standard:

   : 0.02 mm (0.0008 in)

   Limit:

   : 0.1 mm (0.0039 in)

4. If it exceeds the limit, replace camshaft.


PBIC2499E

Camshaft Cam Height

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

   Standard:

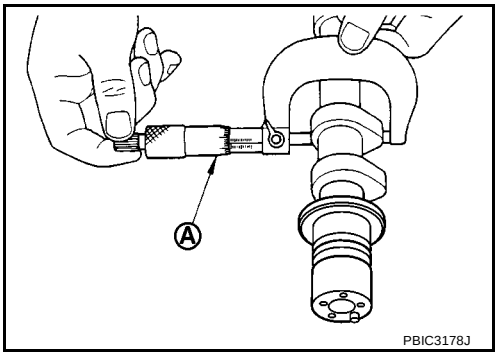
   Intake : 41.705 - 41.895 mm (1.6419 - 1.6494 in)

   Exhaust : 40.175 - 40.365 mm (1.5816 - 1.5891 in)

   Cam wear limit

   : 0.2 mm (0.0078 in)

2. If wear exceeds the limit, replace camshaft.



PBIC3178J

Camshaft Journal Oil Clearance

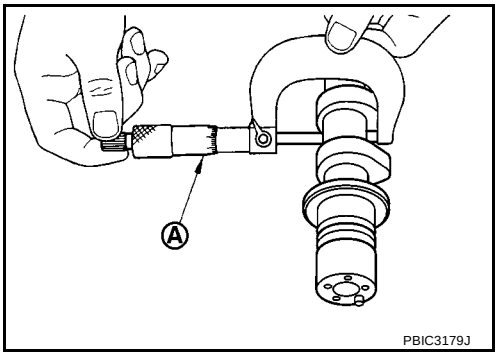
CAMSHAFT JOURNAL DIAMETER

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

Standard:

No. 1 : 27.935 - 27.955 mm (1.0998 - 1.1006 in)

No. 2, 3, 4, 5 : 24.950 - 24.970 mm (0.9822 - 0.9830 in)



PBIC3179J

CAMSHAFT BRACKET INNER DIAMETER

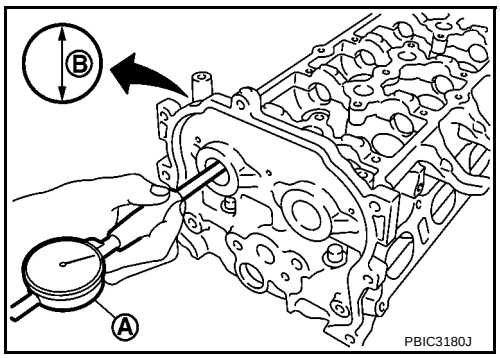
- Tighten camshaft bracket bolts with the specified torque. Refer to EM-162, "INSTALLATION" for the tightening procedure.

- Measure inner diameter (B) of camshaft bracket with a bore gauge (A).

Standard:

No. 1 : 28.000 - 28.021 mm (1.1024 - 1.1032 in)

No. 2, 3, 4, 5 : 25.000 - 25.021 mm (0.9842 - 0.9850 in)



CAMSHAFT JOURNAL OIL CLEARANCE

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

Standard

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

No. 2, 3, 4, 5 : 0.030 - 0.071 mm (0.0011 - 0.0027 in)

Limit

: 0.15 mm (0.0059 in)

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

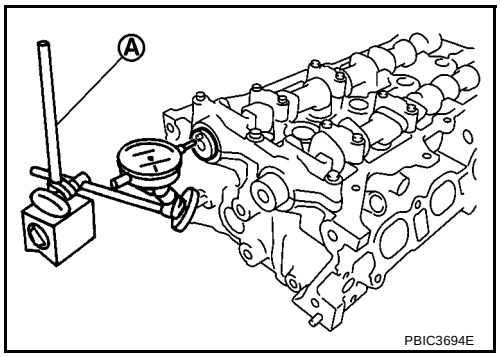
NOTE:
Camshaft brackets cannot be replaced as single parts, because they are machined together with cylinder head. Replace whole cylinder head assembly.

Camshaft End Play

1. Install camshaft in cylinder head. Refer to EM-177, "INSTALLATION" for tightening procedure.
2. Install a dial indicator (A) in thrust direction on front end of camshaft. Measure the camshaft end play on the dial indicator when camshaft is moved forward/backward (in direction to axis).

Standard : 0.075 - 0.153 mm (0.0029 - 0.0060 in)

Limit : 0.2 mm (0.0078 in)



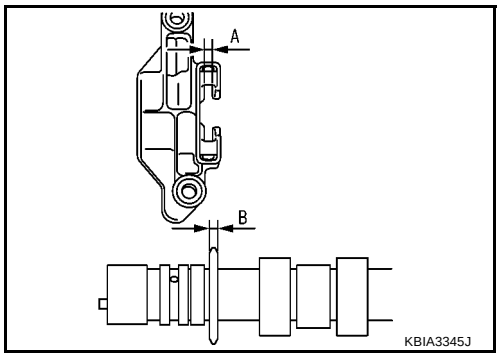
- Measure the following parts if out of the standard.
  - Dimension “A” for cylinder head No. 1 journal bearing

Standard : 4.000 - 4.030 mm (0.1574 - 0.1586 in)

  - Dimension “B” for camshaft thrust

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

- Refer to the standards above, and then replace camshaft and/or cylinder head.



Camshaft Sprocket Runout

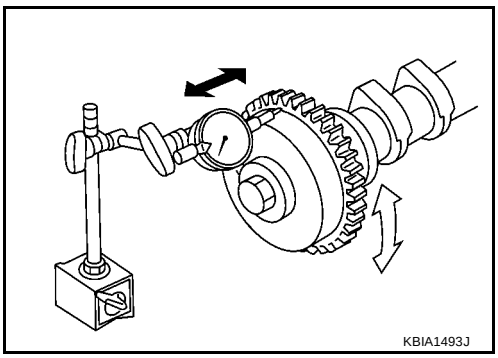
1. Put V-block on precise flat table, and support No. 2 and 5 journals of camshaft.

CAUTION:
Do not support No. 1 journal (on the side of camshaft sprocket) because it has a different diameter from the other four locations.

2. Measure the camshaft sprocket runout with a dial indicator. (Total indicator reading)

Limit : 0.15 mm (0.0059 in)

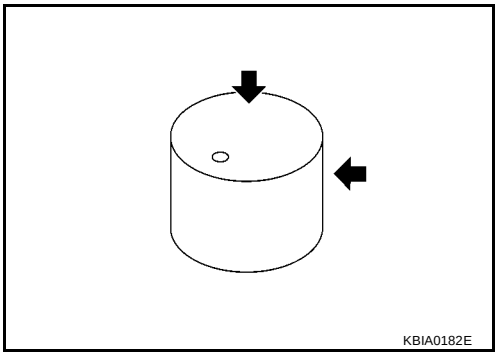
- If it exceeds the limit, replace camshaft sprocket.



Valve Lifter

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

- If anything above is found, replace valve lifter.
  Refer to EM-217, "Available Valve Lifter" .

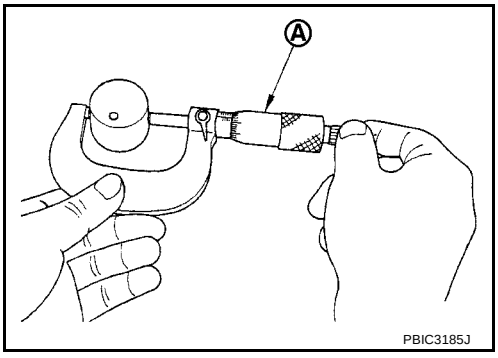


Valve Lifter Clearance

VALVE LIFTER OUTER DIAMETER

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

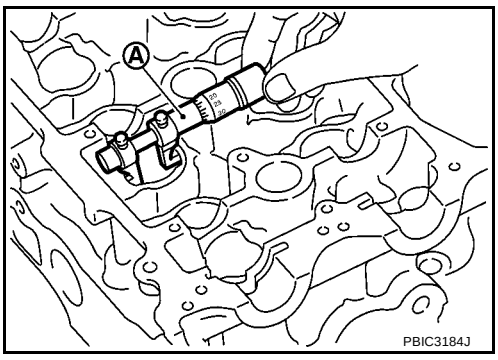
Standard : 29.977 - 29.987 mm (1.1801 - 1.1805 in)



VALVE LIFTER HOLE DIAMETER

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

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



VALVE LIFTER CLEARANCE

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

Standard : 0.013 - 0.044 mm (0.0005 - 0.0017 in)

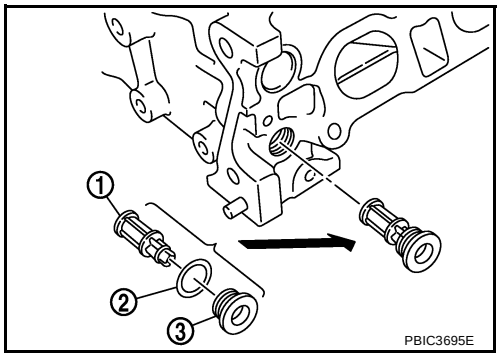
- If out of the standard, referring to the each standard of valve lifter outer diameter and valve lifter hole diameter, replace either or both valve lifter and cylinder head.

INSTALLATION

1. Install the oil filter (1).

   2 : Washer

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



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

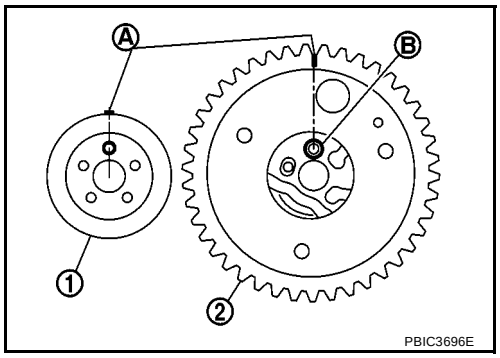
3. Install valve lifter.
   - If it is reused, install in its original positions.

4. Put a matching mark for positioning the camshaft (INT) and the camshaft sprocket (INT) with the following procedure.

   NOTE:
   It prevents the knock pin from engaging with the incorrect pin hole after installing the camshaft (INT) and the camshaft sprocket (INT).

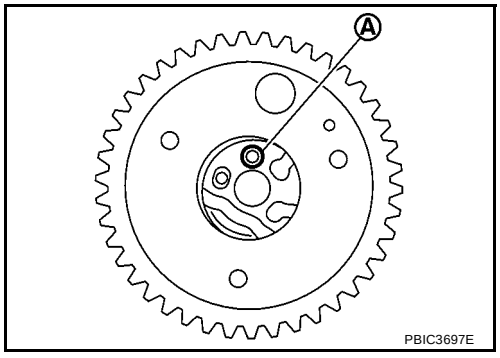
a. Put the matching marks (A) on a line extending from the knock pin position of camshaft (INT) (1) front surface.
   - Put the marks on the visible position with the camshaft sprocket installed. (The figure shows an example.)

b. Put the matching marks on a line extending from the knock pin hole (B) position of camshaft sprocket (INT) (2). (The figure shows an example.)
   - Put the marks on the visible position with it installed to the camshaft.



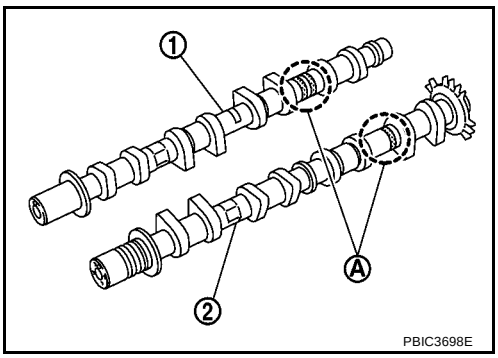
5. Set the camshaft sprocket (INT) to between cylinder head and front cover.
   - Set it with the knock pin hole (A) facing up.

   CAUTION:
   Make sure the stopper pin is inserted at the most advanced position beforehand.



6. Install camshaft.

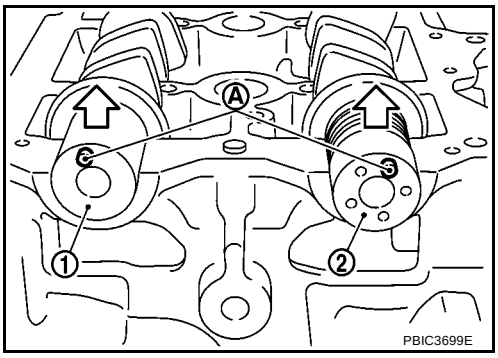
1 : Camshaft (EXH)
2 : Camshaft (INT)
A : Identification mark



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

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

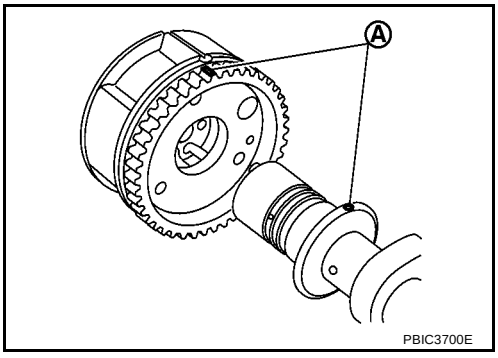
1 : Camshaft (EXH)
2 : Camshaft (INT)
⇦ : Upper side



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

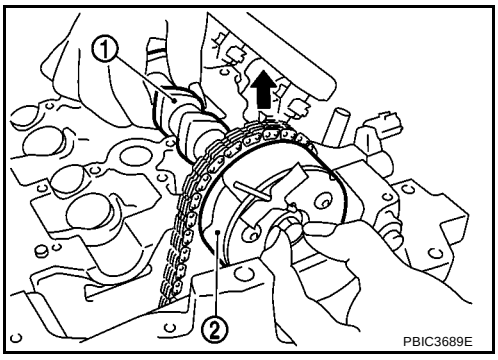
7. Install the camshaft sprocket (INT) to the camshaft (INT) with the following procedure.

a. Refer to the matching mark (A) put according to step “4”. Securely align the knock pin and the pin hole, and then install them.



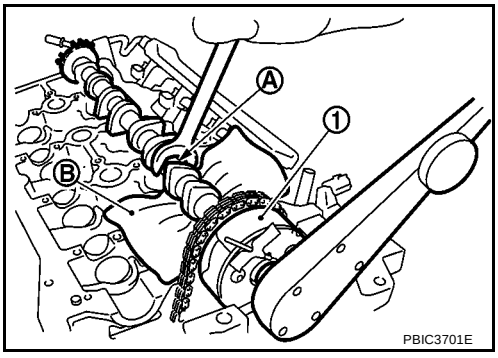
b. Lift up the front side of camshaft (INT) (1), and then temporarily tighten the bolt.

2 : Camshaft sprocket (INT)

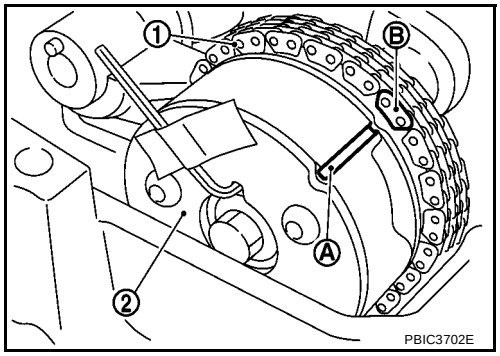


8. Put a thick shop cloth (B) to the lower surface, and then set the tools to the bolt while lifting up the front side of camshaft (INT) (1).
9. Tighten the mounting bolt.

CAUTION:
Hold the camshaft hexagonal part (A), and then secure the camshaft.



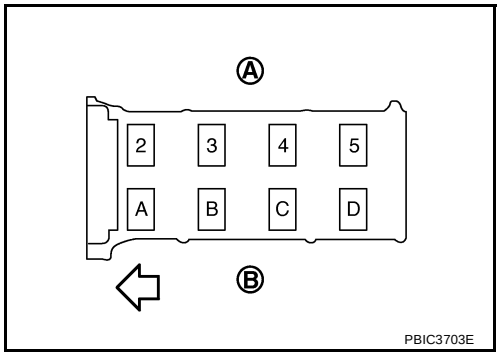
10. Return the camshaft (INT) to the cylinder head quietly.
11. Install timing chain (1) by aligning its matching mark (marked when timing chain is removed) (B) with matching mark (peripheral stamp line) (A) on camshaft sprocket (INT) (2).



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

    A : EXH side
    B : INT side
    ⇦ : Engine front

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



13. Tighten mounting bolts of camshaft brackets in the following steps, in numerical order as shown in the figure.

    A : EXH side
    B : INT side
    ⇦ : Engine front

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

: 2.0 N·m (0.2 kg-m, 1 ft-lb)

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

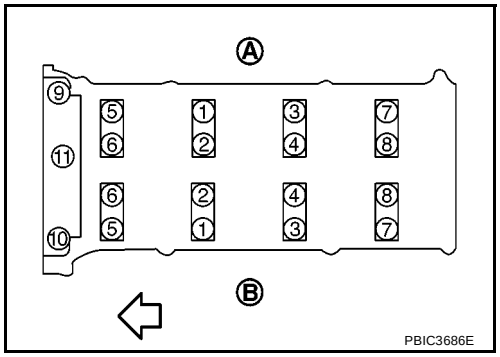
: 2.0 N·m (0.2 kg-m, 1 ft-lb)

c. Tighten all bolts in numerical order.

: 5.9 N·m (0.6 kg-m, 4 ft-lb)

d. Tighten all bolts in numerical order.

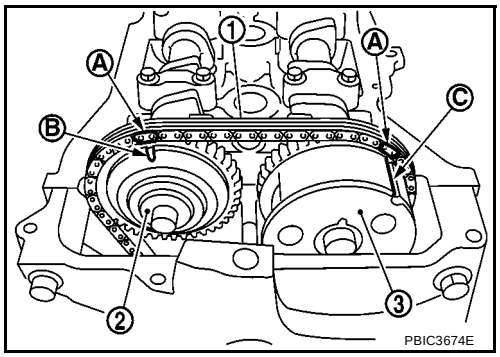
: 10.4 N·m (1.1 kg-m, 8 ft-lb)



14. Install the camshaft (EXH) to the camshaft sprocket (EXH) (2) while aligning the matching make (marked when timing chain is removed) (A) and the matching mark (stamp) (B) of camshaft sprocket (EXH).

    1 : Timing chain
    3 : Camshaft sprocket (INT)
    C : Matching mark (peripheral stamp line)

    - If the positions of knock pin and pin groove are not aligned, move the camshaft (EXH) slightly to correct these positions.

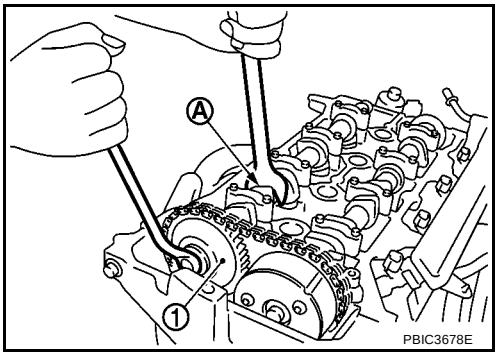


15. Tighten the mounting bolt.

1 : Camshaft sprocket (EXH)

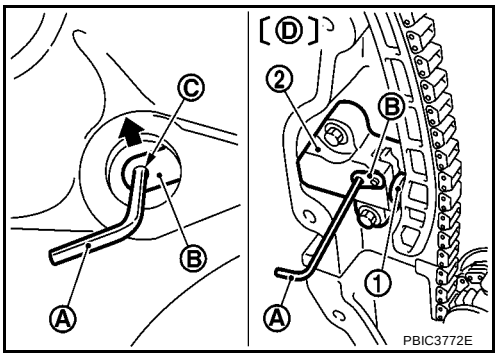
CAUTION:

- **Hold the camshaft hexagonal part (A), and then secure the camshaft.**
- **Make sure that the matching mark (marked when timing chain is removed) and each camshaft sprocket matching mark are in the correct location.**



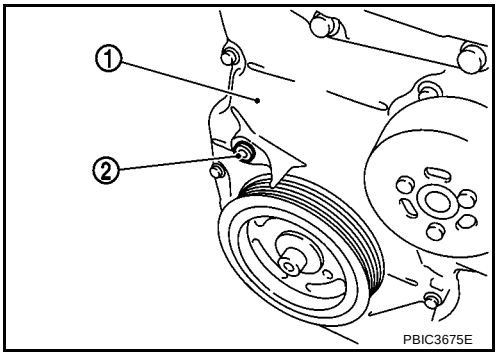
16. Pull out the stopper pin (A), and then apply the tension to the timing chain by rotating the crankshaft pulley clockwise slightly.

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



17. Install the plug (2) to the front cover (1).
- Apply liquid gasket to the threads, and tighten them.

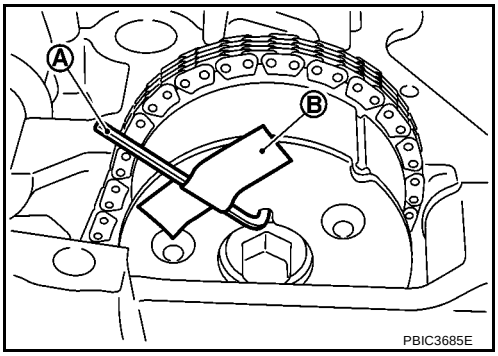
Use Genuine Liquid Gasket or equivalent.



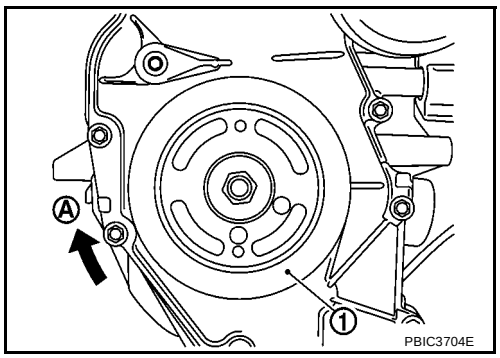
18. Return the camshaft sprocket (INT) in the most retarded position with the following procedure.

a. Remove the stopper pin (A) from the camshaft sprocket (INT).

B : Tape

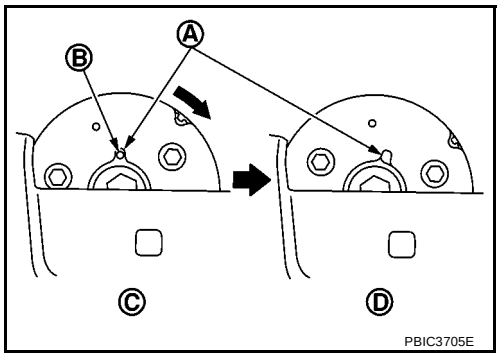


b. Turn the crankshaft pulley (1) slowly clockwise (A) and return the camshaft sprocket (INT) to the most retarded angle position.



- When first turning the crankshaft the camshaft sprocket (INT) will turn. Once it is turned more, and the vane (camshaft) also turns, then it has reached the most retarded angle position.

  B : Stopper pin hole
  C : Most advanced angle
  D : Lock pin engaged



- The most retarded angle position can be checked by seeing if the stopper pin groove (A) is shifted clockwise.
- After spinning the crankshaft slightly in the counterclockwise direction, you can make sure the lock pin has joined by seeing if the vane (camshaft) and the sprocket move together.

19. Install the camshaft position sensor (PHASE) to the rear end of cylinder head.
    - Tighten bolts with it seated completely.
20. Check and adjust valve clearance. Refer to EM-167, "Valve Clearance" .
21. Install in the reverse order of removal.

INSPECTION AFTER INSTALLATION

Inspection for Leaks

The following are procedures for checking fluids leak, lubricates leak.

- Before starting engine, check oil/fluid levels including engine coolant and engine oil. If less than required quantity, fill to the specified level. Refer to MA-35, "RECOMMENDED FLUIDS AND LUBRICANTS" .
- Use procedure below to check for fuel leakage.
  - Turn ignition switch “ON” (with engine stopped). With fuel pressure applied to fuel piping, check for fuel leakage at connection points.
  - Start engine. With engine speed increased, check again for fuel leakage at connection points.
- Run engine to check for unusual noise and vibration.

  NOTE:
  If hydraulic pressure inside timing chain tensioner drops after removal/installation, slack in the guide may generate a pounding noise during and just after engine start. However, this is normal. Noise will stop after hydraulic pressure rises.
- Warm up engine thoroughly to make sure there is no leakage of fuel, or any oil/fluids including engine oil and engine coolant.
- Bleed air from lines and hoses of applicable lines, such as in cooling system.
- After cooling down engine, again check oil/fluid levels including engine oil and engine coolant. Refill to the specified level, if necessary.

Summary of the inspection items:

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

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

Inspection of Camshaft Sprocket (INT) Oil Groove

CAUTION:

- **Perform this inspection only when DTC P0011 is detected in self-diagnostic results of CONSULT-II and it is directed according to inspection procedure of EC section. Refer to EC-832, "ON BOARD DIAGNOSTIC (OBD) SYSTEM" (with EURO-OBD) or EC-1269, "ON BOARD DIAGNOSTIC (OBD) SYSTEM" (without EURO-OBD).**
- **Check when engine is cold so as to prevent burns from the splashing engine oil.**

1. Check engine oil level. Refer to LU-16, "ENGINE OIL" .
2. Perform the following procedure so as to prevent the engine from being unintentionally started while checking.

a. Release the fuel pressure. Refer to EC-861, "FUEL PRESSURE RELEASE" (with EURO-OBD) or EC-1286, "FUEL PRESSURE RELEASE" (Without EURO-OBD).

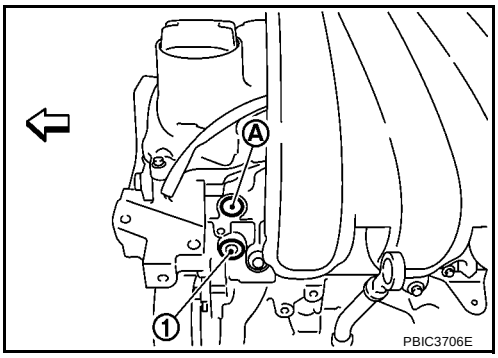
b. Remove intake manifold. Refer to EM-121, "INTAKE MANIFOLD" .

c. Disconnect ignition coil and injector harness connectors.

3. Remove intake valve timing control solenoid valve. Refer to EM-152, "CAMSHAFT" .
4. Crank engine, and then make sure that engine oil comes out from intake valve timing control solenoid valve hole (A). End crank after checking.

1 : Plug

⇦ :Engine front



WARNING:

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

CAUTION:

- **Prevent splashing by using a shop cloth so as to prevent the worker from injury from engine oil and so as to prevent engine oil contamination.**
- **Prevent splashing by using a shop cloth so as to prevent engine oil from being splashed to engine and vehicle. Especially, be careful not to apply engine oil to rubber parts of drive belts, engine mounting insulator, etc. Wipe engine oil off immediately if it is splashed.**

5. Perform the following inspection if engine oil does not come out from intake valve timing control solenoid valve oil hole of the cylinder head.
   - Remove oil filter, and then clean it. Refer to EM-158, "Oil Filter" .
   - Clean oil groove between oil strainer and intake valve timing control solenoid valve. Refer to LU-15, "Lubrication Circuit" .
6. Remove components between intake valve timing control solenoid valve and camshaft sprocket (INT), and then check each oil groove for clogging.
   - Clean oil groove if necessary. Refer to LU-15, "Lubrication Circuit" .
7. After inspection, install removed parts in the reverse order.

Valve Clearance

EBS01J9P

INSPECTION

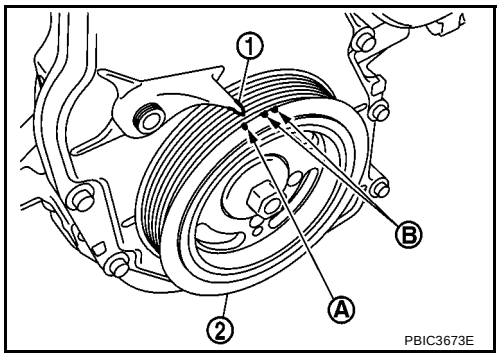
Perform inspection as follows after removal, installation or replacement of camshaft or valve-related parts, or if there is unusual engine conditions regarding valve clearance.

1. Remove rocker cover. Refer to EM-141, "ROCKER COVER" .
2. Measure the valve clearance with the following procedure:

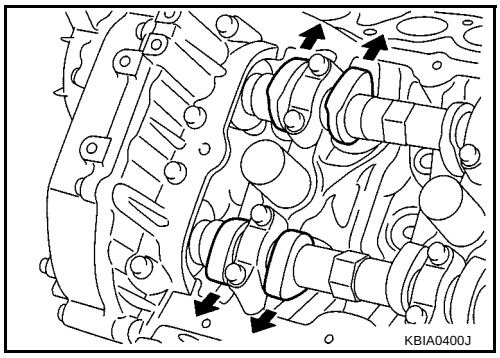
a. Set No. 1 cylinder at TDC of its compression stroke.

- Rotate crankshaft pulley (2) clockwise and align TDC mark (without paint mark) (A) to timing indicator (1) on front cover.

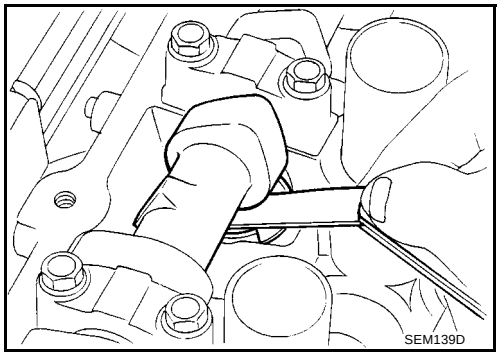
  B : White paint mark



- At the same time, make sure that both intake and exhaust cam noses of No. 1 cylinder face outside as shown in the figure.
- If they do not face outside, rotate crankshaft pulley once more (360 degrees) and align as shown in the figure.



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



Valve clearance:

Unit: mm (in)

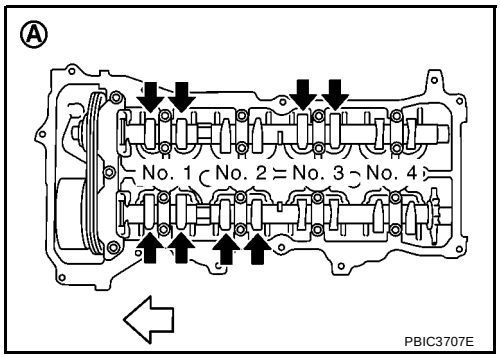
	Cold	Hot * (reference data)
Intake	0.26 - 0.34 (0.010 - 0.013)	0.304 - 0.416 (0.012 - 0.016)
Exhaust	0.29 - 0.37 (0.011 - 0.014)	0.308 - 0.432 (0.012 - 0.017)

*:Approximately 80°C (176°F)

- By referring to the figure, measure the valve clearances at locations marked "×" as shown in the table below [locations indicated with black arrow (⬅) in the figure] with a feeler gauge.

  A : No. 1 cylinder compression TDC

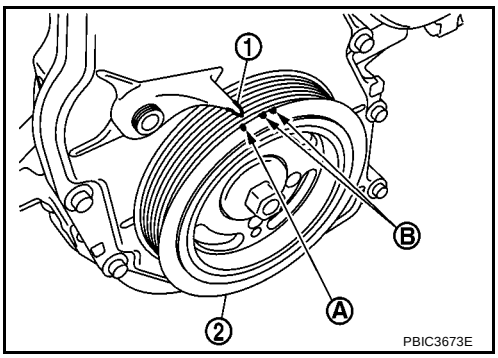
  ⇦ : Engine front



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

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

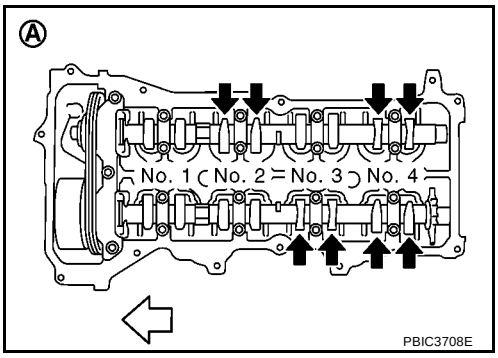
B : White paint mark



- By referring to the figure, measure the valve clearance at locations marked "×" as shown in the table below [locations indicated with black arrow (⬅) in the figure] with a feeler gauge.

A : No. 4 cylinder compression TDC

⇦ : Engine front



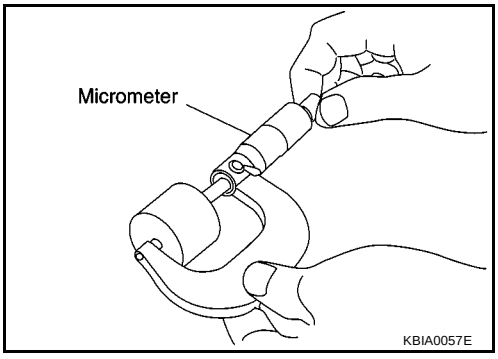
Measuring position		No. 1 CYL.	No. 2 CYL.	No. 3 CYL.	No. 4 CYL.
Measurement point	EXH		×		×
	INT			×	×

3. If out of standard, perform adjustment. Refer to EM-169, "ADJUSTMENT" .

ADJUSTMENT

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

1. Remove camshaft. Refer to EM-152, "REMOVAL" .
2. Remove valve lifters at the locations that are out of the standard.
3. Measure the center thickness of the removed valve lifters with a micrometer.



4. Use the equation below to calculate valve lifter thickness for replacement.

Valve lifter thickness calculation: $t = t_1 + (C_1 - C_2)$

t = Valve lifter thickness to be replaced

t_1 = Removed valve lifter thickness

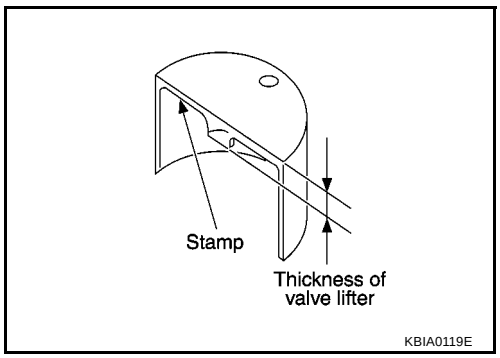
C_1 = Measured valve clearance

C_2 = Standard valve clearance:

Intake : 0.30 mm (0.012 in)

Exhaust : 0.33 mm (0.013 in)

- Thickness of new valve lifter can be identified by stamp mark on the reverse side (inside the cylinder).
- Stamp mark “300” indicates 3.00 mm (0.118 in) in thickness.



NOTE:
Available thickness of valve lifter: 26 sizes range 3.00 to 3.50 mm (0.118 to 0.137 in) in steps of 0.02 mm (0.0008 in) (when manufactured at factory). Refer to EM-217, "Available Valve Lifter" .

5. Install the selected valve lifter.
6. Install camshaft. Refer to EM-162, "INSTALLATION" .
7. Manually rotate crankshaft pulley a few rotations.
8. Make sure that valve clearances for cold engine are within specifications by referring to the specified values. Refer to EM-167, "INSPECTION" .
9. Install all removed parts in the reverse order of removal. Refer to EM-162, "INSTALLATION" .
10. Warm up the engine, and check for unusual noise and vibration.

OIL SEAL

PFP:12279

Removal and Installation of Valve Oil Seal

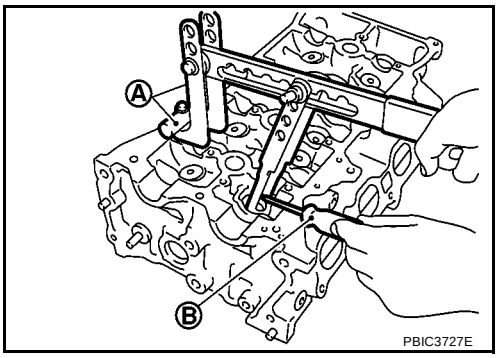
EBS01J9Q

REMOVAL

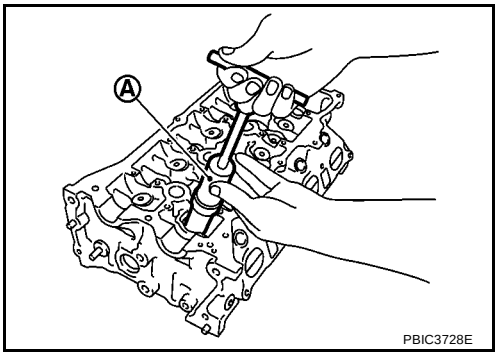
1. Remove camshafts. Refer to EM-152, "CAMSHAFT" .
2. Remove valve lifters. Refer to EM-152, "CAMSHAFT" .
3. Rotate crankshaft, and set piston whose valve oil seal is to be removed to TDC. This will prevent valve from dropping into cylinder.

   CAUTION:
   When rotating crankshaft, be careful to avoid scarring front cover with timing chain.
4. Remove valve collet.
   - Compress valve spring with the valve spring compressor, the attachment and the adapter (SST: KV10116200) (A). Remove valve collet with a magnet hand (B).

   CAUTION:
   When working, be careful not to damage valve lifter holes.



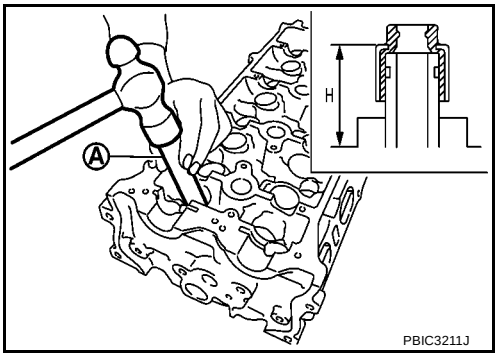
5. Remove valve spring retainer, valve spring and valve spring seat.
6. Remove valve oil seal with the valve oil seal puller (SST: KV10107902) (A).



INSTALLATION

1. Apply new engine oil to valve oil seal joint surface and seal lip.
2. Press in valve oil seal to the height “H” shown in the figure with the valve oil seal drift (SST: KV10115600) (A).

   Height “H” : 13.2 - 13.8 mm (0.519 - 0.543 in)



3. Install in the reverse order of removal after this step.

Removal and Installation of Front Oil Seal

EBS01J9R

REMOVAL

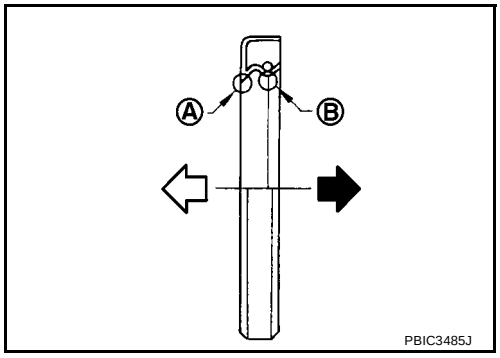
1. Remove the following parts.
   - Front fender protector (RH); Refer to EI-14, "FENDER PROTECTOR" .
   - Drive belt; Refer to EM-115, "DRIVE BELTS" .
   - Crankshaft pulley; Refer to EM-143, "TIMING CHAIN" .
2. Remove front oil seal with a suitable tool.

   CAUTION:
   Be careful not to damage front cover and crankshaft.

INSTALLATION

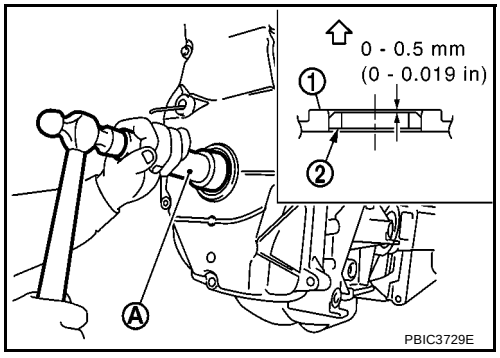
1. Apply new engine oil to new front oil seal joint surface and seal lip.
2. Install front oil seal so that each seal lip is oriented as shown in the figure.

   A : Dust seal lip
   B : Oil seal lip
   ⇦ : Engine outside
   ⬅ : Engine inside



   - Press-fit front oil seal (2) using a drift with outer diameter 50 mm (1.97 in) and inner diameter 44 mm(1.73 in) (commercial service tool) (A) so as to be the dimension specified in the figure.

     1 : Front cover
     ⇦ : Engine front



     CAUTION:
     - **Be careful not to damage front cover and crankshaft.**
     - **Press-fit oil seal straight to avoid causing burrs or tilting.**

3. Install in the reverse order of removal after this step.

Removal and Installation of Rear Oil Seal

EBS01J9S

REMOVAL

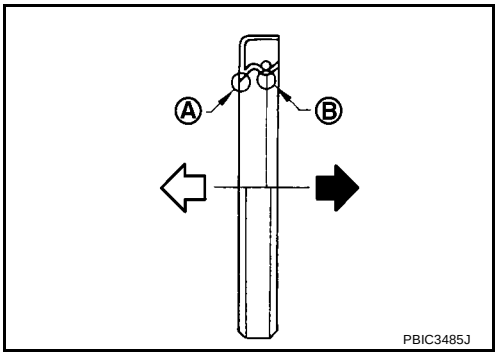
1. Remove transaxle assembly. Refer to MT-7, "REMOVAL AND INSTALLATION" .
2. Remove clutch cover and clutch disk.
   Refer to CL-12, "CLUTCH DISC, CLUTCH COVER AND FLYWHEEL" .
3. Remove flywheel. Refer to EM-190, "CYLINDER BLOCK" .
4. Remove rear oil seal with a suitable tool.

   CAUTION:
   Be careful not to damage crankshaft and cylinder block.

INSTALLATION

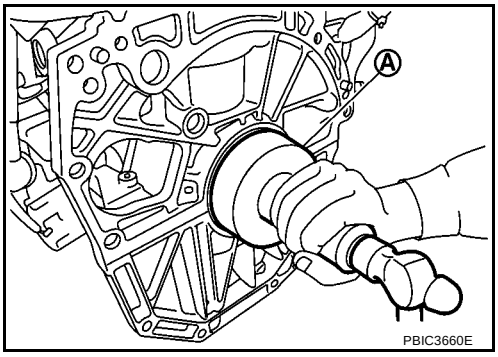
1. Apply the liquid gasket lightly to entire outside area of new rear oil seal.
   Use Genuine Liquid Gasket or equivalent.
2. Install rear oil seal so that each seal lip is oriented as shown in the figure.

   A : Dust seal lip
   B : Oil seal lip
   ⇦ : Engine outside
   ⬅ : Engine inside



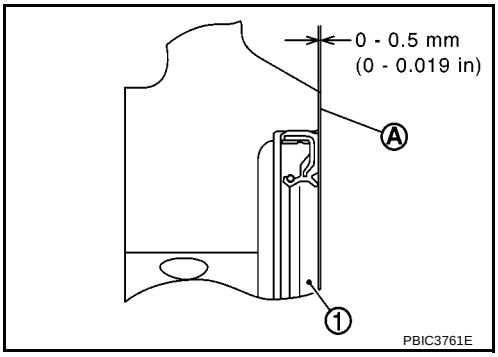
- Press-fit rear oil seal with a drift outer diameter 113 mm (4.45 in) and inner diameter 90 mm (3.54 in) (commercial service tool) (A).

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



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

  A : Rear end surface of cylinder block



3. After press-fitting rear oil seal, completely wipe off any liquid gasket protruding to rear end surface side.
4. Install in the reverse order of removal after this step.

CYLINDER HEAD

PFP:11041

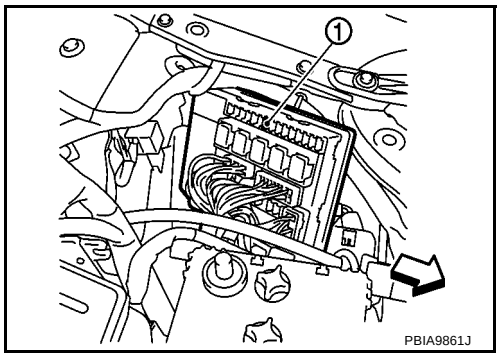
On-Vehicle Service

EBS01J9T

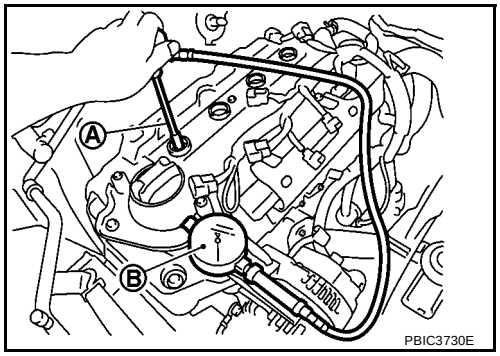
CHECKING COMPRESSION PRESSURE

1. Warm up engine thoroughly. Then, stop it.
2. Release fuel pressure. Refer to EC-861, "FUEL PRESSURE RELEASE" (with EURO-OBD) or EC-1286, "FUEL PRESSURE RELEASE" (without EURO-OBD).
3. Disconnect fuel pump fuse (1) to avoid fuel injection during measurement.

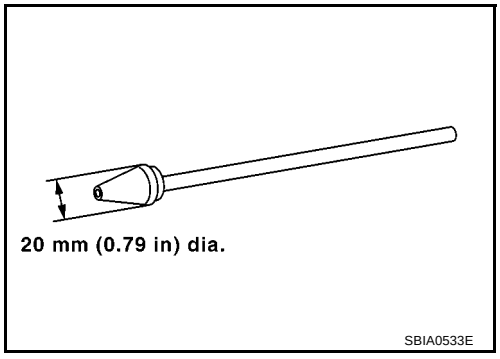
   ⇦ : Vehicle front



4. Remove engine cover. Refer to EM-121, "INTAKE MANIFOLD" .
5. Remove ignition coil and spark plug from each cylinder. Refer to EM-133, "IGNITION COIL" and EM-134, "SPARK PLUG (PLATINUM-TIPPED TYPE)" .
6. Connect an engine tachometer (not required in use of CONSULT-II).
7. Install a compression tester (B) with an adapter (commercial service tool) (A) onto spark plug hole.



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



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

   Compression pressure:

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

Standard	Minimum	Differential limit between cylinders
1,510 (15.1, 15.4, 219) / 200	1,265 (12.65, 12.9, 183) / 200	981 (9.81, 10.0, 142) / 200

CAUTION:

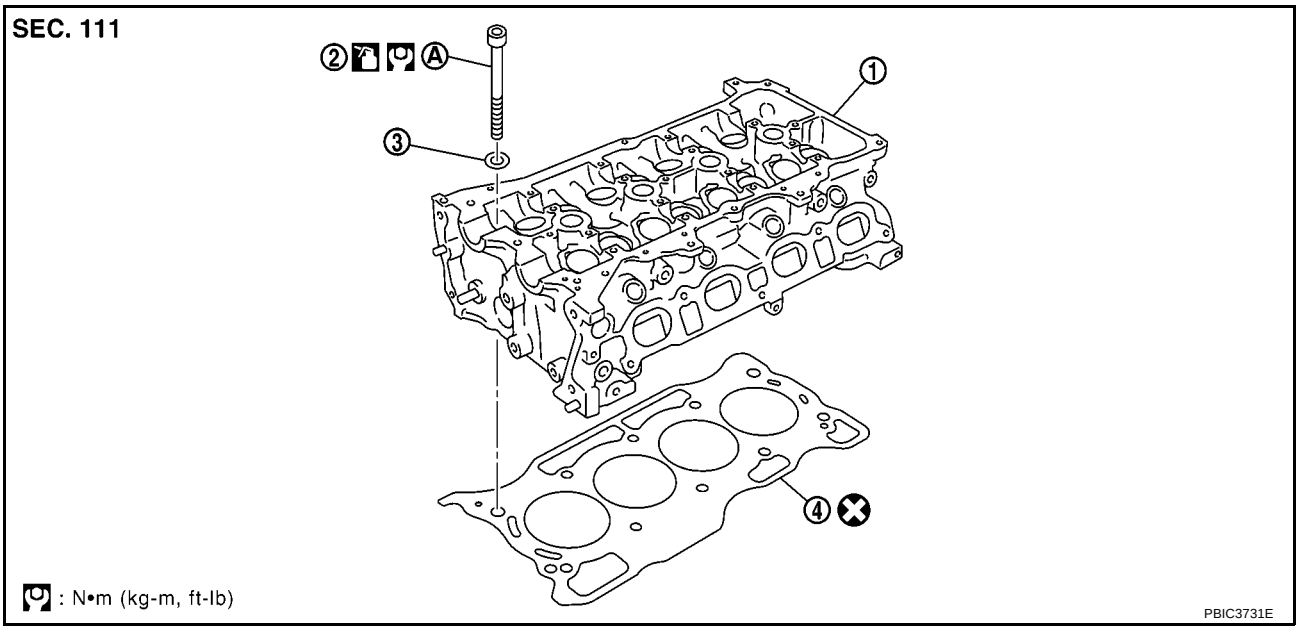
Always use fully a changed battery to obtain the specified engine speed.

- If the engine speed is out of the specified range, check battery liquid for proper gravity. Check engine speed again with normal battery gravity.
- If compression pressure is below minimum value, check valve clearances and parts associated with combustion chamber (Valve, valve seat, piston, piston ring, cylinder bore, cylinder head, cylinder head gasket). After the checking, measure the compression pressure again.
- If some cylinder has low compression pressure, pour small amount of engine oil into the spark plug hole of the cylinder to re-check it for compression.
  - If the added engine oil improves the compression, piston rings may be worn out or damaged. Check piston rings and replace if necessary.
  - If the compression pressure remains at low level despite the addition of engine oil, valves may be malfunctioning. Check valves for damage. Replace valve or valve seat accordingly.
- If two adjacent cylinders have respectively low compression pressure and their compression remains low even after the addition of engine oil, cylinder head gasket is leaking. In such a case, replace cylinder head gasket.

9. After inspection is completed, install removed parts.
10. Start the engine, and confirm that the engine runs smoothly.
11. Perform trouble diagnosis. If DTC appears, erase it. Refer to EC-864, "TROUBLE DIAGNOSIS" (with EURO-models) or EC-1289, "TROUBLE DIAGNOSIS" (without EURO-models).

Components

EBS01J9U



1. Cylinder head assembly
2. Cylinder head bolt
3. Washer
4. Cylinder head gasket
A. Refer to EM-177

Refer to GI-9 for symbol marks in the figure.

Removal and Installation

EBS01J9V

REMOVAL

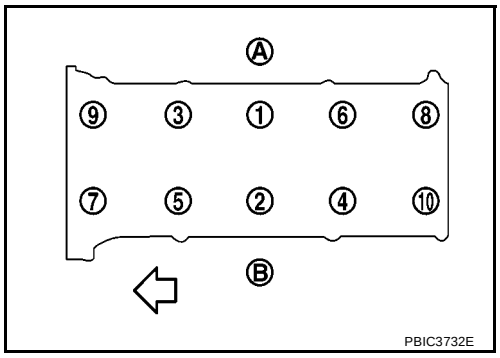
1. Release fuel pressure. Refer to EC-861, "FUEL PRESSURE RELEASE" (with EURO-OBD) or EC-1286, "FUEL PRESSURE RELEASE" (without EURO-OBD).
2. Drain engine coolant and engine oil. Refer to CO-35, "Changing Engine coolant" and LU-17, "Changing Engine Oil" .

   CAUTION:
   Perform this step when the engine is cold.
3. Remove the following components and related parts.
   - Exhaust manifold; Refer to EM-125, "EXHAUST MANIFOLD" .
   - Intake manifold; Refer to EM-121, "INTAKE MANIFOLD" .

- Fuel tube and fuel injector; Refer to EM-136, "FUEL INJECTOR AND FUEL TUBE" .
- Water outlet; Refer to CO-52, "WATER OUTLET" .
- Front fender protector (RH); Refer to EI-14, "FENDER PROTECTOR" .
- Drive belt; Refer to EM-115, "DRIVE BELTS" .
- Front cover; Refer to EM-143, "TIMING CHAIN" .
- Camshaft; Refer to EM-152, "CAMSHAFT" .

4. Remove cylinder head loosening bolts in reverse order as shown in the figure with cylinder head wrench (commercial service tool).

A : EXH side
B : INT side
⇦ : Engine front



5. Remove cylinder head gasket.

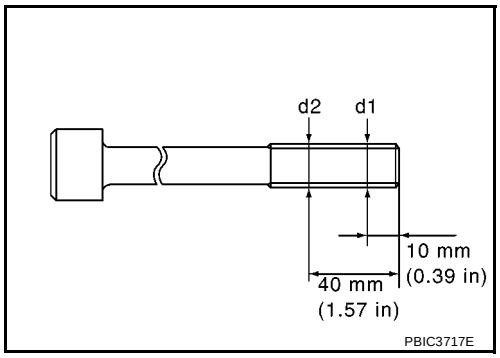
INSPECTION AFTER REMOVAL

Cylinder Head Bolts Outer Diameter

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

Limit (“d1” – “d2”): 0.15 mm (0.0059 in)

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



Cylinder Head Distortion

NOTE:
When performing this inspection, cylinder block distortion should be also checking.
Refer to EM-209, "CYLINDER BLOCK DISTORTION" .

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

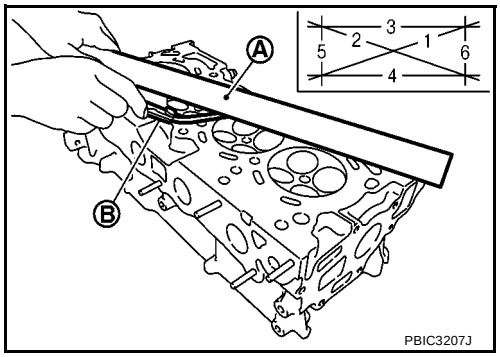
CAUTION:
Use utmost care not to allow gasket debris to enter passages for engine oil or engine coolant.

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

A : Straightedge
B : Feeler gauge

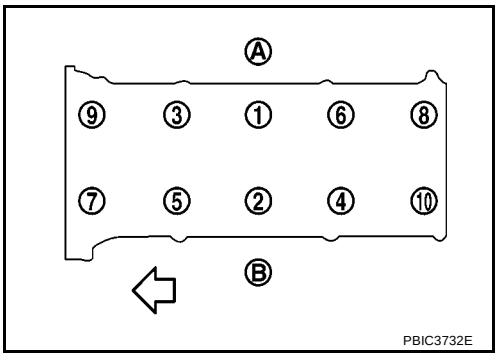
Limit : 0.1 mm (0.004 in)

- If it exceeds the limit, replace cylinder head.



INSTALLATION

1. Install new cylinder head gasket.
2. Tighten cylinder head bolts in numerical order as shown in the figure with the following procedure to install cylinder head.



A : EXH side
B : INT side
⇦ : Engine front

CAUTION:
If cylinder head bolts are re-used, check their outer diameters before installation. Refer to EM-176, "Cylinder Head Bolts Outer Diameter" .

a. Apply new engine oil to threads and seating surfaces of mounting bolts.
b. Tighten all bolts.

: 66.7 N·m (6.8 kg-m, 49 ft-lb)

c. Completely loosen.

: 0 N·m (0 kg-m, 0 ft-lb)

CAUTION:
In this step, loosen bolts in reverse order of that indicated in the figure.

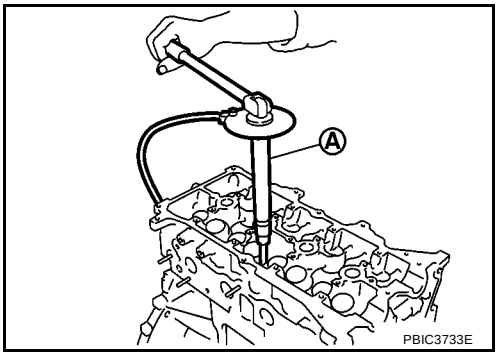
d. Tighten all bolts.

: 40.0 N·m (4.1 kg-m, 30 ft-lb)

e. Turn all bolts 75 degrees clockwise (angle tightening).

CAUTION:
Check and confirm the tightening angle by using the angle wrench (SST: KV10112100) (A) or protractor. Avoid judgment by visual inspection without the tool.

f. Turn all bolts 75 degrees clockwise again (angle tightening).



3. Install in the reverse order of removal after this step.

INSPECTION AFTER INSTALLATION

Inspection for Leaks

The following are procedures for checking fluids leak, lubricates leak and exhaust gases leak.

- Before starting engine, check oil/fluid levels including engine coolant and engine oil. If less than required quantity, fill to the specified level. Refer to MA-35, "RECOMMENDED FLUIDS AND LUBRICANTS" .
- Use procedure below to check for fuel leakage.
  - Turn ignition switch ON (with engine stopped). With fuel pressure applied to fuel piping, check for fuel leakage at connection points.
  - Start engine. With engine speed increased, check again for fuel leakage at connection points.
- Run engine to check for unusual noise and vibration.

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

- Warm up engine thoroughly to make sure there is no leakage of fuel, exhaust gases, or any oil/fluids including engine oil and engine coolant.

- Bleed air from lines and hoses of applicable lines, such as in cooling system.
- After cooling down engine, again check oil/fluid levels including engine oil and engine coolant. Refill to the specified level, if necessary.

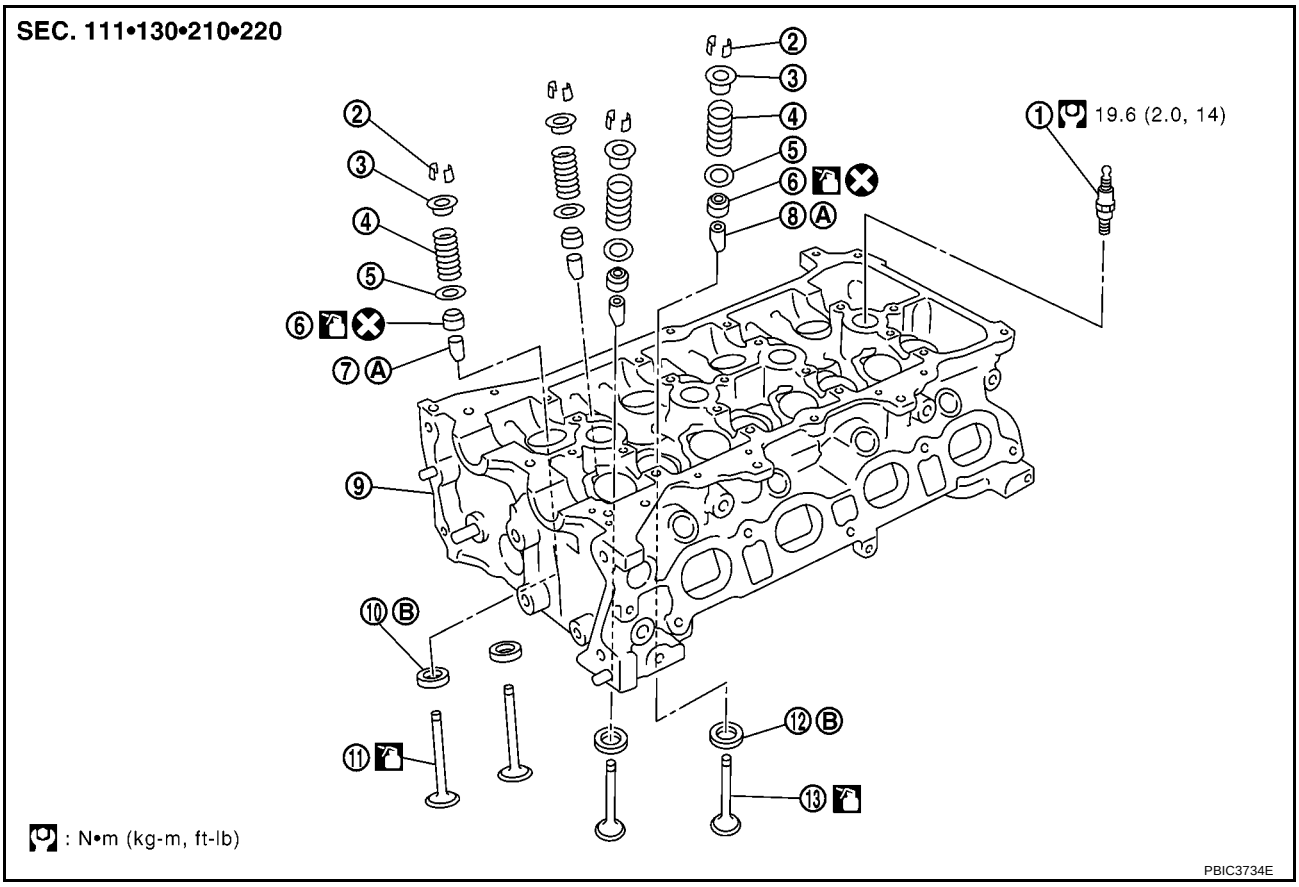
Summary of the inspection items:

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

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

Components

EBS01J9W



1. Spark plug	2. Valve collet	3. Valve spring retainer
4. Valve spring	5. Valve spring seat	6. Valve oil seal
7. Valve guide (EXH)	8. Valve guide (INT)	9. Cylinder head
10. Valve seat (EXH)	11. Valve (EXH)	12. Valve seat (INT)
13. Valve (INT)		
A. Refer to EM-181	B. Refer to EM-183	

Refer to GI-9, "Components" for symbol marks in the figure.

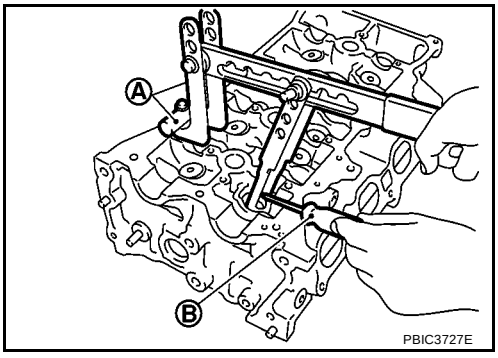
Disassembly and Assembly

EBS01J9X

DISASSEMBLY

1. Remove spark plug with a spark plug wrench (commercial service tool).
2. Remove valve lifter.
   - Identify installation positions, and store them without mixing them up.
3. Remove valve collet.
   - Compress valve spring with the valve spring compressor, the attachment and the adapter (SST: KV10116200) (A). Remove valve collet with a magnet hand (B).

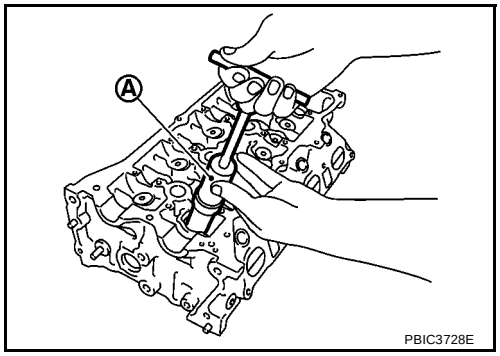
   CAUTION:
   When working, be careful not to damage valve lifter holes.



4. Remove valve spring retainer and valve spring.
5. Push valve stem to combustion chamber side, and remove valve.

- Identify installation positions, and store them without mixing them up.

6. Remove valve oil seal with the valve oil seal puller (SST: KV10107902) (A).

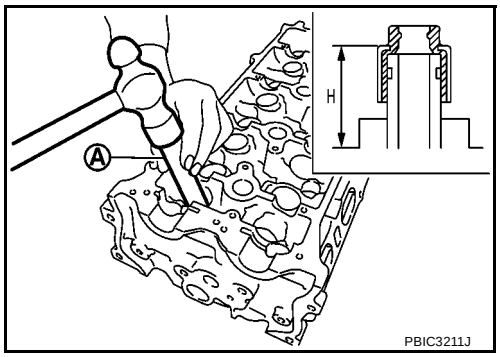


7. Remove valve spring seat.
8. When valve seat must be replaced, refer to EM-183, "VALVE SEAT REPLACEMENT" to removal.
9. When valve guide must be replaced, refer to EM-181, "VALVE GUIDE REPLACEMENT" to removal.

ASSEMBLY

1. Install valve guide if removed. Refer to EM-181, "VALVE GUIDE REPLACEMENT" .
2. Install valve seat if removed. Refer to EM-183, "VALVE SEAT REPLACEMENT" .
3. Install valve oil seal.
   - Install with the valve oil seal drift (SST: KV10115600) (A) to match dimension in the figure.

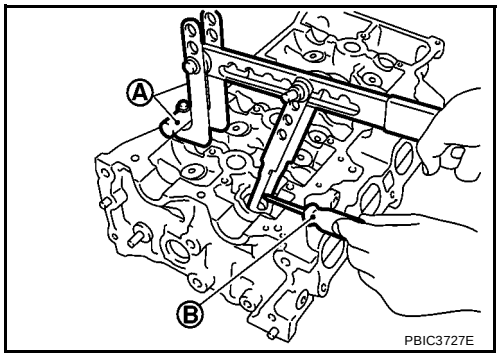
     Height "H" : 13.2 - 13.8 mm (0.519 - 0.543 in)



4. Install valve spring seat.
5. Install valve.
   - Install larger diameter to intake side.
6. Install valve spring.

   NOTE:
   It can be installed in either direction.
7. Install valve spring retainer.
8. Install valve collet.
   - Compress valve spring with the valve spring compressor, the attachment and the adapter (SST: KV10116200) (A). Install valve collet with a magnet hand (B).

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



9. Install valve lifter.
10. Install spark plug with a spark plug wrench (commercial service tool).

Inspection After Disassembly

EBS01J9Y

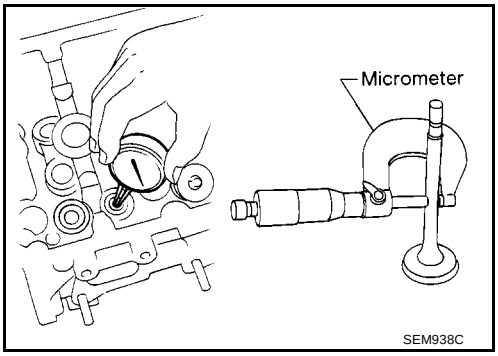
VALVE DIMENSIONS

- Check dimensions of each valve. For dimensions, refer to EM-216, "Valve Dimensions" .
- If dimensions are out of the standard, replace valve.

VALVE GUIDE CLEARANCE

Valve Stem Diameter

Measure the diameter of valve stem with a micrometer.



Standard

Intake : 4.965 - 4.980 mm (0.1954 - 0.1960 in)

Exhaust : 4.955 - 4.970 mm (0.1950 - 0.1956 in)

Valve Guide Inner Diameter

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

Standard

Intake and Exhaust

: 5.000 - 5.018 mm (0.1968 - 0.1975 in)

Valve Guide Clearance

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

Valve guide clearance:

Standard

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

Exhaust : 0.030 - 0.063 mm (0.0012 - 0.0025 in)

Limit

Intake : 0.1 mm (0.004 in)

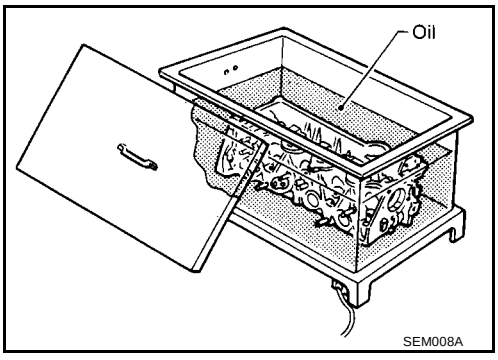
Exhaust : 0.1 mm (0.004 in)

- If it exceeds the limit, replace valve guide and/or valve. When valve guide must be replaced, refer to EM-181, "VALVE GUIDE REPLACEMENT" .

VALVE GUIDE REPLACEMENT

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

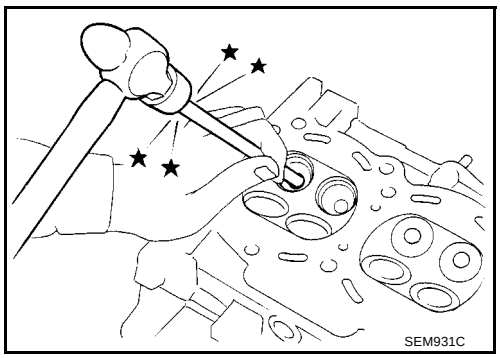
1. To remove valve guide, heat cylinder head to 110 to 130°C (230 to 266°F) by soaking in heated oil.



2. Drive out valve guide with a press [under a 20 kN (2 ton, 2.2 US ton, 2.0 lmp ton) force] or hammer and valve guide drift (commercial service tool).

CAUTION:

Cylinder head contains heat, when working, wear protective equipment to avoid getting burned.

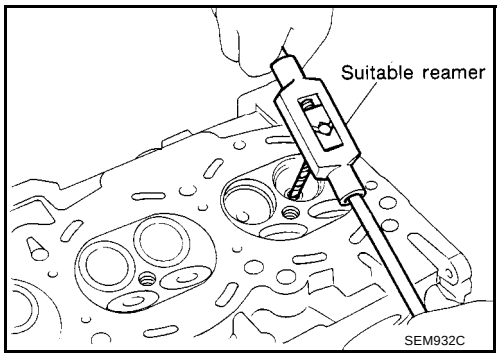


3. Ream cylinder head valve guide hole with a valve guide reamer (commercial service tool).

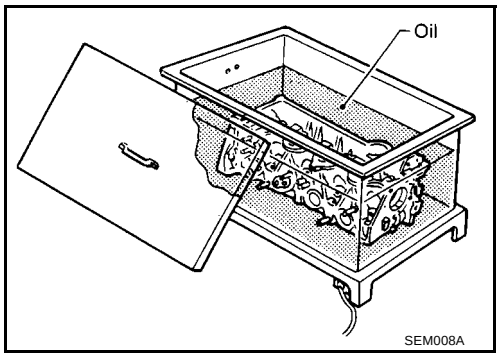
Valve guide hole diameter (for service parts):

Intake and exhaust

: 9.175 - 9.196 mm (0.3612 - 0.3620 in)



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

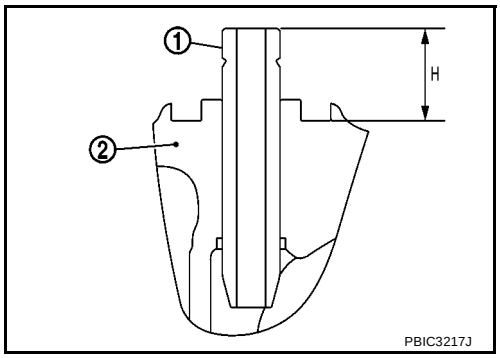


5. Using a valve guide drift (commercial service tool), press valve guide (1) from camshaft side to dimensions as shown in the figure.

Projection “H”: : 11.4 - 11.8 mm (0.448 - 0.464 in)

CAUTION:

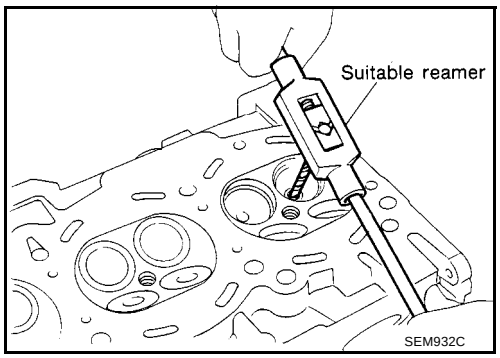
Cylinder head (2) contains heat, when working, wear protective equipment to avoid getting burned.



6. Apply reamer finish to valve guide with a valve guide reamer (commercial service tool).

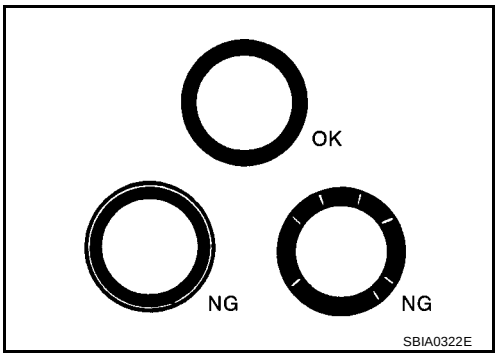
Standard

5.000 - 5.018 mm (0.1968 - 0.1975 in)



VALVE SEAT CONTACT

- After confirming that the dimensions of valve guides and valves are within specifications, perform this procedure.
- Apply prussian blue (or white lead) onto contacting surface of valve seat to check the condition of the valve contact on the surface.
- Check if the contact area band is continuous all around the circumference.
- If not, grind to adjust valve fitting and check again. If the contacting surface still has NG conditions even after the re-check, replace valve seat. Refer to EM-183, "VALVE SEAT REPLACEMENT" .



VALVE SEAT REPLACEMENT

When valve seat is removed, replace with oversized [0.5 mm (0.020 in)] valve seat.

1. Bore out old seat until it collapses. Boring should not continue beyond the bottom face of the seat recess in cylinder head. Set the machine depth stop to ensure this. Refer to EM-219, "Valve Seat" .

   CAUTION:
   Prevent to scratch cylinder head by excessive boring.

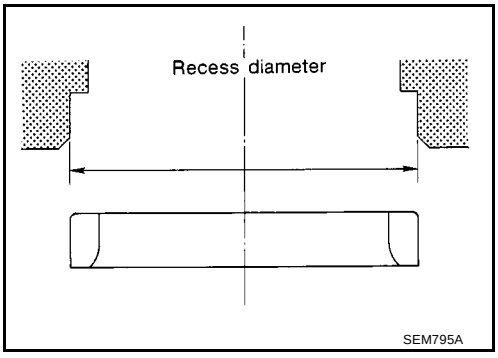
2. Ream cylinder head recess diameter for service valve seat.

   Oversize [0.5 mm (0.020 in)]

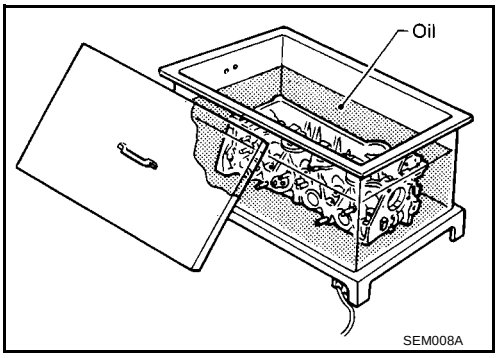
   Intake : 31.900 - 31.916 mm (1.2559 - 1.2565 in)

   Exhaust : 26.400 - 26.416 mm (1.0393 - 1.0399 in)

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



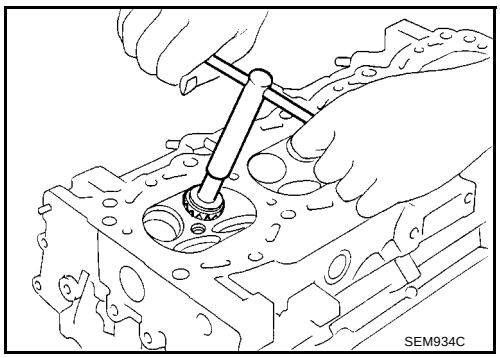
3. Heat cylinder head to 110 to 130°C (230 to 266°F) by soaking in heated oil.



4. Provide valve seats cooled well with a dry ice. Press-fit valve seats into cylinder head.

   CAUTION:
   - **Avoid directly to touching cold valve seats.**
   - **Cylinder head contains heat, when working, wear protective equipment to avoid getting burned.**

5. Using a valve seat cutter set (commercial service tool) or a valve seat grinder, finish valve seat to the specified dimensions. For dimensions, refer to EM-219, "Valve Seat" .



CAUTION:

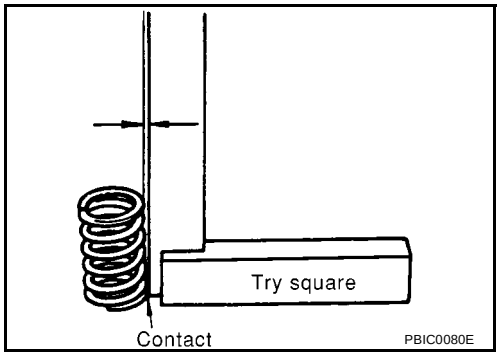
When using a valve seat cutter, firmly grip the cutter handle with both hands. Then, press on the contacting surface all around the circumference to cut in a single drive. Improper pressure on with the cutter or cutting many different times may result in stage valve seat.

6. Using compound, grind to adjust valve fitting.
7. Check again for normal contact. Refer to EM-183, "VALVE SEAT CONTACT" .

VALVE SPRING SQUARENESS

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

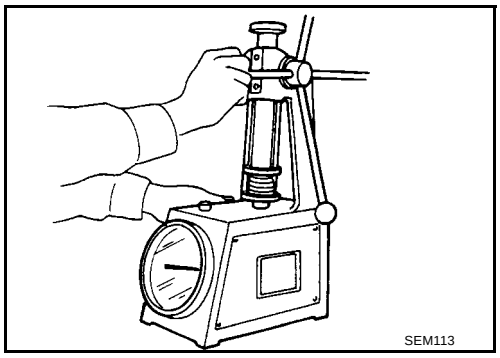
Limit : 1.8 mm (0.070 in)



- If it exceeds the limit, replace valve spring.

VALVE SPRING DIMENSIONS AND VALVE SPRING PRESSURE LOAD

- Check valve spring pressure with valve spring seat installed at the specified spring height.



Standard:

Free height	42.26 mm (1.6637 in)
Installation height	32.40 mm (1.2755 in)
Installation load	136 - 154 N (13.9 - 15.7 kg, 31 - 35 lb)
Height during valve open	23.96 mm (0.9433 in)
Load with valve open	262 - 296 N (26.7 - 30.2 kg, 59 - 67 lb)

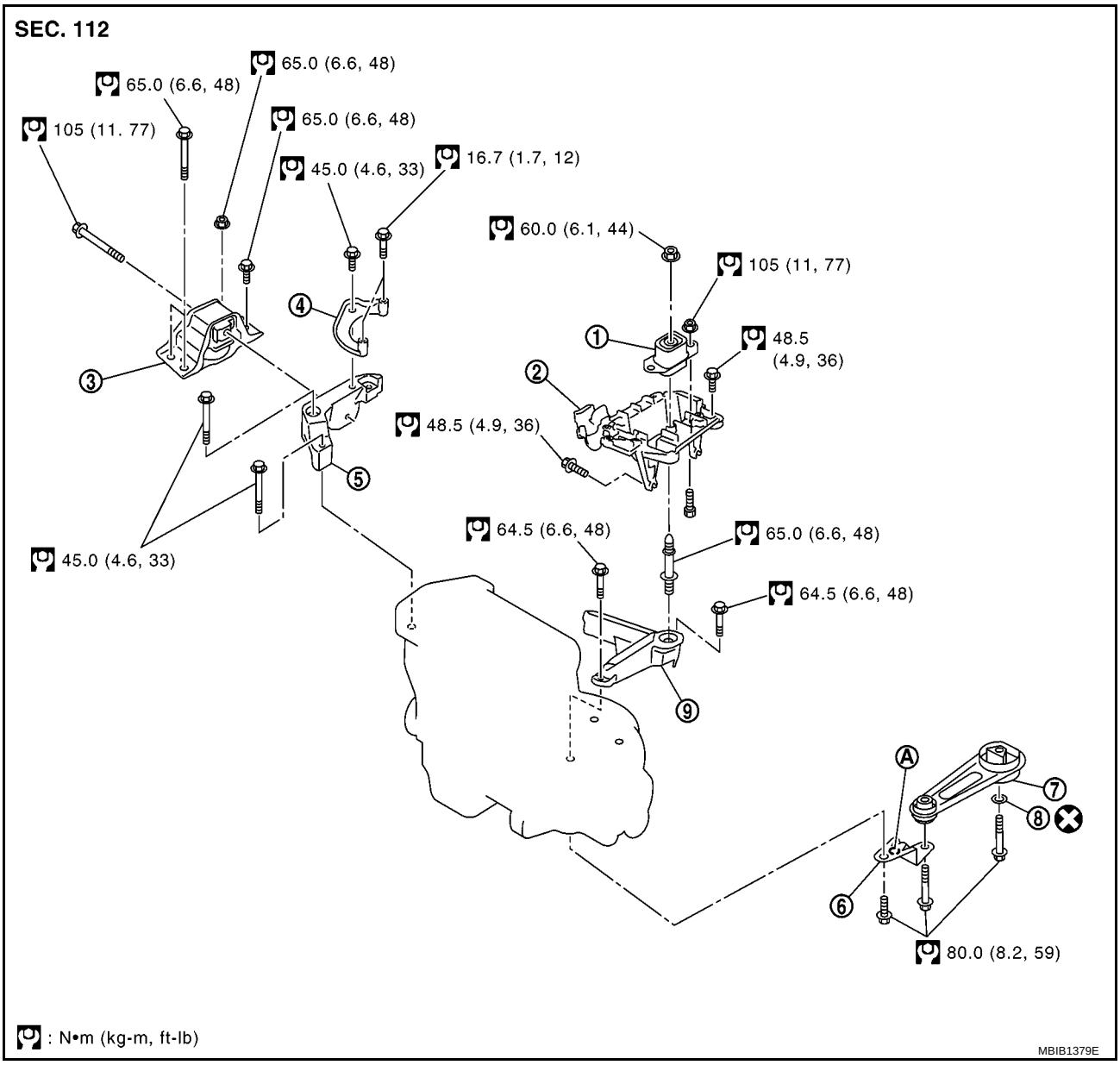
- If the installation load or load with valve open is out of the standard, replace valve spring.

ENGINE ASSEMBLY

PFP:10001

Components

EBS01J9Z



1. Engine mounting insulator (LH)
2. Engine mounting bracket (LH)
3. Engine mounting insulator (RH)
4. Engine mounting stay (RH)
5. Engine mounting bracket (RH)
6. Rear engine mounting bracket
7. Rear torque rod
8. Washer
9. Engine mountin bracket (LH)

A. Front mark

Refer to GI-9, "Components" for symbol marks in the figure.

Removal and Installation

EBS01JA0

WARNING:

- **Situate the vehicle on a flat and solid surface.**
- **Place chocks at front and back of rear wheels.**
- **Attach proper slingers and bolts described in PARTS CATALOG if engine slingers are not equipped.**

CAUTION:

- **Always be careful to work safely, avoid forceful or uninstructed operations.**
- **Do not start working until exhaust system and coolant are cool enough.**

- **If items or work required are not covered by the engine section, 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 a transmission jack or similar tool before starting work, in preparation for the backward shift of center of gravity.**
- **For supporting points for lifting and jacking point at rear axle, refer to GI-38, "Garage Jack and Safety Stand" and GI-39, "2-Pole Lift" .**

REMOVAL

Outline

Remove the engine and the transaxle assembly from the vehicle downward. Separate the engine and the transaxle.

Preparation

1. When engine can be hoisted, remove hood assembly. Refer to BL-8, "HOOD" .
2. When engine can be hoisted, remove cowl top cover and cowl top extension assembly. Refer to EI-13, "COWL TOP" .
3. Release fuel pressure. Refer to EC-861, "FUEL PRESSURE RELEASE" (with EURO-OBD) or EC-1286, "FUEL PRESSURE RELEASE" (without EURO-OBD).
4. Drain engine coolant from radiator. Refer to CO-35, "Changing Engine coolant" .

   CAUTION:
   Perform this step when the engine is cold.
5. Remove the following parts.
   - Engine undercover
   - Remove headlamp. Refer to LT-7, "HEADLAMP -CONVENTIONAL TYPE-" or LT-42, "HEADLAMP - DAYTIME LIGHT SYSTEM -" .
   - Remove cowl top. Refer to EI-13, "COWL TOP"
   - Front fender protector (RH and LH); Refer to EI-14, "FENDER PROTECTOR" .
   - Front road wheels and tires; Refer toWT-5, "ROAD WHEEL AND TYRE ASSEMBLY" .
   - Battery and battery tray; Refer to SC-6, "BATTERY" .
   - Drive belt; Refer to EM-115, "DRIVE BELTS" .
   - Air duct and air cleaner case assembly; Refer to EM-119, "AIR CLEANER AND AIR DUCT" .
   - Radiator hose (upper and lower) and cooling fan assembly; Refer to CO-38, "RADIATOR" .
   - Exhaust front tube; Refer to EX-4, "EXHAUST SYSTEM" .

Engine Room LH

1. Disconnect all connections of engine harness around the engine mounting insulator (LH), and then temporarily secure the engine harness into the engine side.

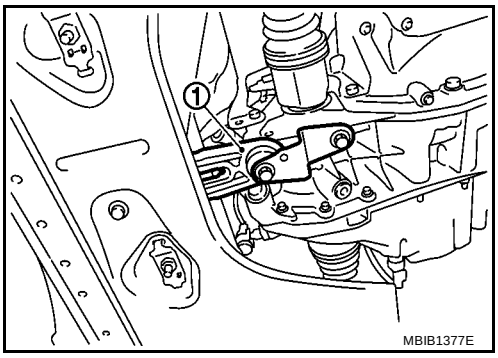
   CAUTION:
   Protect connectors using a resin bag to protect against foreign materials during the operation.
2. Disconnect fuel feed hose at engine side. Refer to EM-136, "FUEL INJECTOR AND FUEL TUBE" .
3. Disconnect heater hoses, and install plugs them to prevent engine coolant from draining.
   Refer to CO-52, "WATER OUTLET" .
4. Disconnect control linkage from transaxle. Refer to MT-12, "CONTROL LINKAGE" .
5. Remove ground cable at transaxle side.

Engine Room RH

1. Remove ground cable between front cover and vehicle.
2. Alternator and alternator bracket; Refer to SC-16, "CHARGING SYSTEM" .
3. Remove A/C compressor (with A/C models) with piping connected from the engine. Temporarily secure it on the vehicle side with a rope to avoid putting load on it. Refer to ATC-95, "Removal and Installation for Compressor" (with auto A/C models) or MTC-68, "Removal and Installation for Compressor" (with manual A/C models).

Vehicle Underbody

1. Remove front wheel sensor (LH and RH) for ABS from steering knuckle. Refer to BRC-101, "WHEEL SENSORS" (with ESP models) or BRC-45, "WHEEL SENSORS" (without ESP models).
2. Remove brake caliper assembly with piping connected from steering knuckle. Temporarily secure it on the vehicle side with a rope to avoid load on it. Refer to BR-21, "FRONT DISC BRAKE" .
3. Remove drive shafts (LH and RH) from steering knuckle. Refer to FAX-10, "FRONT DRIVE SHAFT" .
4. Remove rear torque rod (1).



5. Preparation for the separation work of transaxle is as follows:
   - Remove transaxle joint bolts which pierce at oil pan (upper) lower rear side. Refer to MT-7, "REMOVAL AND INSTALLATION" .

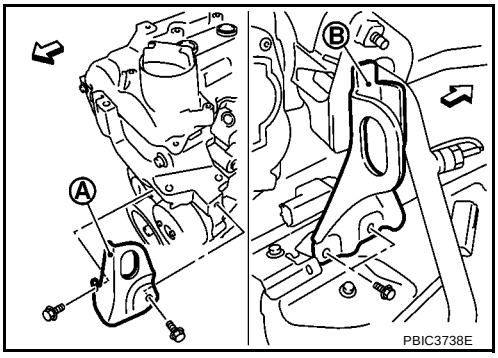
Removal

1. When engine can be hoisted, remove the intake manifold to prevent the hanging chain from interfering. Refer to EM-121, "INTAKE MANIFOLD" .
2. When engine can be hoisted, install engine slinger to cylinder head front left side (A) and rear right side (B) and support the engine position with a hoist.

   ⇦ : Engine front

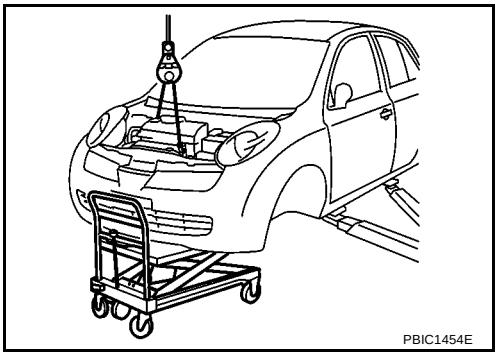
   Slinger bolts

   : 25.5 N·m (2.6 kg-m, 19 ft-lb)

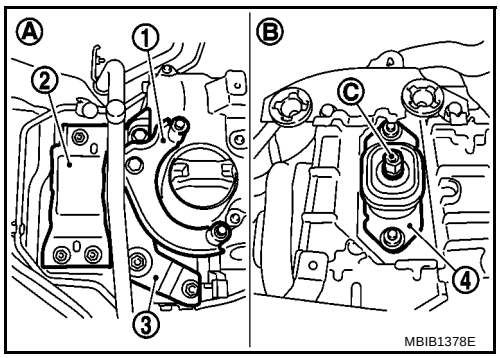


3. Lift with a hoist and secure the engine in appropriate position.
4. Use a manual lift table caddy (commercial service tool) (A) or equivalently rigid tool such as a transmission jack. Securely support bottom of the engine and the transaxle, and simultaneously adjust hoist tension.

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



5. Remove engine mounting stay (RH) (1), engine mounting insulator (RH) (2) and engine mounting bracket (RH) (3).



4 : Engine mounting insulator (LH)
A : Engine front side
B : Transaxle side

6. Remove engine mounting through bolt-securing nut (C).

7. Remove the engine and the transaxle assembly from the vehicle downward by carefully operating supporting tools.

CAUTION:

- **During the operation, make sure that no part interferes with the vehicle side.**
- **Before and during this lifting, always check if any harnesses are left connected.**
- **During the removal operation, always be careful to prevent the vehicle from falling off the lift due to changes in the center of gravity.**
- **If necessary, support the vehicle by setting jack or suitable tool at the rear.**

Separation

CAUTION:

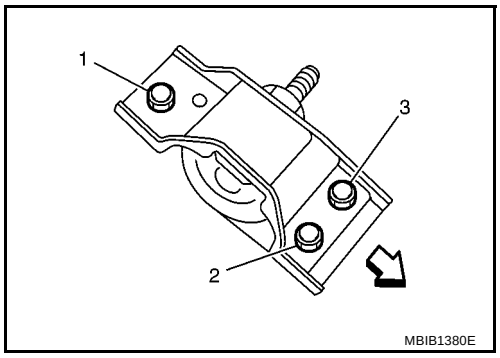
During operation, securely support the engine by placing a piece of wood under the engine oil pan and transaxle oil pan. Securely support the engine slingers with a hoist.

1. When the engine hoisting is not performed simultaneously, install engine slinger to cylinder head front left side and rear right side. Refer to EM-186, "REMOVAL" .
2. Remove starter motor. Refer to SC-46, "STARTING SYSTEM" .
3. Lift with a hoist and position above engine.
4. Separate the engine and the transaxle. Refer to MT-7, "REMOVAL AND INSTALLATION" .

INSTALLATION

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

- Do not allow engine oil to get on engine mounting insulator. Be careful not to damage engine mounting insulator.
- When installation directions are specified, install parts according to the direction marks on them referring to the figure of components. Refer to EM-185, "Components" .
- Make sure that each mounting insulator is seated properly, and tighten mounting nuts and bolts.
- Tighten engine mounting insulator (RH) bolts in the numerical order shown in the figure.



⇦ : Vehicle front

INSPECTION AFTER INSTALLATION

Inspection for Leaks

The following are procedures for checking fluids leak, lubricates leak and exhaust gases leak.

- Before starting engine, check oil/fluid levels including engine coolant and engine oil. If less than required quantity, fill to the specified level. Refer to MA-35, "RECOMMENDED FLUIDS AND LUBRICANTS" .
- Use procedure below to check for fuel leakage.

- Turn ignition switch ON (with engine stopped). With fuel pressure applied to fuel piping, check for fuel leakage at connection points.
- Start engine. With engine speed increased, check again for fuel leakage at connection points.

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

Summary of the inspection items:

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

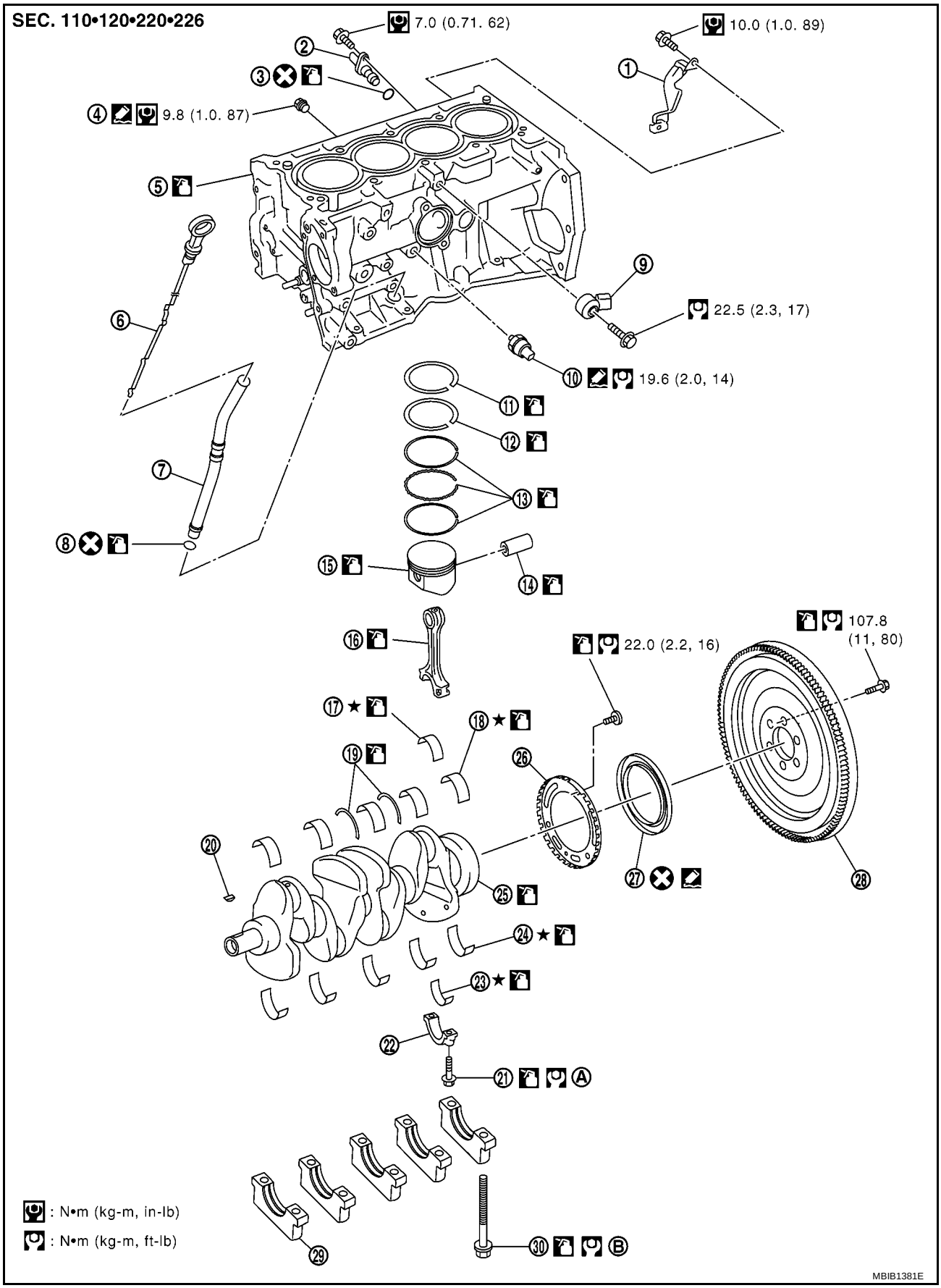
* Transmission/transaxle fluid, power steering fluid, brake fluid, etc.

CYLINDER BLOCK

PFP:11010

Components

EBS01JA1



1.	Crank shaft position sensor (POS) cover	2.	Crankshaft position sensor (POS)	3.	O-ring
4.	Water drain plug	5.	Cylinder block	6.	Oil level gauge
7.	Oil level gauge guide	8.	O-ring	9.	Knock sensor
10.	Oil pressure switch	11.	Top ring	12.	Second ring
13.	Oil ring	14.	Piston pin	15.	Piston
16.	Connecting rod	17.	Connecting rod bearing (upper)	18.	Main bearing (upper)
19.	Thrust bearing	20.	Crankshaft key	21.	Connecting rod bolt
22.	Connecting rod cap	23.	Connecting rod bearing (lower)	24.	Main bearing (lower)
25.	Crankshaft	26.	Signal plate	27.	Flywheel
28.	Rear oil seal	29.	Main bearing cap	30.	Main bearing cap bolt
A.	Refer to EM-194	B.	Refer to EM-194		

Refer to GI-9 for symbol marks in the figure.

Disassembly and Assembly

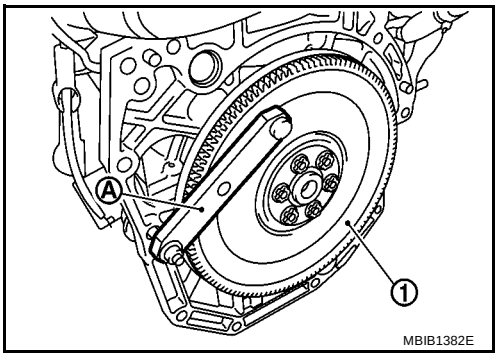
EBS01JA2

DISASSEMBLY

NOTE:
Explained here is how to disassemble with an engine stand supporting mating surface of transaxle. When using different type of engine stand, note with difference in steps and etc.

1. Remove the engine and the transaxle assembly from the vehicle, and separate the transaxle from the engine. Refer to EM-185, "ENGINE ASSEMBLY" .
2. Remove clutch cover and clutch disc. Refer to CL-12, "CLUTCH DISC, CLUTCH COVER AND FLYWHEEL" .
3. Remove flywheel.
   - Secure flywheel with a stopper plate (SST: KV11105210) (A), and remove mounting bolts.
   - Using TORX socket (size E20), loosen mounting bolts.

   CAUTION:
   Be careful not to damage or scratch and contact surface for clutch disc of flywheel.

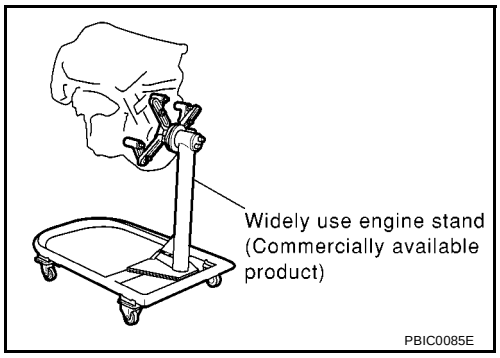


4. Lift the engine with a hoist to install it onto widely use engine stand.

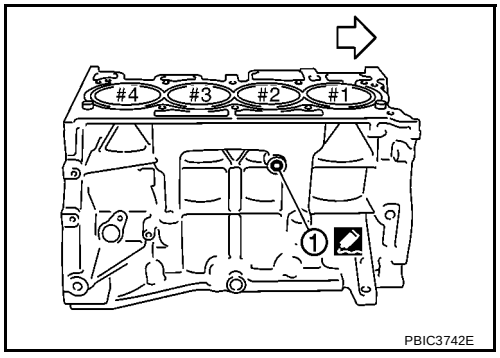
   CAUTION:
   - **Use the engine stand that has a load capacity [approximately 150 kg (331 lb) or more] large enough for supporting the engine weight.**
   - If the load capacity of stand is not adequate, remove the following parts beforehand to reduce the potential risk of overturning stand.
   - Intake manifolds; Refer to EM-121, "INTAKE MANIFOLD" .
   - Exhaust manifold; Refer to EM-125, "EXHAUST MANIFOLD" .
   - Rocker cover; Refer to EM-141, "ROCKER COVER" .

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

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



5. Drain engine oil. Refer to LU-16, "ENGINE OIL" .
6. Drain engine coolant by removing water drain plug (1) from inside of the engine.

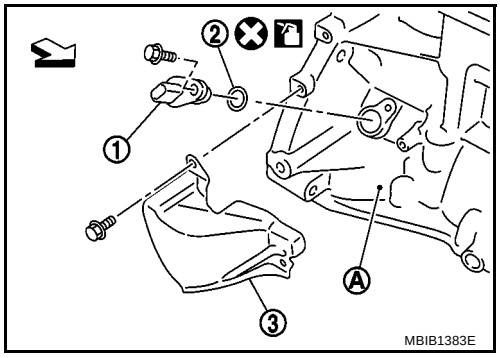


⇦ : Engine front

7. Remove cylinder head. Refer to EM-174, "CYLINDER HEAD" .
8. Remove oil pan (upper and lower). Refer to EM-128, "OIL PAN AND OIL STRAINER" .
9. Remove knock sensor.

CAUTION:
Carefully handle knock sensor avoiding shocks.

10. Remove cover, and then crankshaft position sensor (POS).



⇦ : Engine front

1. Crank shaft position sensor (POS)
2. O ring
3. Cover

A. Cylinder block LHD side

CAUTION:
- **Avoid impacts such as a dropping.**
- **Do not disassemble.**
- **Keep it away from metal particles.**
- **Do not place the sensor in a location where it is exposed to magnetism.**

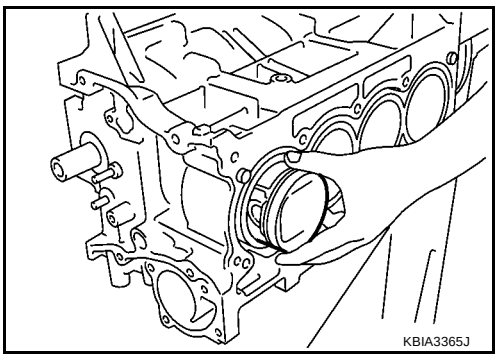
11. Remove piston and connecting rod assembly with the following procedure:
    - Before removing piston and connecting rod assembly, check the connecting rod side clearance. Refer to EM-206, "CONNECTING ROD SIDE CLEARANCE" .

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

c. Using a hammer handle or similar tool, push piston and connecting rod assembly out to the cylinder head side.

CAUTION:

- **Be careful not to damage matching surface with connecting rod cap.**
- **Be careful not to damage the cylinder wall and crankshaft pin, resulting from an interference of the connecting rod big end.**



12. Remove connecting rod bearings.

CAUTION:

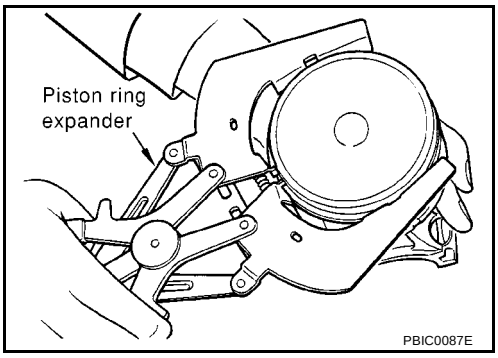
Identify installation positions, and store them without mixing them up.

13. Remove piston rings form piston.

- Before removing piston rings, check the piston ring side clearance. Refer to EM-207, "PISTON RING SIDE CLEARANCE" .
- Use a piston ring expander (commercial service tool).

CAUTION:

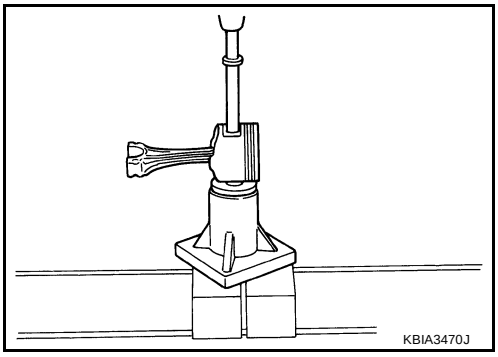
- **When removing piston rings, be careful not to damage the piston.**
- **Be careful not to damage piston rings by expanding them excessively.**



14. Remove piston from connecting rod.

- Use a piston pin press stand (SST) and a press to remove the piston pin.
- For the details of SST, refer to the following.

Press stand	**: ST13030020**
Drift	**: KV10109730**
Center cap	**: KV10110310**



CAUTION:

Be careful not to damage the piston and connecting rod.

NOTE:

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

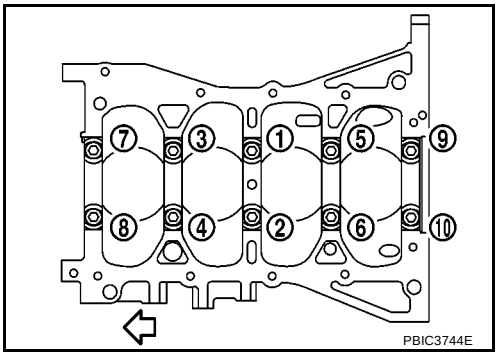
15. Remove the main bearing cap in the following procedure.

- Measure crankshaft end play before loosening main bearing cap bolts. Refer to EM-206, "CRANKSHAFT END PLAY" .

a. Loosen and remove bolts in several steps in reverse of the numerical order shown in the figure.

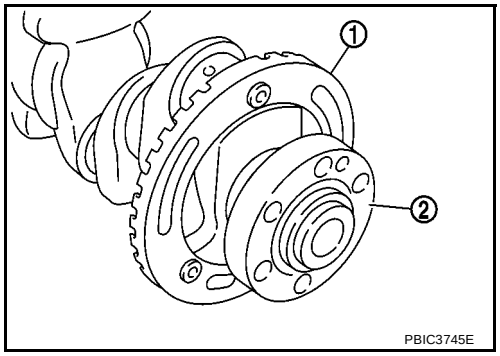
⇦ : Engine front

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



b. Remove the main bearing cap from the cylinder block while tapping lightly with a plastic hammer.

16. Remove crankshaft (2).



CAUTION:

- **Be careful not damage or deform signal plate (1) mounted on crankshaft.**
- **When setting crankshaft on a flat floor surface, use a block of wood to avoid interference between signal plate and the floor surface.**
- **Do not remove signal plate unless it is necessary to do so.**

NOTE:
When removing or installing signal plate, use TORX socket (size T40).

17. Pull rear oil seal out from rear end of crankshaft.
18. Remove main bearing (upper and lower) and thrust bearings from cylinder block and main bearing cap.

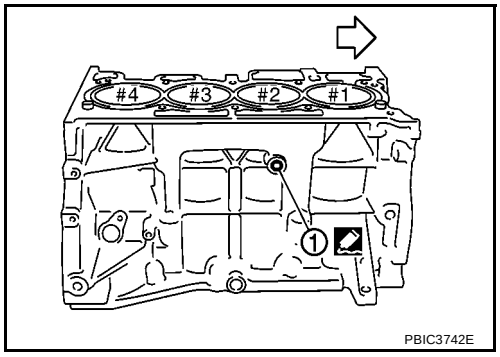
CAUTION:
Identify installation positions, and store them without mixing them up.

ASSEMBLY

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

CAUTION:
Use a goggles to protect your eye.

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



⇦ : Engine front

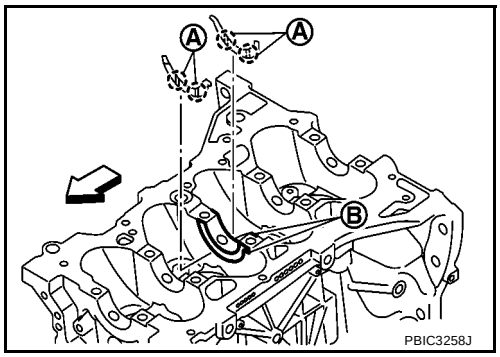
Use Genuine Liquid Gasket or equivalent.

: 9.8 N·m (1.0 kg-m, 87 in-lb)

3. Install main bearings and thrust bearings with the following procedure:

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

b. Install thrust bearings to the both sides of the No. 3 journal housing (B) on cylinder block.

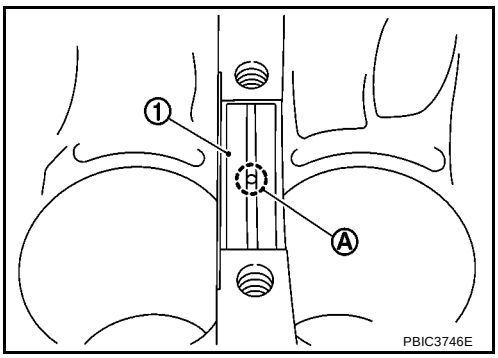


⇦ : Engine front

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

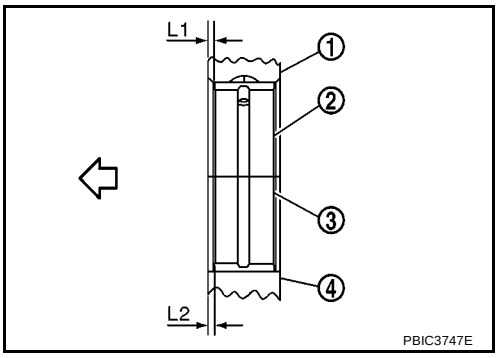
c. Install the main bearings (1) paying attention to the direction.

- Install the one with oil holes (A) onto cylinder block and the one without oil holes onto main bearing cap.
- Before installing main bearings, apply new engine oil to the bearing surface (inside). Do not apply engine oil to the back surface, but thoroughly clean it.
- Ensure the oil holes on cylinder block and those on the corresponding bearing are aligned.



- Install the main bearing in the position shown in the figure.

1 : Cylinder block
2 : Main bearing (upper)
3 : Main bearing (lower)
4 : Main bearing cap
⇦ : Engine front



NOTE:
Install the main bearing in the center position with the following dimension. For service operation, the center position can be checked visually.

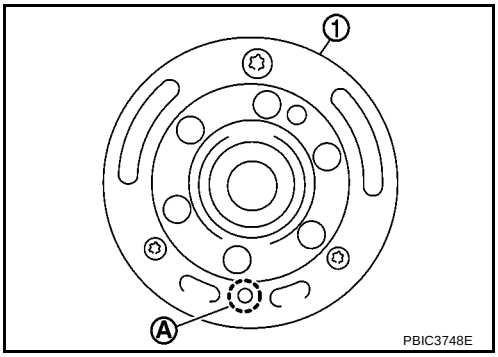
Journal position	No. 1	No. 2	No. 3	No. 4	No. 5
L1 [Unit: mm (in)]	1.65–2.05 (0.064-0.080)	1.25–1.65 (0.049-0.064)	2.30–2.70 (0.090-0.106)	1.25–1.65 (0.049-0.064)	1.60–2.00 (0.062-0.078)
L2 [Unit: mm (in)]	1.30–1.70 (0.051-0.066)	1.30–1.70 (0.051-0.066)	2.30–2.70 (0.090-0.106)	1.30–1.70 (0.051-0.066)	1.30–1.70 (0.051-0.066)

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

4. Install signal plate to crankshaft if removed.

a. Set the signal plate (1) with the flange facing toward the counterweight side (engine front side) to the crankshaft rear surface.

A : Dowel pin hole



b. After positioning crankshaft and signal plate with positioning dowel pin, tighten bolt.

NOTE:
Dowel pin of crankshaft and signal plate is provided as a set for each.

c. Remove dowel pin.

CAUTION:
Be sure to remove dowel pin.

5. Install crankshaft to cylinder block.

- While turning crankshaft by hand, make sure that it turns smoothly.

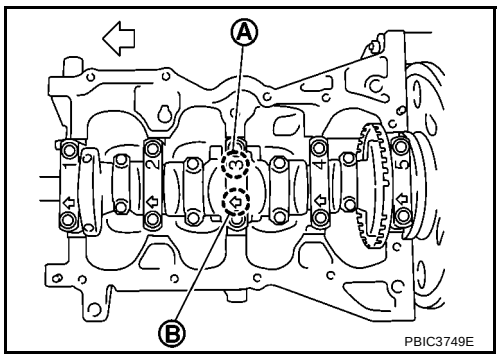
CAUTION:
Do not install rear oil seal yet.

6. Install main bearing caps.

- Install the main bearing cap while referring to the front mark (B) and the journal number stamp (A).

  ⇦ : Engine front

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

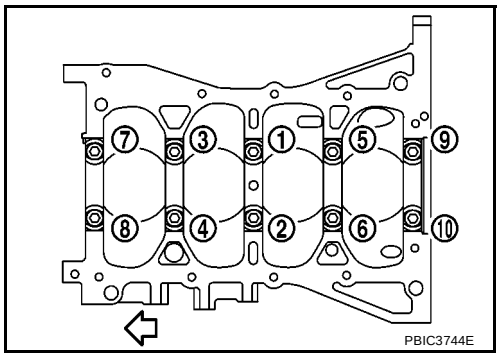


7. Tighten main bearing cap bolts in numerical order shown in the figure with the following steps.

   ⇦ : Engine front

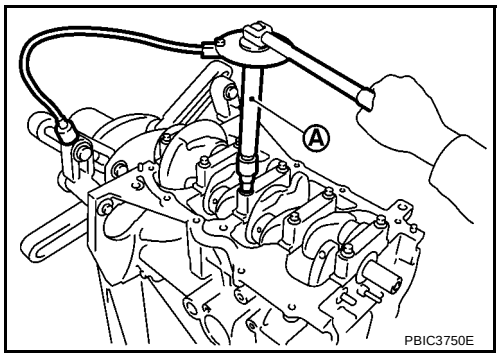
a. Apply new engine oil to threads and seat surfaces of the mounting bolts.
b. Tighten main bearing cap bolts.

   : 32.4 N·m (3.3 kg-m, 24 ft-lb)



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

   CAUTION:
   Check and confirm the tightening angle by using the angle wrench (SST: KV10112100) (A) or protractor. Avoid judgment by visual inspection without the tool.



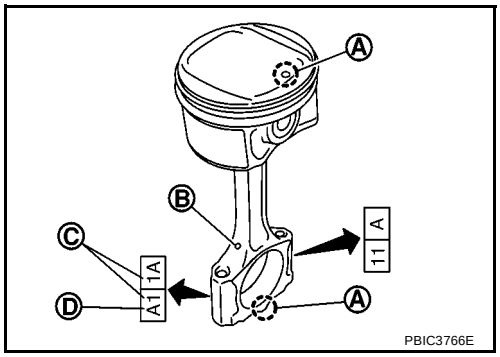
- After installing the mounting bolts, make sure that crankshaft can be rotated smoothly by hand.
- Check crankshaft end play. Refer to EM-206, "CRANKSHAFT END PLAY" .

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

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

   B : Oil hole
   D : Connecting rod big end grade

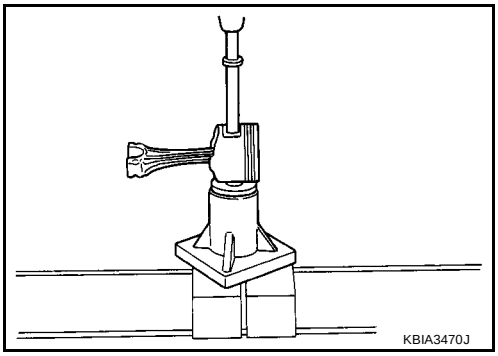
   NOTE:
   The symbols without notes are for management



b. Press-fit the piston pin using the piston pin press stand (SST).

- For the details of SST, refer to the following.

Press stand	**: ST13030020**
Spring	**: ST13030030**
Drift	**: KV10109730**
Center shaft	**: KV10114120**
Center cap	**: KV10110310**



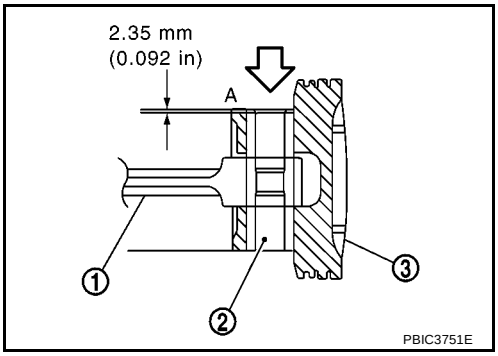
CAUTION:
Press-fit the piston so as not to damage it.

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

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

  1 : Connecting rod
  ⇦ : Press-fit direction

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



9. Using a piston ring expander (commercial service tool), install piston rings.

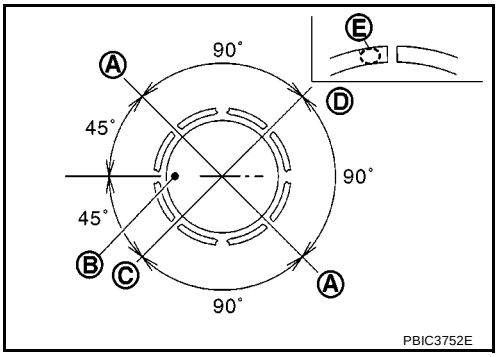
CAUTION:

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

  A : Oil ring upper or lower rail gap (either of them)
  C : Second ring and oil ring spacer gap
  D : Top ring gap

- Install second ring with the stamped mark (E) facing upward.

  Stamped mark:
  Second ring : R



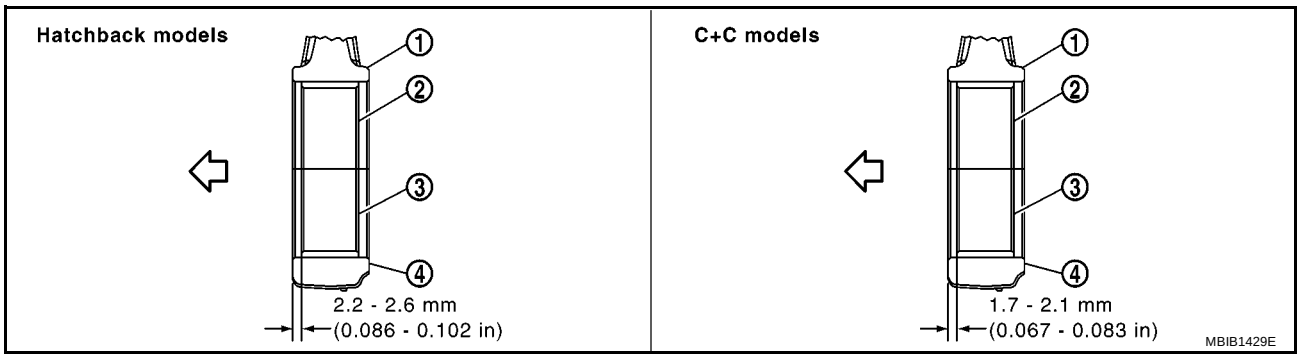
10. Install connecting rod bearings to connecting rod and connecting rod cap.

- When installing connecting rod bearings, apply new engine oil to the bearing surface (inside). Do not apply engine oil to the back surface, but thoroughly clean it.
- Install the bearing in the center position.

  NOTE:
  There is no stopper tab.

- Make sure that the oil holes on connecting rod and connecting rod bearing are aligned.

- Install the connecting rod in the dimension shown in the figure.

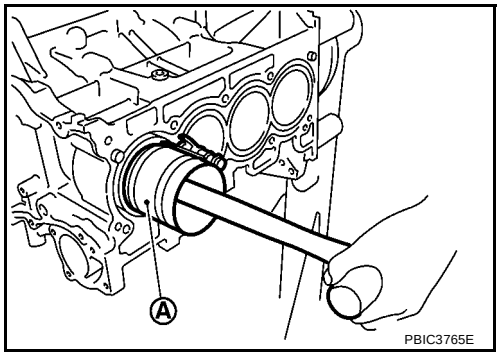


1 : Connecting rod
2 : Connecting rod bearing (upper)
3 : Connecting rod bearing (lower)
4 : Connecting rod cap
⇦ : Engine front

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

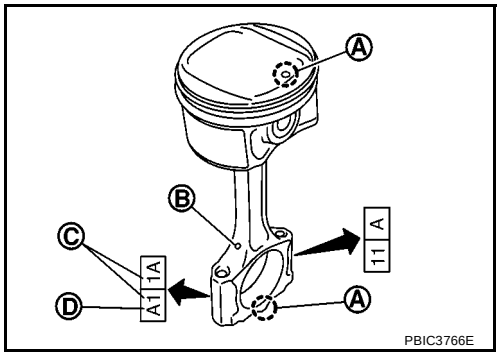
11. Install piston and connecting rod assembly to crankshaft.
- Position crankshaft pin corresponding to connecting rod to be installed onto the bottom dead center.
- Apply new engine oil sufficiently to the cylinder bore, piston and crankshaft pin.
- Match the cylinder position with the cylinder number on connecting rod to install.
- Using the piston ring compressor (SST: EM03470000) (A) or suitable tool, install piston with the front mark on the piston head facing the front of the engine.

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



12. Install connecting rod cap.
- Match the stamped cylinder number marks (C) on connecting rod with those on connecting rod cap to install.

A : Front mark
B : Oil hole
D : Connecting rod big end grade



13. Inspect outer diameter of connecting rod bolts.
Refer to EM-214, "CONNECTING ROD BOLT OUTER DIAMETER" .
14. Tighten connecting rod bolt with the following procedure:
a. Apply new engine oil to the threads and seats of connecting rod bolts.
b. Tighten bolts in several steps.

: 27.5 N·m (2.8 kg-m, 20 ft-lb)

c. Completely loosen bolts.

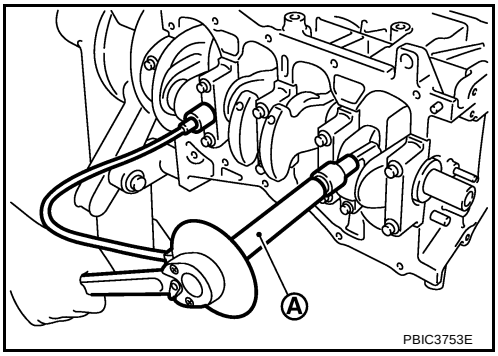
: 0 N·m (0 kg-m, 0 ft-lb)

d. Tighten bolts in several steps.

: 19.6 N·m (2.0 kg-m, 14 ft-lb)

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

CAUTION:
Check and confirm the tightening angle by using the angle wrench (SST: KV10112100) (A) or protractor. Avoid judgement by visual inspection without the tool.



- After tightening connecting rod bolt, make sure that crankshaft rotates smoothly.
- Check the connecting rod side clearance. Refer to EM-206, "CONNECTING ROD SIDE CLEARANCE" .

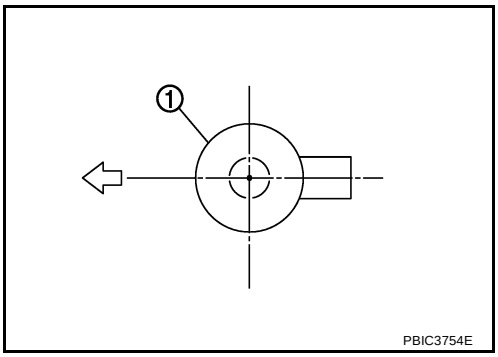
15. Install oil pan (upper). Refer to EM-129, "INSTALLATION" .

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

16. Install rear oil seal. Refer to EM-173, "INSTALLATION" .
17. Install flywheel.
    - When installing flywheel to crankshaft, make sure that align crankshaft side dowel pin with flywheel side dowel pin hole correctly.
18. Install knock sensor (1).

⇦ : Engine front

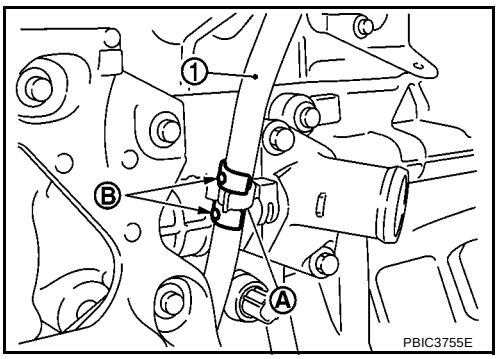
- Install connectors so that they are positioned towards the rear of the engine.



CAUTION:
- **Do not tighten mounting bolt while holding the connector.**
- **If any impact by dropping is applied to knock sensor, replace it with a new one.**

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

19. Install crankshaft position sensor (POS).
    - Tighten bolts with it seated completely.
20. For the oil level gauge guide (1), fix the position (B) shown in the figure to the water inlet clip (A) after inserting to the cylinder block side.



21. Assemble in the reverse order of disassembly after this step.

How to Select Piston and Bearing

EBS01JA3

DESCRIPTION

Selection points	Selection parts	Selection items	Selection methods
Between cylinder block and crankshaft	Main bearing	Main bearing grade (bearing thickness)	Determined by match of cylinder block bearing housing grade (inner diameter of housing) and crankshaft journal grade (outer diameter of journal)
Between crankshaft and connecting rod	Connecting rod bearing	Connecting rod bearing grade (bearing thickness)	Combining service grades for connecting rod big end diameter and crankshaft pin outer diameter determine connecting rod bearing selection.

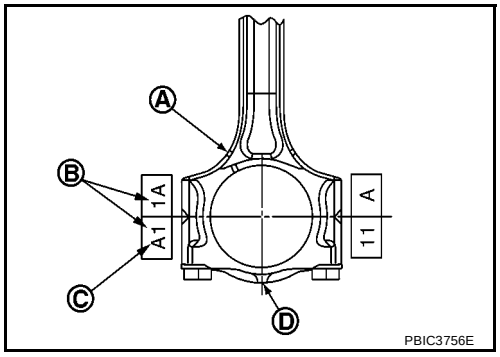
- The identification grade stamped on each part is the grade for the dimension measured in new condition. This grade cannot apply to reused parts.
- For reused or repaired parts, measure the dimension accurately. Determine the grade by comparing the measurement with the values of each selection table.
- 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 CONNECTING ROD BEARING

When New Connecting Rod and Crankshaft Are Used

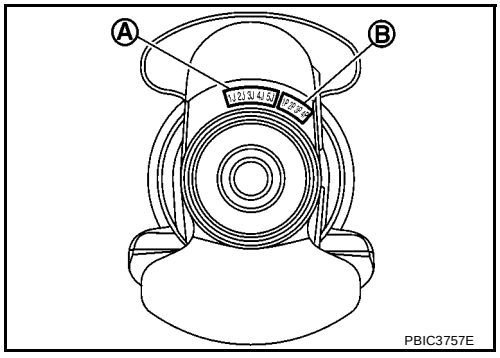
1. Apply connecting rod big end diameter grade stamped (C) on connecting rod side face to the row in the “Connecting Rod Bearing Selection Table”.

   A : Oil hole
   B : Cylinder number
   D : Front mark



2. Apply crankshaft pin journal diameter grade stamped (B) on crankshaft front side to the column in the “Connecting Rod Bearing Selection Table”.

   A : Main journal diameter grade (No. 1 to 5 from left)
   B : Crankshaft pin journal diameter grade (No. 1 to 4 from left)



3. Read the symbol at the cross point of selected row and column in the “Connecting Rod Bearing Selection Table”.
4. Apply the symbol obtained to the “Connecting Rod Bearing Grade Table” to select connecting rod bearing.

When Crankshaft and Connecting Rod Are Reused

1. Measure the dimensions of the connecting rod big end diameter and crankshaft pin journal diameter individually. Refer to EM-208, "CONNECTING ROD BIG END DIAMETER" and EM-211, "CRANKSHAFT PIN JOURNAL DIAMETER" .
2. Apply the measured dimension to the “Connecting Rod Bearing Selection Table”.
3. Read the symbol at the cross point of selected row and column in the “Connecting Rod Bearing Selection Table”.

4. Apply the symbol obtained to the “Connecting Rod Bearing Grade Table” to select connecting rod bearing.

Connecting Rod Bearing Selection Table

Crankshaft pin journal diameter: I.D. mark	Crankshaft pin journal diameter: Axle diameter Unit mm (in)	Connecting rod big end diameter: I.D. mark	A	B	C	D	E	F	G	H	J	K	L	M	N
		Hole diameter Unit: mm (in)	43.000 - 43.001 (1.6929 - 1.6929)	43.001 - 43.002 (1.6929 - 1.6930)	43.002 - 43.003 (1.6930 - 1.6930)	43.003 - 43.004 (1.6930 - 1.6931)	43.004 - 43.005 (1.6931 - 1.6931)	43.005 - 43.006 (1.6931 - 1.6931)	43.006 - 43.007 (1.6931 - 1.6932)	43.007 - 43.008 (1.6932 - 1.6932)	43.008 - 43.009 (1.6932 - 1.6933)	43.009 - 43.010 (1.6933 - 1.6933)	43.010 - 43.011 (1.6933 - 1.6933)	43.011 - 43.012 (1.6933 - 1.6934)	43.012 - 43.013 (1.6934 - 1.6934)
A	39.971 - 39.970 (1.5737 - 1.5736)		0	0	0	0	0	01	01	01	1	1	1	12	12
B	39.970 - 39.969 (1.5736 - 1.5736)		0	0	0	0	01	01	01	1	1	1	12	12	12
C	39.969 - 39.968 (1.5736 - 1.5735)		0	0	0	01	01	01	1	1	1	12	12	12	2
D	39.968 - 39.967 (1.5735 - 1.5735)		0	0	01	01	01	1	1	1	12	12	12	2	2
E	39.967 - 39.966 (1.5735 - 1.5735)		0	01	01	01	1	1	1	12	12	12	2	2	2
F	39.966 - 39.965 (1.5735 - 1.5734)		01	01	01	1	1	1	12	12	12	2	2	2	23
G	39.965 - 39.964 (1.5734 - 1.5734)		01	01	1	1	1	12	12	12	2	2	2	23	23
H	39.964 - 39.963 (1.5734 - 1.5733)		01	1	1	1	12	12	12	2	2	2	23	23	23
J	39.963 - 39.962 (1.5733 - 1.5733)		1	1	1	12	12	12	2	2	2	23	23	23	3
K	39.962 - 39.961 (1.5733 - 1.5733)		1	1	12	12	12	2	2	2	23	23	23	3	3
L	39.961 - 39.960 (1.5733 - 1.5732)		1	12	12	12	2	2	2	23	23	23	3	3	3
M	39.960 - 39.959 (1.5732 - 1.5732)		12	12	12	2	2	2	23	23	23	3	3	3	34
N	39.959 - 39.958 (1.5732 - 1.5731)		12	12	2	2	2	23	23	23	3	3	3	34	34
P	39.958 - 39.957 (1.5731 - 1.5731)		12	2	2	2	23	23	23	3	3	3	34	34	34
R	39.957 - 39.956 (1.5731 - 1.5731)		2	2	2	23	23	23	3	3	3	34	34	34	4
S	39.956 - 39.955 (1.5731 - 1.5730)		2	2	23	23	23	3	3	3	34	34	34	4	4
T	39.955 - 39.954 (1.5730 - 1.5730)		2	23	23	23	3	3	3	34	34	34	4	4	4
U	39.954 - 39.953 (1.5730 - 1.5729)		23	23	23	3	3	3	34	34	34	4	4	4	4

PBIC3758E

Connecting Rod Bearing Grade Table (Hatchback Models)

Unit: mm (in)

Grade number		Thickness	Identification color	Remarks
0		1.494 - 1.497 (0.0588 - 0.0589)	Black	Grade and color are the same for upper and lower bearings.
1		1.497 - 1.500 (0.0589 - 0.0590)	Brown	
2		1.500 - 1.503 (0.0590 - 0.0591)	Green	
3		1.503 - 1.506 (0.0591 - 0.0592)	Yellow	
4		1.506 - 1.509 (0.0592 - 0.0594)	Blue	
01	UPR	1.494 - 1.497 (0.0588 - 0.0589)	Black	Grade and color are different for upper and lower bearings.
	LWR	1.497 - 1.500 (0.0589 - 0.0590)	Brown	
12	UPR	1.497 - 1.500 (0.0589 - 0.0590)	Brown	
	LWR	1.500 - 1.503 (0.0590 - 0.0591)	Green	
23	UPR	1.500 - 1.503 (0.0590 - 0.0591)	Green	
	LWR	1.503 - 1.506 (0.0591 - 0.0592)	Yellow	
34	UPR	1.503 - 1.506 (0.0591 - 0.0592)	Yellow	
	LWR	1.506 - 1.509 (0.0592 - 0.0594)	Blue	

Connecting Rod Bearing Grade Table (C+C Models)

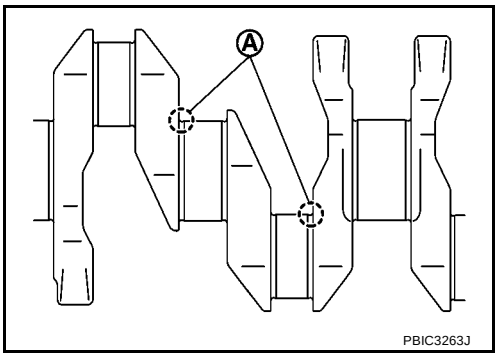
Unit: mm (in)

Grade number		Thickness	Identification color	Remarks
0		1.501 - 1.498 (0.0591 - 0.0590)	Black	Grade and color are the same for upper and lower bearings.
1		1.504 - 1.501 (0.0592 - 0.0591)	Brown	
2		1.507 - 1.504 (0.0593 - 0.0592)	Green	
3		1.510 - 1.507 (0.0594 - 0.0593)	Yellow	
4		1.513 - 1.510 (0.0596 - 0.0594)	Blue	
01	UPR	1.501 - 1.498 (0.0591 - 0.0590)	Black	Grade and color are different for upper and lower bearings.
	LWR	1.504 - 1.501 (0.0592 - 0.0590)	Brown	
12	UPR	1.504 - 1.501 (0.0592 - 0.0590)	Brown	
	LWR	1.507 - 1.504 (0.0593 - 0.0592)	Green	
23	UPR	1.507 - 1.504 (0.0593 - 0.0592)	Green	
	LWR	1.510 - 1.507 (0.0594 - 0.0593)	Yellow	
34	UPR	1.510 - 1.507 (0.0594 - 0.0593)	Yellow	
	LWR	1.513 - 1.510 (0.0596 - 0.0594)	Blue	

Undersize Bearings Usage Guide

- When the specified connecting rod bearing oil clearance is not obtained with standard size connecting rod bearings, use undersize (US) bearings.
- When using undersize (US) bearing, measure the connecting rod bearing inner diameter with bearing installed, and grind the crankshaft pin so that the connecting rod bearing oil clearance satisfies the standard.

CAUTION:
In grinding crankshaft pin to use undersize bearings, keep the fillet R (A) [0.8 - 1.2 mm (0.031 - 0.047 in)].



Bearing undersize table (Hatchback Models)

Unit: mm (in)

Size	Thickness
US 0.25 (0.0098)	1.623 - 1.631 (0.0638 - 0.0642)

Bearing undersize table (C+C Models)

Unit: mm (in)

Size	Thickness
US 0.25 (0.0098)	1.623 - 1.635 (0.0639 - 0.0644)

HOW TO SELECT MAIN BEARING

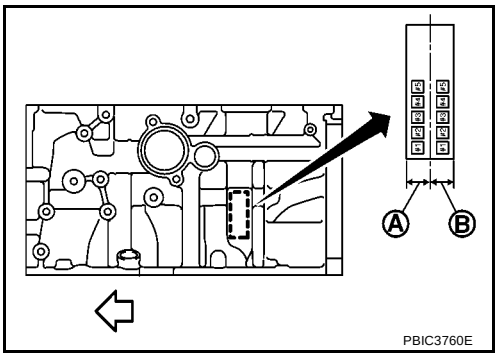
When New Cylinder Block and Crankshaft Are Used

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

   A : Basic stamp mark

   ⇦ : Engine front

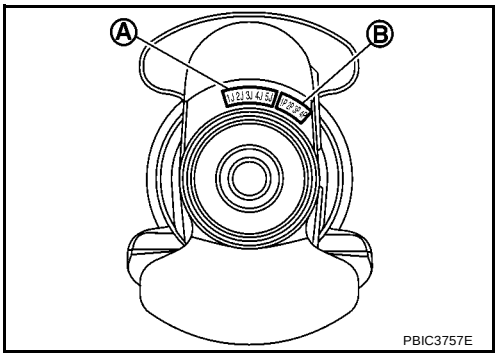
   - If there is a corrected stamp mark (B) on cylinder block, use it as a correct reference.



2. Apply main journal diameter grade stamped (A) on crankshaft front side to column in the "Main Bearing Selection Table".

   A : Main journal diameter grade (No. 1 to 5 from left)

   B : Crankshaft pin journal diameter grade (No. 1 to 4 from left)



3. Read the symbol at the cross point of selected row and column in the "Main Bearing Selection Table".
4. Apply the symbol obtained to the "Main Bearing Grade Table" to select main bearing.

   NOTE:
   Service part is available as a set of both upper and lower.

When Cylinder Block and Crankshaft Are Reused

1. Measure the dimensions of the cylinder block main bearing housing inner diameter and crankshaft main journal diameter individually. Refer to EM-209, "MAIN BEARING HOUSING INNER DIAMETER" and EM-211, "CRANKSHAFT MAIN JOURNAL DIAMETER" .

2. Apply the measured dimension to the “Main Bearing Selection Table”.
3. Read the symbol at the cross point of selected row and column in the “Main Bearing Selection Table”.
4. Apply the symbol obtained to the “Main Bearing Grade Table” to select main bearing.

Main Bearing Selection Table

Crankshaft main journal diameter: I.D. mark	Crankshaft main journal diameter: Axle diameter Unit mm (in)	Cylinder block main bearing housing inner diameter: I.D. mark	A	B	C	D	E	F	G	H	J	K	L	M	N	P	R	S	T	U	V	W
		Hole diameter Unit: mm (in)	51.997 - 51.998 (2.0471 - 2.0472)	51.998 - 51.999 (2.0472 - 2.0472)	51.999 - 52.000 (2.0472 - 2.0472)	52.000 - 52.001 (2.0472 - 2.0472)	52.001 - 52.002 (2.0473 - 2.0473)	52.002 - 52.003 (2.0473 - 2.0473)	52.003 - 52.004 (2.0474 - 2.0474)	52.004 - 52.005 (2.0474 - 2.0474)	52.005 - 52.006 (2.0474 - 2.0474)	52.006 - 52.007 (2.0475 - 2.0475)	52.007 - 52.008 (2.0475 - 2.0475)	52.0008 - 52.009 (2.0476 - 2.0476)	52.009 - 52.010 (2.0476 - 2.0476)	52.010 - 52.011 (2.0476 - 2.0476)	52.011 - 52.012 (2.0477 - 2.0477)	52.012 - 52.013 (2.0477 - 2.0477)	52.013 - 52.014 (2.0478 - 2.0478)	52.014 - 52.015 (2.0478 - 2.0478)	52.015 - 52.016 (2.0478 - 2.0478)	52.016 - 52.017 (2.0479 - 2.0479)
A	47.979 - 47.978 (1.8889 - 1.8889)		0	0	0	0	0	0	0	01	01	01	1	1	1	12	12	12	2	2	2	23
B	47.978 - 47.977 (1.8889 - 1.8889)		0	0	0	0	0	0	01	01	01	1	1	1	12	12	12	2	2	2	23	23
C	47.977 - 47.976 (1.8889 - 1.8888)		0	0	0	0	0	01	01	01	1	1	1	12	12	12	2	2	2	23	23	23
D	47.976 - 47.975 (1.8888 - 1.8888)		0	0	0	0	01	01	01	1	1	1	12	12	12	2	2	2	23	23	23	3
E	47.975 - 47.974 (1.8888 - 1.8887)		0	0	0	01	01	01	1	1	1	12	12	12	2	2	2	23	23	23	3	3
F	47.974 - 47.973 (1.8887 - 1.8887)		0	0	01	01	01	1	1	1	12	12	12	2	2	2	23	23	23	3	3	3
G	47.973 - 47.972 (1.8887 - 1.8887)		0	01	01	01	1	1	1	12	12	12	2	2	2	23	23	23	3	3	3	34
H	47.972 - 47.971 (1.8887 - 1.8886)		01	01	01	1	1	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34
J	47.971 - 47.970 (1.8886 - 1.8886)		01	01	1	1	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34
K	47.970 - 47.969 (1.8886 - 1.8885)		01	1	1	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4
L	47.969 - 47.968 (1.8885 - 1.8885)		1	1	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4
M	47.968 - 47.967 (1.8885 - 1.8885)		1	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4
N	47.967 - 47.966 (1.8885 - 1.8884)		1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45
P	47.966 - 47.965 (1.8884 - 1.8884)		12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45
R	47.965 - 47.964 (1.8884 - 1.8883)		12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45
S	47.964 - 47.963 (1.8883 - 1.8883)		12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45	5
T	47.963 - 47.962 (1.8883 - 1.8883)		2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45	5	5
U	47.962 - 47.961 (1.8883 - 1.8882)		2	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45	5	5	5
V	47.961 - 47.960 (1.8882 - 1.8882)		2	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45	5	5	5	5
W	47.960 - 47.959 (1.8882 - 1.8881)		23	23	23	3	3	3	34	34	34	4	4	4	45	45	45	5	5	5	5	5

PBIC3759E

Main Bearing Grade Table

Unit: mm (in)

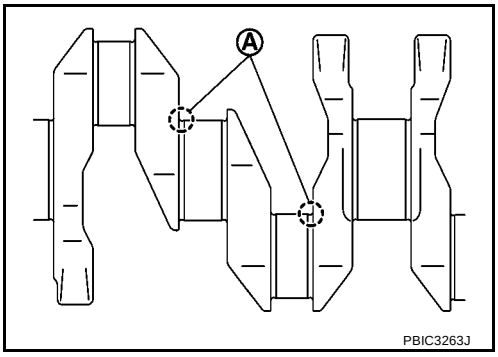
Grade number		Thickness	Identification color	Remarks
0		1.996 - 1.999 (0.0785 - 0.0787)	Black	Grade and color are the same for upper and lower bearings.
1		1.999 - 2.002 (0.0787 - 0.0788)	Brown	
2		2.002 - 2.005 (0.0788 - 0.0789)	Green	
3		2.005 - 2.008 (0.0789 - 0.0790)	Yellow	
4		2.008 - 2.011 (0.0790 - 0.0791)	Blue	
5		2.011 - 2.014 (0.0791 - 0.0792)	Pink	
01	UPR	1.996 - 1.999 (0.0785 - 0.0787)	Black	Grade and color are different for upper and lower bearings.
	LWR	1.999 - 2.002 (0.0787 - 0.0788)	Brown	
12	UPR	1.999 - 2.002 (0.0787 - 0.0788)	Brown	
	LWR	2.002 - 2.005 (0.0788 - 0.0789)	Green	
23	UPR	2.002 - 2.005 (0.0788 - 0.0789)	Green	
	LWR	2.005 - 2.008 (0.0789 - 0.0790)	Yellow	
34	UPR	2.005 - 2.008 (0.0789 - 0.0790)	Yellow	
	LWR	2.008 - 2.011 (0.0790 - 0.0791)	Blue	
45	UPR	2.008 - 2.011 (0.0790 - 0.0791)	Blue	
	LWR	2.011 - 2.014 (0.0791 - 0.0792)	Pink	

Use Undersize Bearing Usage Guide

- When the specified main bearing oil clearance is not obtained with standard size main bearings, use undersize (US) bearing.
- When using undersize (US) bearing, measure the main bearing inner diameter with bearing installed, and grind main journal so that the main bearing oil clearance satisfies the standard.

CAUTION:

In grinding crankshaft main journal to use undersize bearings, keep fillet R (A) [0.8 - 1.2 mm (0.031 - 0.047 in)].



Bearing undersize table

Unit: mm (in)

Size	Thickness
US 0.25 (0.0098)	2.126 - 2.134 (0.0837 - 0.0840)

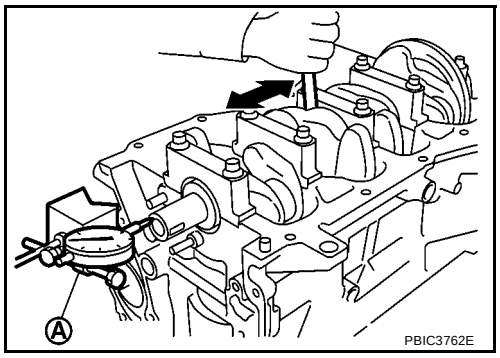
Inspection After Disassembly

EBS01JA4

CRANKSHAFT END PLAY

- Measure the clearance between thrust bearings and crankshaft arm when crankshaft is moved fully forward or backward with a dial indicator (A).

Standard : 0.098 - 0.260 mm (0.0038 - 0.0102 in)
Limit : 0.35 mm (0.0137 in)

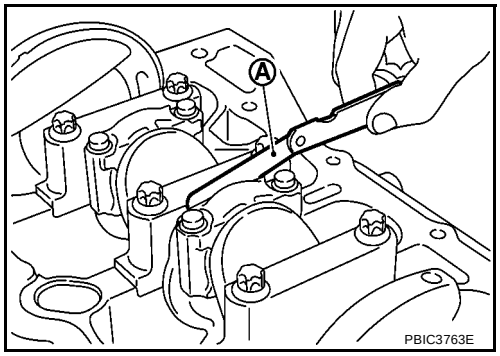


- If the measured value exceeds the limit, replace thrust bearings, and measure again. If it still exceeds the limit, replace crankshaft also.

CONNECTING ROD SIDE CLEARANCE

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

Standard : 0.200 - 0.352 mm (0.0079 - 0.0138 in)



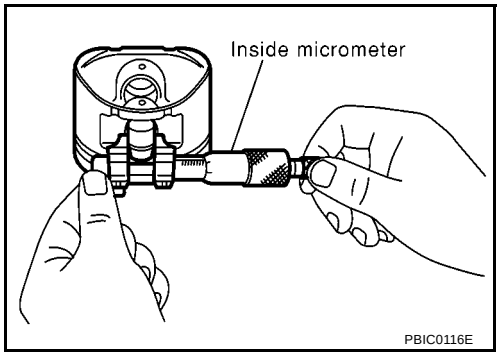
- If the measured value exceeds the limit, replace connecting rod, and measure again. If it still exceeds the standard, replace crankshaft also.

PISTON TO PISTON PIN OIL CLEARANCE

Piston Pin Hole Diameter

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

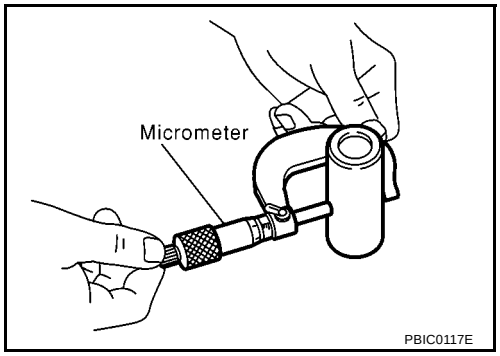
Standard: 19.006 - 19.012 mm (0.7482 - 0.7485 in)



Piston Pin Outer Diameter

Measure the outer diameter of piston pin with a micrometer.

Standard: 18.996 - 19.002 mm (0.7478 - 0.7481 in)



Piston to Piston Pin Oil Clearance

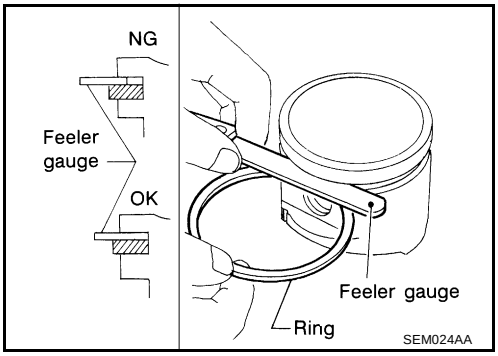
(Piston to piston pin oil clearance) = (Piston pin hole diameter) – (Piston pin outer diameter)

Standard: 0.008 - 0.012 mm (0.0003 - 0.0004 in)

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

PISTON RING SIDE CLEARANCE

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



Standard:

Top ring	**: 0.040 - 0.080 mm (0.0015 - 0.0031 in)**
2nd ring	**: 0.030 - 0.070 mm (0.0012 - 0.0028 in)**
Oil ring	**: 0.045 - 0.125 mm (0.0017 - 0.0049 in)**

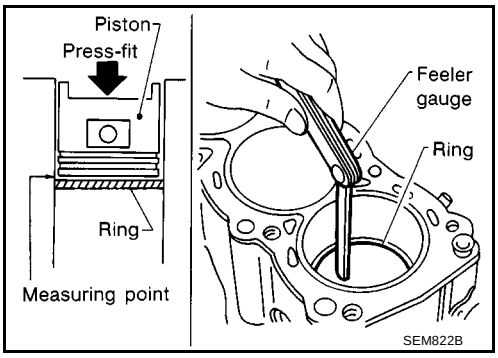
Limit:

Top ring	**: 0.11 mm (0.0043 in)**
2nd ring	**: 0.10 mm (0.0039 in)**

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

PISTON RING END GAP

- Make sure that cylinder bore inner diameter is within the specification. Refer to EM-210, "Cylinder Bore Inner Diameter" .
- Lubricate with new engine oil to piston and piston ring, and then insert piston ring until middle of cylinder with piston, and measure piston ring end gap with a feeler gauge.



Standard:

Top ring	**: 0.20 - 0.30 mm (0.0078 - 0.0118 in)**
2nd ring	**: 0.35 - 0.50 mm (0.0137 - 0.0196 in)**
Oil ring (rail ring)	**: 0.20 - 0.60 mm (0.0079 - 0.0236 in)**

Limit:

Top ring	**: 0.50 mm (0.0196 in)**
2nd ring	**: 0.66 mm (0.0259 in)**
Oil ring (rail ring)	**: 0.92 mm (0.0362 in)**

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

CONNECTING ROD BEND AND TORSION

- Check with a connecting rod aligner.

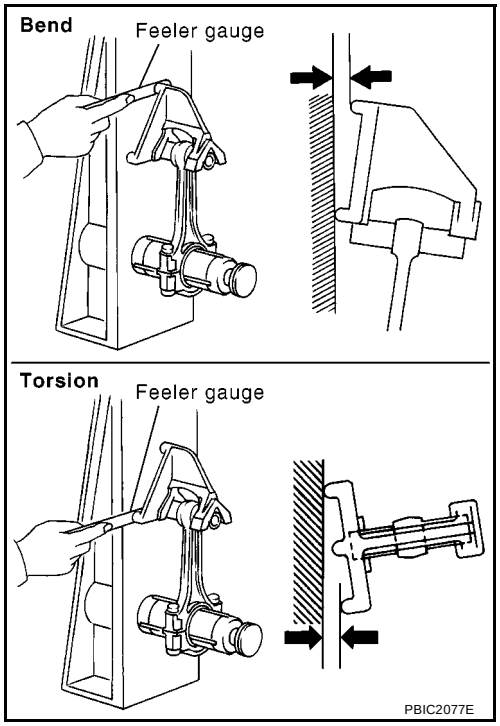
Bend:

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.

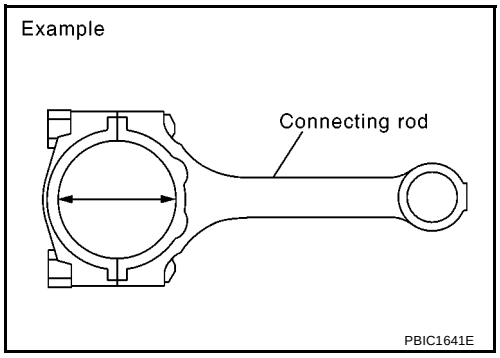


CONNECTING ROD BIG END DIAMETER

- Install connecting rod cap without connecting rod bearing installed, and tightening connecting rod bolts to the specified torque. Refer to EM-194, "ASSEMBLY" for the tightening procedure.
- Measure the inner diameter of connecting rod big end with an inside micrometer.

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

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

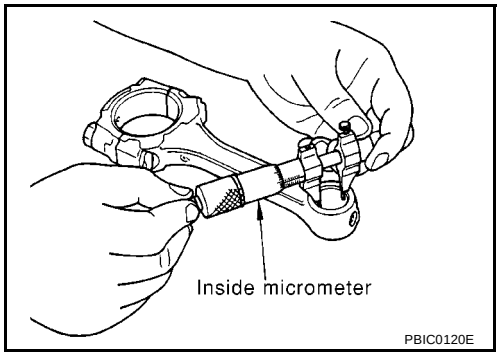


CONNECTING ROD BUSHING OIL CLEARANCE

Connecting Rod Bushing Inner Diameter

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

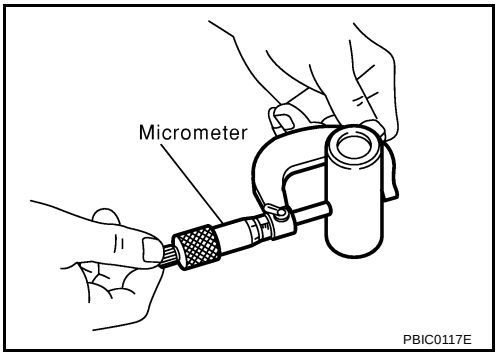
Standard: 18.958 - 18.978 mm (0.7463 - 0.7471 in)



Piston Pin Outer Diameter

Measure the outer diameter of piston pin with a micrometer.

Standard: 18.996 - 19.002 mm (0.7478 - 0.7481 in)



Connecting Rod Bushing Oil Clearance

(Connecting rod bushing oil clearance) = (Connecting rod bushing inner diameter) – (Piston pin outer diameter)

Standard: –0.018 to –0.044 mm (–0.0007 to –0.0017 in)

- If the measured value is out of the standard, replace connecting rod assembly and/or piston and piston pin assembly.
- If replacing connecting rod assembly, refer to EM-211, "CONNECTING ROD BEARING OIL CLEARANCE" to select connecting rod bearing.

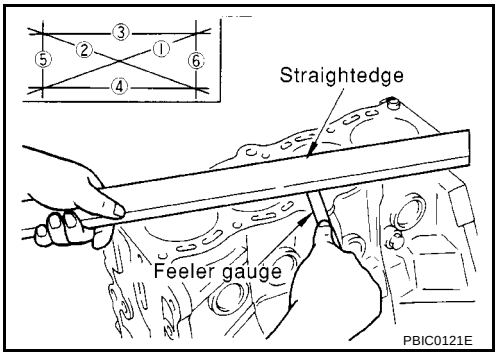
CYLINDER BLOCK DISTORTION

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

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

- Measure the distortion on the cylinder block upper face at some different points in six directions with a straight edge and a feeler gauge.

Limit: 0.1 mm (0.004 in)

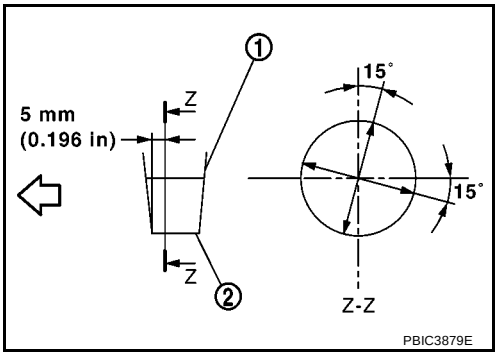


- If it exceeds the limit, replace cylinder block.

MAIN BEARING HOUSING INNER DIAMETER

- Install main bearing cap without main bearings installed, and tighten main bearing cap bolts to the specified torque. Refer to EM-194, "ASSEMBLY" for the tightening procedure.
- Measure the inner diameter of main bearing housing with a bore gauge.
- Measure the position shown in the figure [5 mm (0.196 in) rearward from main bearing housing front side end surface) in the 2 directions as shown in the figure. The smaller one is the measured value.

1 : Cylinder block
2 : Main bearing cap
⇦ : Engine front



Standard: 51.997 - 52.017 mm (2.0471 - 2.0479 in)

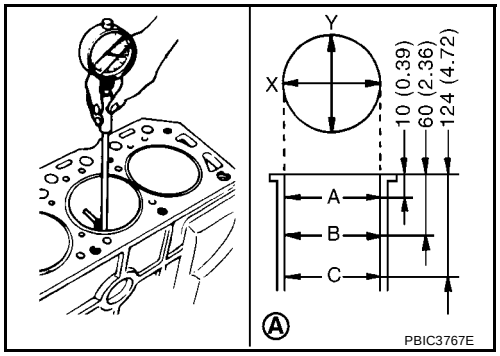
- If out of the standard, replace cylinder block and main bearing caps as an assembly.

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

PISTON TO CYLINDER BORE CLEARANCE

Cylinder Bore Inner Diameter

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



A : Unit: mm (in)

NOTE:
When determining cylinder bore grade, measure cylinder bore at “B” position.

Standard inner diameter:
78.000 - 78.015 mm (3.0708 - 3.0714 in)

Wear limit:
0.2 mm (0.008 in)

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

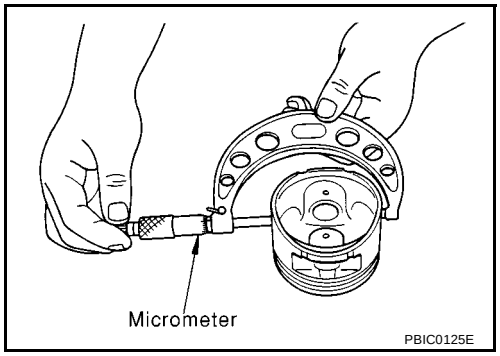
Taper limit (Difference between “A” and “C”):
0.010 mm (0.0004 in)

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

NOTE:
There is no service setting for oversized piston.

Piston Skirt Diameter

Measure the outer diameter of piston skirt with a micrometer.



Measure point
: Distance from the top 37.1 mm (1.460 in)

Standard
: 77.965 - 77.980 mm (3.0694 - 3.0700 in)

Piston to Cylinder Bore Clearance

Calculate by piston skirt diameter and cylinder bore inner diameter (direction “X”, position “B”).
(Clearance) = (Cylinder bore inner diameter) – (Piston skirt diameter)

Standard : 0.020 - 0.050 mm (0.0007 - 0.0019 in)
Limit : 0.09 mm (0.0035 in)

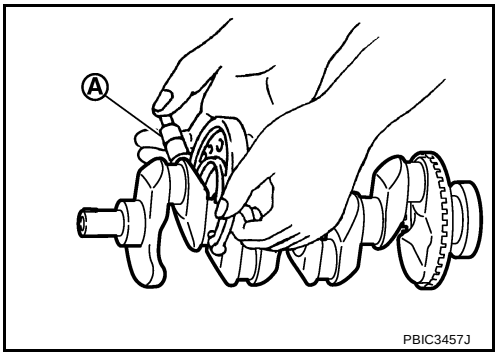
- If it exceeds the limit, replace piston and piston pin assembly and/or cylinder block.

CRANKSHAFT MAIN JOURNAL DIAMETER

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

  Standard: 47.959 - 47.979 mm (1.8881 - 1.8888 in) dia.

- If out of the standard, measure the main bearing oil clearance. Then use undersize bearing. Refer to EM-212, "MAIN BEARING OIL CLEARANCE" .



CRANKSHAFT PIN JOURNAL DIAMETER

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

  Standard: 39.953 - 39.971 mm (1.5729-1.5736 in) dia.

- If out of the standard, measure the connecting rod bearing oil clearance. Then use undersize bearing. Refer to EM-211, "CONNECTING ROD BEARING OIL CLEARANCE" .

OUT-OF-ROUND AND TAPER OF CRANKSHAFT

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

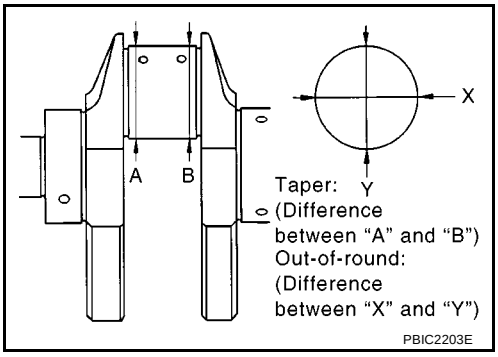
  Limit:

  Out-of-round (Difference between “X” and “Y”)

  : 0.003 mm (0.0001 in)

  Taper (Difference between “A” and “B”)

  : 0.004 mm (0.0001 in)



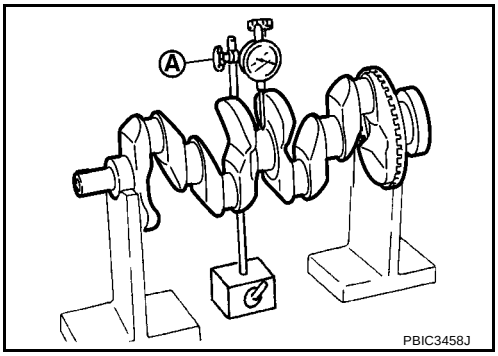
- If the measured value exceeds the limit, correct or replace crankshaft.
- If corrected, measure the bearing oil clearance of the corrected main journal and/or pin journal. Then select main bearing and/or connecting rod bearing. Refer to EM-212, "MAIN BEARING OIL CLEARANCE" and/or EM-211, "CONNECTING ROD BEARING OIL CLEARANCE" .

CRANKSHAFT RUNOUT

- Place a V-block on a precise flat table to support the journals on the both end of crankshaft.
- Place a dial indicator (A) straight up on the No. 3 journal.
- While rotating crankshaft, read the movement of the pointer on the dial indicator. (Total indicator reading)

  Limit : 0.10 mm (0.0039 in)

- If it exceeds the limit, replace crankshaft.



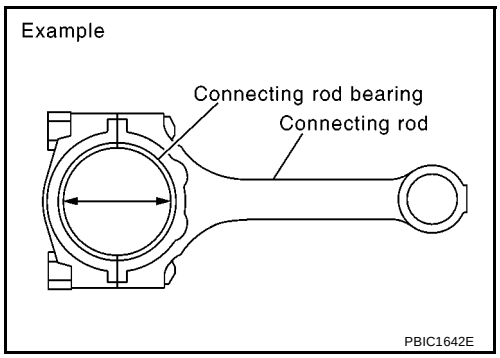
CONNECTING ROD BEARING OIL CLEARANCE

Method by Calculation

- Install connecting rod bearings to connecting rod and cap, and tighten connecting rod bolts to the specified torque. Refer to EM-194, "ASSEMBLY" for tightening procedure.

- Measure the inner diameter of connecting rod bearing with an inside micrometer.
  (Bearing oil clearance) = (Connecting rod bearing inner diameter) – (Crankshaft pin journal diameter)

  Standard : 0.037 - 0.047 mm (0.0014 - 0.0018 in)
  Limit : 0.10 mm (0.0039 in)



- If the clearance exceeds the limit, select proper connecting rod bearing according to connecting rod big end diameter and crankshaft pin journal diameter to obtain the specified bearing oil clearance. Refer to EM-200, "HOW TO SELECT CONNECTING ROD BEARING" .

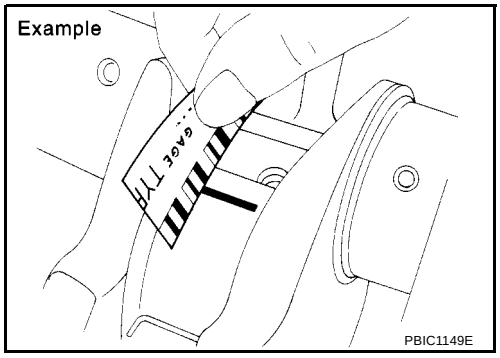
Method of Using Plastigage

- Remove engine oil and dust on crankshaft pin and the surfaces of each bearing completely.
- Cut a plastigage slightly shorter than the bearing width, and place it in crankshaft axial direction, avoiding oil holes.
- Install connecting rod bearings to connecting rod and cap, and tighten connecting rod bolts to the specified torque. Refer to EM-194, "ASSEMBLY" for the tightening procedure.

  CAUTION:
  Do not rotate crankshaft.

- Remove connecting rod cap and bearing, and using the scale on the plastigage bag, measure the plastigage width.

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



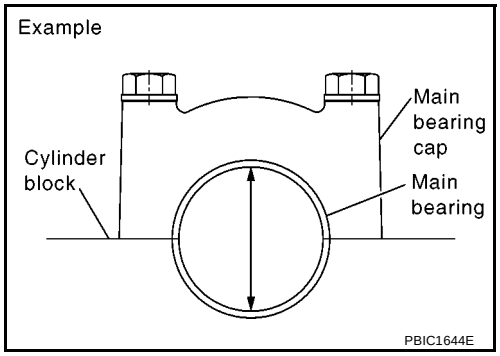
MAIN BEARING OIL CLEARANCE

Method by Calculation

- Install main bearings to cylinder block and main bearing cap, and tighten main bearing cap bolts to the specified torque. Refer to EM-194, "ASSEMBLY" for the tightening procedure.
- Measure the inner diameter of main bearing with a bore gauge.

(Bearing oil clearance) = (Main bearing inner diameter) – (Crankshaft main journal diameter)

Standard:
: 0.024 - 0.034 mm (0.0009 - 0.0013 in)



- If the clearance exceeds the limit, select proper main bearing according to main bearing inner diameter and crankshaft main journal diameter to obtain the specified bearing oil clearance. Refer to EM-203, "HOW TO SELECT MAIN BEARING" .

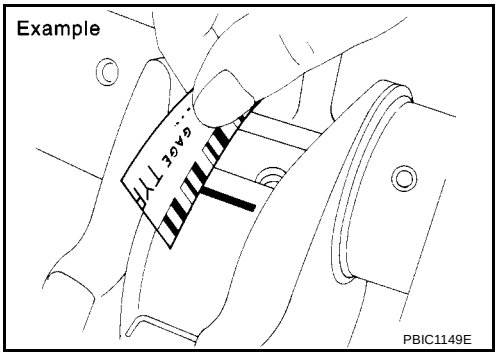
Method of Using Plastigage

- Remove engine oil and dust on crankshaft main journal and the surfaces of each bearing completely.
- Cut a plastigage slightly shorter than the bearing width, and place it in crankshaft axial direction, avoiding oil holes.
- Install main bearings to cylinder block and main bearing cap, and tighten main bearing cap bolts to the specified torque. Refer to EM-194, "ASSEMBLY" for the tightening procedure.

  CAUTION:
  Do not rotate crankshaft.

- Remove main bearing cap and bearings, and using the scale on the plastigage bag, measure the plastigage width.

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

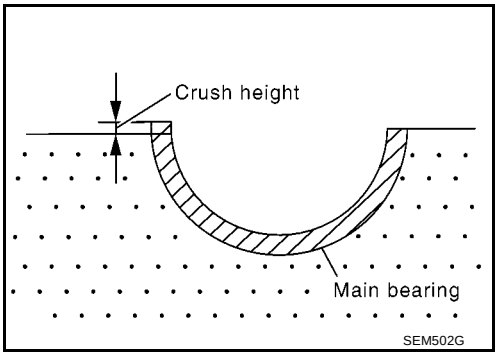


MAIN BEARING CRUSH HEIGHT

- When main bearing cap is removed after being tightened to the specified torque with main bearings installed, the tip end of bearing must protrude. Refer toEM-194, "ASSEMBLY" for the tightening procedure.

  Standard: There must be crush height.

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

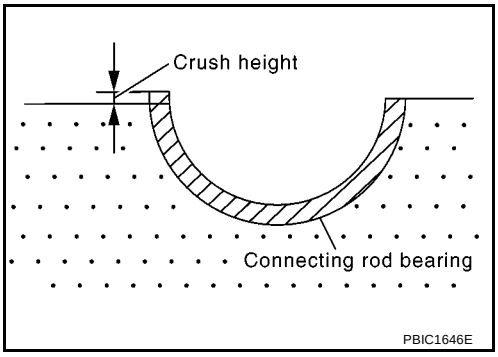


CONNECTING ROD BEARING CRUSH HEIGHT

- When connecting rod bearing cap is removed after being tightened to the specified torque with connecting rod bearings installed, the tip end of bearing must protrude. Refer to EM-194, "ASSEMBLY" for the tightening procedure.

  Standard: There must be crush height.

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

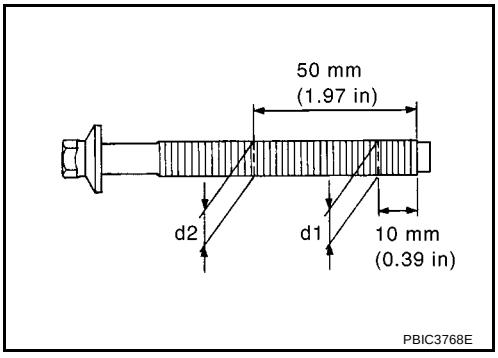


MAIN BEARING CAP BOLT OUTER DIAMETER

- Measure the outer diameters (“d_1 ”, “d_2”) at two positions as shown in the figure.
- If reduction appears in a position other than “d_2 ” , regard it as “d_2” .

  Limit (“d_1 ” – “d_2 ”): 0.2 mm (0.0078 in)

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

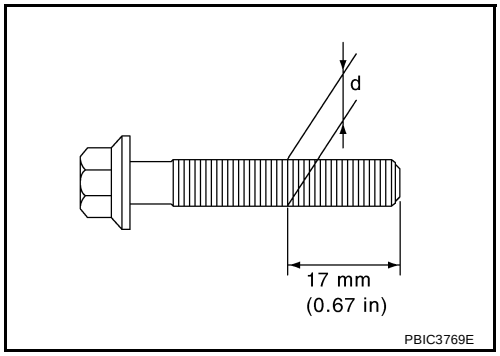


CONNECTING ROD BOLT OUTER DIAMETER

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

Limit: 7.75 mm (0.3051 in)

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

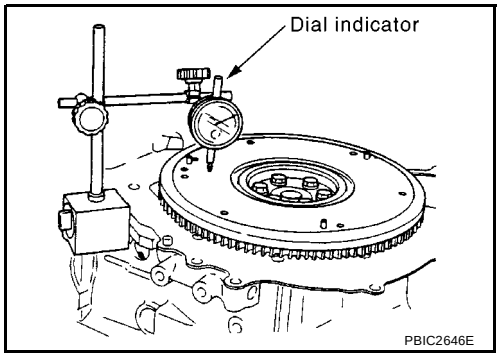


FLYWHEEL DEFLECTION

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

Standard : 0.25 mm (0.0098 in) or less.

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



SERVICE DATA AND SPECIFICATIONS (SDS)

PFP:00030

Standard and Limit

EBS01JA5

GENERAL SPECIFICATIONS

Engine type		HR16DE
Cylinder arrangement		In-line 4
Displacement cm^3 (cu in)		1,598 (97.51)
Bore and stroke mm (in)		78.0 x 83.6 (3.070 x 3.291)
Valve arrangement		DOHC
Firing order		1-3-4-2
Number of piston rings	Compression	2
	Oil	1
Compression ratio		9.8
Compression pressure kPa (bar, kg/cm^2 , psi) / 200 rpm	Standard	1,510 (15.1, 15.4, 219)
	Minimum	1,265 (12.69, 12.9, 183)
	Differential limit between cylinders	981 (9.81, 10.0, 142)

DRIVE BELT

Belt Deflection:

Location		Deflection adjustment *		Unit: mm (in)
		Used belt		New belt
		Limit	After adjusted	
Drive belt	With A/C models	7.9 (0.31)	4.8 - 5.3 (0.19 - 0.21)	4.2 - 4.5 (0.17 - 0.18)
	Without A/C models	7.1 (0.28)	4.3 - 4.7 (0.17 - 0.19)	3.6 - 3.9 (0.14 - 0.15)
Applied pushing force	98 N (10 kg, 22lb)			

*: When engine is cold.

EXHAUST MANIFOLD

Unit: mm (in)

Items	Limit
Surface distortion	0.3 (0.012)

SPARK PLUG (PLATINUM-TIPPED TYPE)

Unit: mm (in)

Make		NGK
Standard type		PLZKAR6A-11
Hot type		PLZKAR5A-11
Cold type		PLZKAR7A-11
Spark plug gap	Standard	1.1 (0.043)

CYLINDER HEAD

Unit: mm (in)

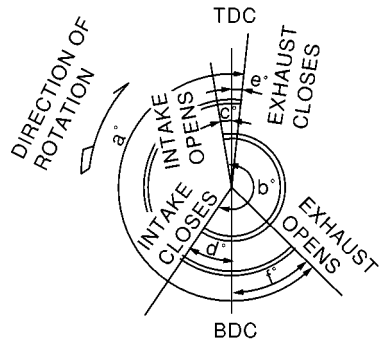
Items	Limit
Head surface distortion	0.1 (0.004)

VALVE

Valve Timing

Unit: degree

Valve timing



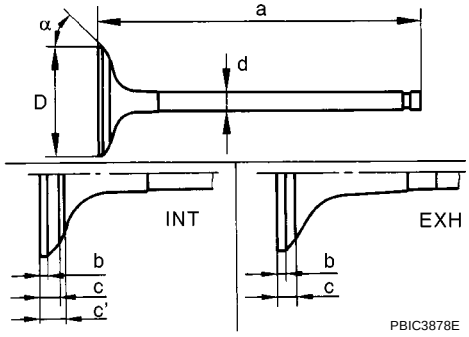
PBIC0187E

a	b	c	d	e	f
208	228	-11 (19)	59 (19)	4	24

( ): Valve timing control “ON”

Valve Dimensions

Unit: mm (in)



PBIC3878E

Valve head diameter “D”	Intake	31.0 - 31.3 (1.220 - 1.232)
	Exhaust	25.3 - 25.6 (0.996 - 1.007)
Valve length “a”	Intake	101.65 (4.0019)
	Exhaust	102.46 (4.0338)
“b”	Intake	1.0 (0.0393)
	Exhaust	1.0 (0.0393)
“c”	Intake	2.1 - 2.8 (0.0826 - 0.1102)
	Exhaust	2.3 - 3.0 (0.0905 - 0.1181)
“c′ ”	Intake	3.0 (0.1181)
	Exhaust	–
“d ”	Intake	4.965 - 4.980 (0.1954 - 0.1960 in)
	Exhaust	4.955 - 4.970 (0.1950 - 0.1956 in)
Valve seat angle “α”	Intake	45°15′ - 45°45′
	Exhaust	

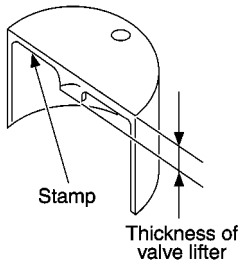
Valve Clearance

Unit: mm (in)

	Cold	Hot * (reference data)
Intake	0.26 - 0.34 (0.010 - 0.013)	0.304 - 0.416 (0.012 - 0.016)
Exhaust	0.29 - 0.37 (0.011 - 0.014)	0.308 - 0.432 (0.012 - 0.017)

*:Approximately 80°C (176°F)

Available Valve Lifter



KBIA0119E

Thickness mm (in)	Identification mark
3.00 (0.1181)	300
3.02 (0.1188)	302
3.04 (0.1196)	304
3.06 (0.1204)	306
3.08 (0.1212)	308
3.10 (0.1220)	310
3.12 (0.1228)	312
3.14 (0.1236)	314
3.16 (0.1244)	316
3.18 (0.1251)	318
3.20 (0.1259)	320
3.22 (0.1267)	322
3.24 (0.1275)	324
3.26 (0.1283)	326
3.28 (0.1291)	328
3.30 (0.1299)	330
3.32 (0.1307)	332
3.34 (0.1314)	334
3.36 (0.1322)	336
3.38 (0.1330)	338
3.40 (0.1338)	340
3.42 (0.1346)	342
3.44 (0.1354)	344
3.46 (0.1362)	346
3.48 (0.1370)	348
3.50 (0.1377)	350

Valve Spring

Standard:

Free height	42.26 mm (1.6637 in)
Installation height	32.40 mm (1.2755 in)
Installation load	136 - 154 N (13.9 - 15.7 kg, 31 - 35 lb)
Height during valve open	23.96 mm (0.9433 in)
Load with valve open	262 - 296 N (26.7 - 30.2 kg, 59 - 67 lb)

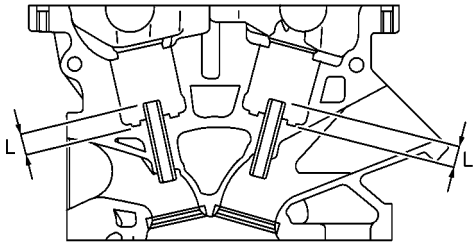
Valve Lifter

Unit: mm (in)

Items	Standard
Valve lifter outer diameter	29.977 - 29.987 (1.1801 - 1.1805)
Valve lifter hole diameter	30.000 - 30.021 (1.1811 - 1.1819)
Valve lifter clearance	0.013 - 0.044 (0.0005 - 0.0017)

Valve Guide

Unit: mm (in)

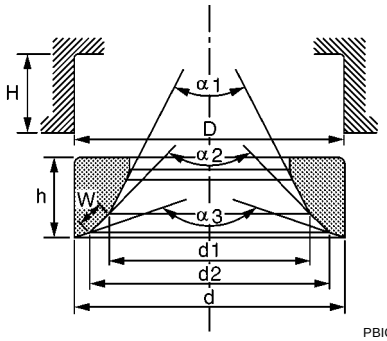


PBIC0184E

Items		Standard part	Service part
Valve guide	Outer diameter	9.023 - 9.034 (0.3552 - 0.3556)	9.223 - 9.234 (0.3631 - 0.3635)
	Inner diameter (Finished size)	5.000 - 5.018 (0.1968 - 0.1975)	
Cylinder head valve guide hole diameter		8.975 - 8.996 (0.3533 - 0.3541)	9.175 - 9.196 (0.3612 - 0.3620)
Interference fit of valve guide		0.027 - 0.059 (0.0011 - 0.0023)	
Items		Standard	Limit
Valve guide clearance	Intake	0.020 - 0.053 (0.0008 - 0.0021)	0.1 (0.004)
	Exhaust	0.030 - 0.063 (0.0012 - 0.0025)	0.1 (0.004)
Projection length “H”		11.4 - 11.8 (0.448 - 0.464)	

Valve Seat

Unit: mm (in)



PBIC2745E

Items		Standard	Oversize [0.5 (0.02)] (Service)
Cylinder head seat recess diameter “D”	Intake	31.400 - 31.416 (1.2362 - 1.2368)	31.900 - 31.916 (1.2559 - 1.2565)
	Exhaust	25.900 - 25.916 (1.0196 - 1.0203)	26.400 - 26.416 (1.0393 - 1.0399)
Valve seat outer diameter “d”	Intake	31.497 - 31.513 (1.2400 - 1.2406)	31.997 - 32.013 (1.2597 - 1.2603)
	Exhaust	25.997 - 26.013 (1.0235 - 1.0241)	26.497 - 26.513 (1.0431 - 1.0438)
Valve seat interference fit	Intake	0.081 - 0.113 (0.0032 - 0.0044)	
	Exhaust	0.081 - 0.113 (0.0032 - 0.0044)	
Diameter “d1”*1	Intake	29.0 (1.141)	
	Exhaust	23.0 (0.905)	
Diameter “d2”*2	Intake	30.6 - 30.8 (1.204 - 1.212)	
	Exhaust	24.9 - 25.1 (0.980 - 0.988)	
Angle “α1”	Intake	60°	
	Exhaust	60°	
Angle “α2”	Intake	89°45′ - 90°15′	
	Exhaust	89°45′ - 90°15′	
Angle “α3”	Intake	120°	
	Exhaust	120°	
Contacting width “W”*3	Intake	1.05 - 1.35 (0.0413 - 0.0531)	
	Exhaust	1.25 - 1.55 (0.0492 - 0.0610)	
Height “h”	Intake	6.0 (0.236)	5.45 (0.214)
	Exhaust	6.0 (0.236)	5.43 (0.213)
Depth “H”		6.0 (0.236)	

*1 : Diameter made by intersection point of conic angles α1 and α2

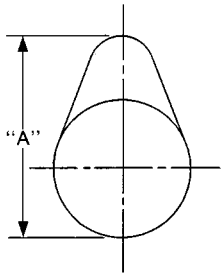
*2 : Diameter made by intersection point of conic angles α2 and α3

*3 : Machining data

CAMSHAFT AND CAMSHAFT BEARING

Unit: mm (in)

Items	Standard	Limit
Camshaft runout [TIR*]	0.02 (0.0008)	0.1 (0.0039)



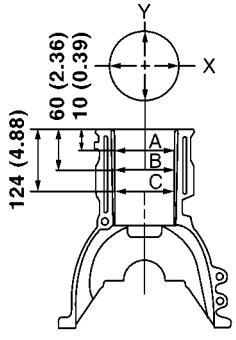
SEM671

Camshaft cam height "A"	Intake	41.705 - 41.895 (1.6419 - 1.6494)	—
	Exhaust	40.175 - 40.365 (1.5816 - 1.5891)	—
Camshaft journal outer diameter	No. 1	27.935 - 27.955 (1.0998 - 1.1006)	—
	No. 2, 3, 4, 5	24.950 - 24.970 (0.9822 - 0.9830)	—
Camshaft bracket inner diameter	No. 1	28.000 - 28.021 (1.1024 - 1.1032)	—
	No. 2, 3, 4, 5	25.000 - 25.021 (0.9842 - 0.9850)	—
Camshaft journal oil clearance	No. 1	0.045 - 0.086 (0.0018 - 0.0034)	—
	No. 2, 3, 4, 5	0.030 - 0.071 (0.0011 - 0.0027)	—
Camshaft end play		0.075 - 0.153 (0.0029 - 0.0060)	0.2 (0.0078)
Camshaft sprocket runout [TIR*]		—	0.15 (0.0059)

*: Total indicator reading

CYLINDER BLOCK

Unit: mm (in)



PBIC3924E

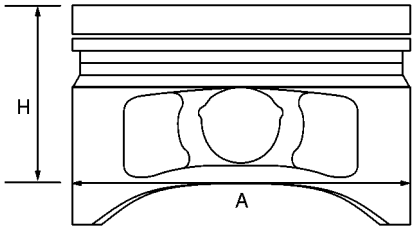
Surface distortion		Limit	0.1 (0.004)
Cylinder bore	Inner diameter	Standard	78.000 - 78.015 (3.0708 - 3.0714)
		Wear limit	0.2 (0.008)
Out-of-round (Difference between "X" and "Y")		Limit	0.015 (0.0006)
Taper (Difference between "A" and "C")			0.010 (0.0004)

Cylinder block main bearing housing inner diameter grade	Grade No. A	51.997 - 51.998 (2.0471 - 2.0472)
	Grade No. B	51.998 - 51.999 (2.0472 - 2.0472)
	Grade No. C	51.999 - 52.000 (2.0472 - 2.0472)
	Grade No. D	52.000 - 52.001 (2.0472 - 2.0472)
	Grade No. E	52.001 - 52.002 (2.0473 - 2.0473)
	Grade No. F	52.002 - 52.003 (2.0473 - 2.0473)
	Grade No. G	52.003 - 52.004 (2.0474 - 2.0474)
	Grade No. H	52.004 - 52.005 (2.0474 - 2.0474)
	Grade No. J	52.005 - 52.006 (2.0474 - 2.0474)
	Grade No. K	52.006 - 52.007 (2.0475 - 2.0475)
	Grade No. L	52.007 - 52.008 (2.0475 - 2.0475)
	Grade No. M	52.008 - 52.009 (2.0476 - 2.0476)
	Grade No. N	52.009 - 52.010 (2.0476 - 2.0476)
	Grade No. P	52.010 - 52.011 (2.0476 - 2.0476)
	Grade No. R	52.011 - 52.012 (2.0477 - 2.0477)
	Grade No. S	52.012 - 52.013 (2.0477 - 2.0477)
	Grade No. T	52.013 - 52.014 (2.0478 - 2.0478)
	Grade No. U	52.014 - 52.015 (2.0478 - 2.0478)
	Grade No. V	52.015 - 52.016 (2.0478 - 2.0478)
	Grade No. W	52.016 - 52.017 (2.0479 - 2.0479)
Difference in inner diameter between cylinders	Standard	Less than 0.03 (0.0012)

PISTON, PISTON RING AND PISTON PIN

Available Piston

Unit: mm (in)



PBIC0188E

Piston skirt diameter “A”	77.965 - 77.980 (3.0694 - 3.0700)
Piston height “H” dimension	37.1 (1.460)
Piston pin hole diameter	19.006 - 19.012 (0.7482 - 0.7485)
Piston to cylinder bore clearance	0.020 - 0.050 (0.0007 - 0.0019)

Piston Ring

Unit: mm (in)

Items		Standard	Limit
Side clearance	Top	0.040 - 0.080 (0.0015 - 0.0031)	0.11 (0.0043)
	2nd	0.030 - 0.070 (0.0012 - 0.0028)	0.10 (0.0039)
	Oil (rail ring)	0.045 - 0.125 (0.0017 - 0.0049)	—
End gap	Top	0.20- 0.30 (0.0078 - 0.0118)	0.50 (0.0196)
	2nd	0.35 - 0.50 (0.0137 - 0.0196)	0.66 (0.0259)
	Oil (rail ring)	0.20 - 0.60 (0.0079 - 0.0236)	0.92 (0.0362)

Piston Pin

Unit: mm (in)

Piston pin outer diameter		18.996 - 19.002 (0.7478 - 0.7481)
Piston to piston pin oil clearance	Standard	0.008 - 0.012 (0.0003 - 0.0004)
Connecting rod bushing oil clearance	Standard	–0.018 to –0.044 (–0.0007 to –0.0017)

CONNECTING ROD

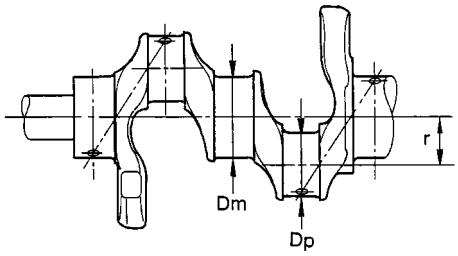
Unit: mm (in)

Center distance		129.84 - 129.94 (5.1118 - 5.1157)
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*		18.958 - 18.978 (0.7463 - 0.7471)
Side clearance	Standard	0.200 - 0.352 (0.0079 - 0.0138)
Connecting rod big end diameter	Grade No. A Grade No. B Grade No. C Grade No. D Grade No. E Grade No. F Grade No. G Grade No. H Grade No. J Grade No. K Grade No. L Grade No. M Grade No. N	43.000 - 43.001 (1.6929 - 1.6929) 43.001 - 43.002 (1.6929 - 1.6930) 43.002 - 43.003 (1.6930 - 1.6930) 43.003 - 43.004 (1 6930 - 1.6931) 43.004 - 43.005 (1.6931 - 1.6931) 43.005 - 43.006 (1.6931 - 1.6931) 43.006 - 43.007 (1.6931 - 1.6932) 43.007 - 43.008 (1.6932 - 1.6932) 43.008 - 43.009 (1.6932 - 1.6933) 43.009 - 43.010 (1.6933 - 1.6933) 43.010 - 43.011 (1.6933 - 1.6933) 43.011 - 43.012 (1.6933 - 1.6934) 43.012 - 43.013 (1.6934 - 1.6934)

*: After installing in connecting rod

CRANKSHAFT

Unit: mm (in)



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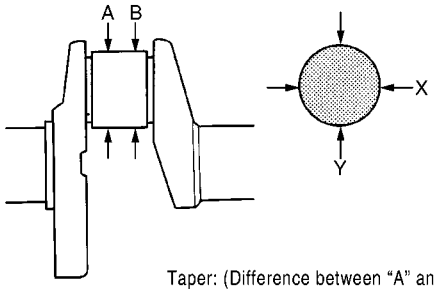


Taper: (Difference between “A” and “B”)
Out-of-round: (Difference between “X” and “Y”)

SBIA0535E

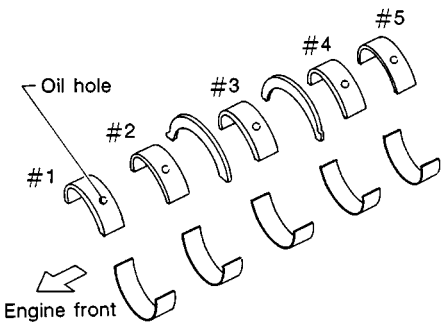
Center distance “r”		41.68 - 41.76 (1.6409 - 1.6440)
Out-of-round (Difference between “X” and “Y”)	Limit	0.003 (0.0001)
Taper (Difference between “A” and “B”)	Limit	0.004 (0.0001)
Runout [TIR*]	Limit	0.10 (0.0039)
Crankshaft end play	Standard	0.098 - 0.260 (0.0038 - 0.0102)
	Limit	0.35 (0.0137)

Crankshaft pin journal diameter grade. “DP”	Grade No. A	39.971 - 39.970 (1.5737 - 1.5736)
	Grade No. B	39.970 - 39.969 (1.5736 - 1.5736)
	Grade No. C	39.969 - 39.968 (1.5736 - 1.5735)
	Grade No. D	39.968 - 39.967 (1.5735 - 1.5735)
	Grade No. E	39.967 - 39.966 (1.5735 - 1.5735)
	Grade No. F	39.966 - 39.965 (1.5736 - 1.5734)
	Grade No. G	39.965 - 39.964 (1.5735 - 1.5734)
	Grade No. H	39.964 - 39.963 (1.5734 - 1.5733)
	Grade No. J	39.963 - 39.962 (1.5734 - 1.5733)
	Grade No. K	39.962 - 39.961 (1.5733 - 1.5733)
	Grade No. L	39.961 - 39.960 (1.5733 - 1.5732)
	Grade No. M	39.960 - 39.959 (1.5732 - 1.5732)
	Grade No. N	39.959 - 39.958 (1.5732 - 1.5731)
	Grade No. P	39.958 - 39.957 (1.5731 - 1.5731)
	Grade No. R	39.957 - 39.956 (1.5731 - 1.5731)
	Grade No. S	39.956 - 39.955 (1.5731 - 1.5730)
	Grade No. T	39.955 - 39.954 (1.5730 - 1.5730)
	Grade No. U	39.954 - 39.953 (1.5730 - 1.5729)
Crankshaft main journal diameter grade. “Dm”	Grade No. A	47.979 - 47.978 (1.8889 - 1.8889)
	Grade No. B	47.978 - 47.977 (1.8889 - 1.8889)
	Grade No. C	47.977 - 47.976 (1.8889 - 1.8888)
	Grade No. D	47.976 - 47.975 (1.8888 - 1.8888)
	Grade No. E	47.975 - 47.974 (1.8888 - 1.8887)
	Grade No. F	47.974 - 47.973 (1.8887 - 1.8887)
	Grade No. G	47.973 - 47.972 (1.8887 - 1.8887)
	Grade No. H	47.972 - 47.971 (1.8887 - 1.8886)
	Grade No. J	47.971 - 47.970 (1.8886 - 1.8886)
	Grade No. K	47.970 - 47.969 (1.8886 - 1.8885)
	Grade No. L	47.969 - 47.968 (1.8885 - 1.8885)
	Grade No. M	47.968 - 47.967 (1.8885 - 1.8885)
	Grade No. N	47.967 - 47.966 (1.8885 - 1.8884)
	Grade No. P	47.966 - 47.965 (1.8884 - 1.8884)
	Grade No. R	47.995 - 47.964 (1.8884 - 1.8883)
	Grade No. S	47.994 - 47.963 (1.8883 - 1.8883)
	Grade No. T	47.963 - 47.962 (1.8883 - 1.8883)
	Grade No. U	47.962 - 47.961 (1.8883 - 1.8882)
	Grade No. V	47.961 - 47.960 (1.8882 - 1.8882)
	Grade No. W	47.960 - 47.959 (1.8882 - 1.8881)

*: Total indicator reading

MAIN BEARING

Unit: mm (in)



SEM685D

Grade number		Thickness	Identification color	Remarks
0		1.996 - 1.999 (0.0785 - 0.0787)	Black	Grade and color are the same for upper and lower bearings.
1		1.999 - 2.002 (0.0787 - 0.0788)	Brown	
2		2.002 - 2.005 (0.0788 - 0.0789)	Green	
3		2.005 - 2.008 (0.0789 - 0.0790)	Yellow	
4		2.008 - 2.011 (0.0790 - 0.0791)	Blue	
5		2.011 - 2.014 (0.0791 - 0.0792)	Pink	
01	UPR	1.996 - 1.999 (0.0785 - 0.0787)	Black	Grade and color are different for upper and lower bearings.
	LWR	1.999 - 2.002 (0.0787 - 0.0788)	Brown	
12	UPR	1.999 - 2.002 (0.0787 - 0.0788)	Brown	
	LWR	2.002 - 2.005 (0.0788 - 0.0789)	Green	
23	UPR	2.002 - 2.005 (0.0788 - 0.0789)	Green	
	LWR	2.005 - 2.008 (0.0789 - 0.0790)	Yellow	
34	UPR	2.005 - 2.008 (0.0789 - 0.0790)	Yellow	
	LWR	2.008 - 2.011 (0.0790 - 0.0791)	Blue	
45	UPR	2.008 - 2.011 (0.0790 - 0.0791)	Blue	
	LWR	2.011 - 2.014 (0.0791 - 0.0792)	Pink	

Undersize

Unit: mm (in)

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

Bearing Oil Clearance

Unit: mm (in)

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

CONNECTING ROD BEARING

Hatchback Models

Unit: mm (in)

Grade number	Thickness	Identification color	Remarks
0	1.494 - 1.497 (0.0588 - 0.0589)	Black	Grade and color are the same for upper and lower bearings.
1	1.497 - 1.500 (0.0589 - 0.0590)	Brown	
2	1.500 - 1.503 (0.0590 - 0.0591)	Green	
3	1.503 - 1.506 (0.0591 - 0.0592)	Yellow	
4	1.506 - 1.509 (0.0592 - 0.0594)	Blue	

01	UPR	1.494 - 1.497 (0.0588 - 0.0589)	Black	Grade and color are different for upper and lower bearings.
	LWR	1.497 - 1.500 (0.0589 - 0.0590)	Brown	
12	UPR	1.497 - 1.500 (0.0589 - 0.0590)	Brown	
	LWR	1.500 - 1.503 (0.0590 - 0.0591)	Green	
23	UPR	1.500 - 1.503 (0.0590 - 0.0591)	Green	
	LWR	1.503 - 1.506 (0.0591 - 0.0592)	Yellow	
34	UPR	1.503 - 1.506 (0.0591 - 0.0592)	Yellow	
	LWR	1.506 - 1.509 (0.0592 - 0.0594)	Blue	

C+C Models

Unit: mm (in)

Grade number		Thickness	Identification color	Remarks
0		1.501 - 1.498 (0.0591 - 0.0590)	Black	Grade and color are the same for upper and lower bearings.
1		1.504 - 1.501 (0.0592 - 0.0591)	Brown	
2		1.507 - 1.504 (0.0593 - 0.0592)	Green	
3		1.510 - 1.507 (0.0594 - 0.0593)	Yellow	
4		1.513 - 1.510 (0.0596 - 0.0594)	Blue	
01	UPR	1.501 - 1.498 (0.0591 - 0.0590)	Black	Grade and color are different for upper and lower bearings.
	LWR	1.504 - 1.501 (0.0592 - 0.0590)	Brown	
12	UPR	1.504 - 1.501 (0.0592 - 0.0590)	Brown	
	LWR	1.507 - 1.504 (0.0593 - 0.0592)	Green	
23	UPR	1.507 - 1.504 (0.0593 - 0.0592)	Green	
	LWR	1.510 - 1.507 (0.0594 - 0.0593)	Yellow	
34	UPR	1.510 - 1.507 (0.0594 - 0.0593)	Yellow	
	LWR	1.513 - 1.510 (0.0596 - 0.0594)	Blue	

Undersize (Hatchback Models)

Unit: mm (in)

Item	Thickness	Crankshaft pin journal diameter
US 0.25 (0.0098)	1.623 - 1.631 (0.0638 - 0.0642)	Grind so that bearing clearance is the specified value.

Undersize (C+C Models)

Unit: mm (in)

Item	Thickness	Crankshaft pin journal diameter
US 0.25 (0.0098)	1.623 - 1.635 (0.0639 - 0.0644)	Grind so that bearing clearance is the specified value.

Bearing Oil Clearance (Hatchback Models)

Unit: mm (in)

Connecting rod bearing oil clearance	Standard	0.037 - 0.047 (0.0014 - 0.0018)
	Limit	0.10 (0.0039)

Bearing Oil Clearance (C+C Models)

Unit: mm (in)

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

APPLICATION NOTICE

PFP:00000

How to Check Vehicle Type

EBS01IO1

Confirm K9K engine type with Model written on identification plate (refer to GI-44, "IDENTIFICATION INFORMATION"),then refer to service information in EM section.

Vehicle type	Engine type
xTKxxxxK12Vxx	Euro3 48kW
xTKxxxxK12Yxx	Euro3 60kW
xTKxxxxK12Txx	Euro4 50kW
xTKxxxxK12Uxx	Euro4 63kW

PRECAUTIONS

PFP:00001

Precautions for Drain Coolant

EBS01C5X

Drain coolant when engine is cooled.

Precautions for Disconnecting Fuel Piping

EBS01C5Y

- 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

EBS01C5Z

- When instructed to use special service tools, use the specified tools. Always be careful to work safely, avoid forceful or uninstructed operations.
- Exercise maximum care to avoid damage to mating or sliding surfaces.
- Cover openings of engine system with tape or the equivalent, if necessary, to seal out foreign materials.
- Mark and arrange disassembly parts in an organized way for easy troubleshooting and re-assembly.
- When loosening nuts and bolts, as a basic rule, start with the one furthest outside, then the one diagonally opposite, and so on. If the order of loosening is specified, do exactly as specified.

Precautions for Inspection, Repair and Replacement

EBS01C60

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

Precautions for Assembly and Installation

EBS01C61

- Use torque wrench to tighten bolts or nuts to specified value.
- When tightening nuts and bolts, as a basic rule, equally tighten in several different steps starting with the ones in center, then ones on inside and outside diagonally in this order. If the order of tightening is specified, do exactly same as specified.
- Replace with new gasket, packing, oil seal or O-ring.
- Thoroughly wash, clean, and air-blow each part. Carefully check oil or coolant passages for any restriction and blockage.
- Avoid damaging sliding or mating surfaces. Completely remove foreign materials such as cloth lint or dust. Before assemble, spread the oil on sliding surfaces well.
- Release air within route when refilling after draining coolant.
- Before starting engine, apply fuel pressure to fuel lines with turning ignition switch ON (with engine stopped). Then make sure that there are no leaks at fuel line connections.
- After repairing, start engine and increase engine speed to check coolant, fuel, oil, and exhaust systems for leakage.

Parts Requiring Angular Tightening

EBS01C62

- Use an angle wrench for the final tightening of the following engine parts.
  - Cylinder head bolts
  - Lower cylinder block bolts
  - Connecting rod cap bolts
  - Crankshaft pulley bolt (No angle wrench is required as the bolt flange is provided with notches for angular tightening)
- Do not use a torque value for final tightening.
- The torque value for these parts are for a preliminary step.
- Ensure thread and seat surfaces are clean and coated with engine oil.

Precautions For Liquid Gasket

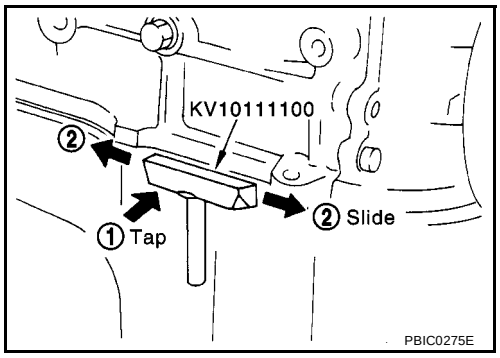
EBS01C63

REMOVAL OF LIQUID GASKET

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

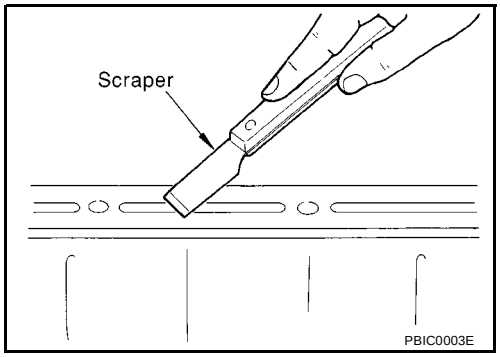
  CAUTION:
  Be careful not to damage the mating surfaces.
- In areas where the cutter is difficult to use, use a plastic hammer to lightly tap the liquid gasket applied area.

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

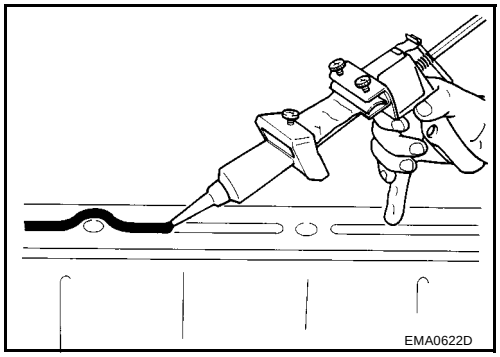


LIQUID GASKET APPLICATION PROCEDURE

1. Using a scraper, remove the old liquid gasket adhering to the gasket application surface and the mating surface.
   - Remove the liquid gasket completely from the groove of the gasket application surface, mounting bolts and bolt holes.
2. Wipe the gasket application surface and the mating surface with white gasoline (lighting and heating use) to remove adhering moisture, grease and foreign materials.
3. Attach the liquid gasket to the tube presser.
   Use Genuine Liquid Gasket or equivalent.

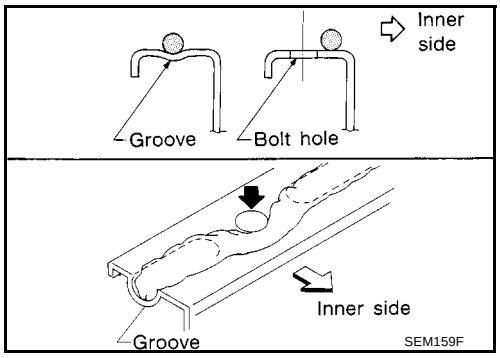


4. Apply the liquid gasket without breaks to the specified location with the specified dimensions.
   - If there is a groove for the liquid gasket application, apply the gasket to the groove.



   - As for the bolt holes, normally apply the gasket inside the holes. If specified, it should be applied outside the holes. Make sure to read the instruction in this manual.
   - Within five minutes of gasket application, install the mating component.
   - If the liquid gasket protrudes, wipe it off immediately.
   - Do not retighten after the installation.
   - After 30 minutes or more have passed from the installation, fill the engine oil and coolant.

   CAUTION:
   If there are instructions in this manual, observe them.



Cleanliness Instructions Which Must Be Followed When Working On The High Pressure Direct Injection System

EBS01C64

RISKS RELATING TO CONTAMINATION

The system is very sensitive to contamination. The risks caused by the introduction of contamination are:

- Damage to or destruction of the high pressure injection system,
- Seizing or leaking of a component.

All After-Sales operations must be performed under very clean conditions. This means that no impurities (particles a few microns in size) must be allowed to enter the system during dismantling or into the circuits via the fuel unions. The cleanliness principle must be applied from the filter to the injectors.

The Sources Of Contamination

EBS01C65

Contamination is caused by:

- Metal or plastic chips,
- Paint,
- Fibres,
  - Of cardboard,
  - Brushes,
  - Paper,
  - Clothing,
  - Cloths.
- Foreign bodies such as hairs,
- Ambient air,
- Etc.

CAUTION:

It is forbidden to clean the engine using a high pressure washer because of the risk of damaging connections. Also moisture may collect in the connectors and cause electrical connection problems.

Precautions To Be Followed Before Any Work Is Carried Out On The Injection System

EBS01C66

- Ensure that you have the plugs for the unions to be opened [bag of plugs sold by the Parts Stores - Nissan part No.: 16830 BN700 (Renault part No.: 77 01 206 804)]. Plugs are to be used once only. After use, they must be thrown away (once used they are soiled and cleaning is not sufficient to make them reusable). Unused plugs must be thrown away.
- Ensure that you have the resealable plastic bags for storing removed parts. There is less risk of parts stored in this way being exposed to contamination. The bags must be used only once, and after use they must be thrown away.
- Make sure that lint-free cleaning cloths are available. The use of conventional cloth or paper is prohibited. These are not lint-free and may contaminate the fuel circuit of the system. Each lint-free cloth should only be used once.

Cleaning Precautions To Be Followed Before Carrying Out Any Work On The Fuel System

EBS01C67

- For each operation, use new thinner (used thinner contains impurities). Pour it into a clean receptacle.
- For each operation, use a clean brush which is in good condition (the brush must not shed its bristles).
- Use a brush and thinners to clean the connections to be opened.
- Blow compressed air over the cleaned parts (tools, bench and parts, connections and injection system zone). Check that no bristles remain adhered.
- Wash your hands before and during the operation if necessary.
- When wearing leather protective gloves, cover these with latex gloves.

Precautions To Be Followed During The Operation

EBS01C68

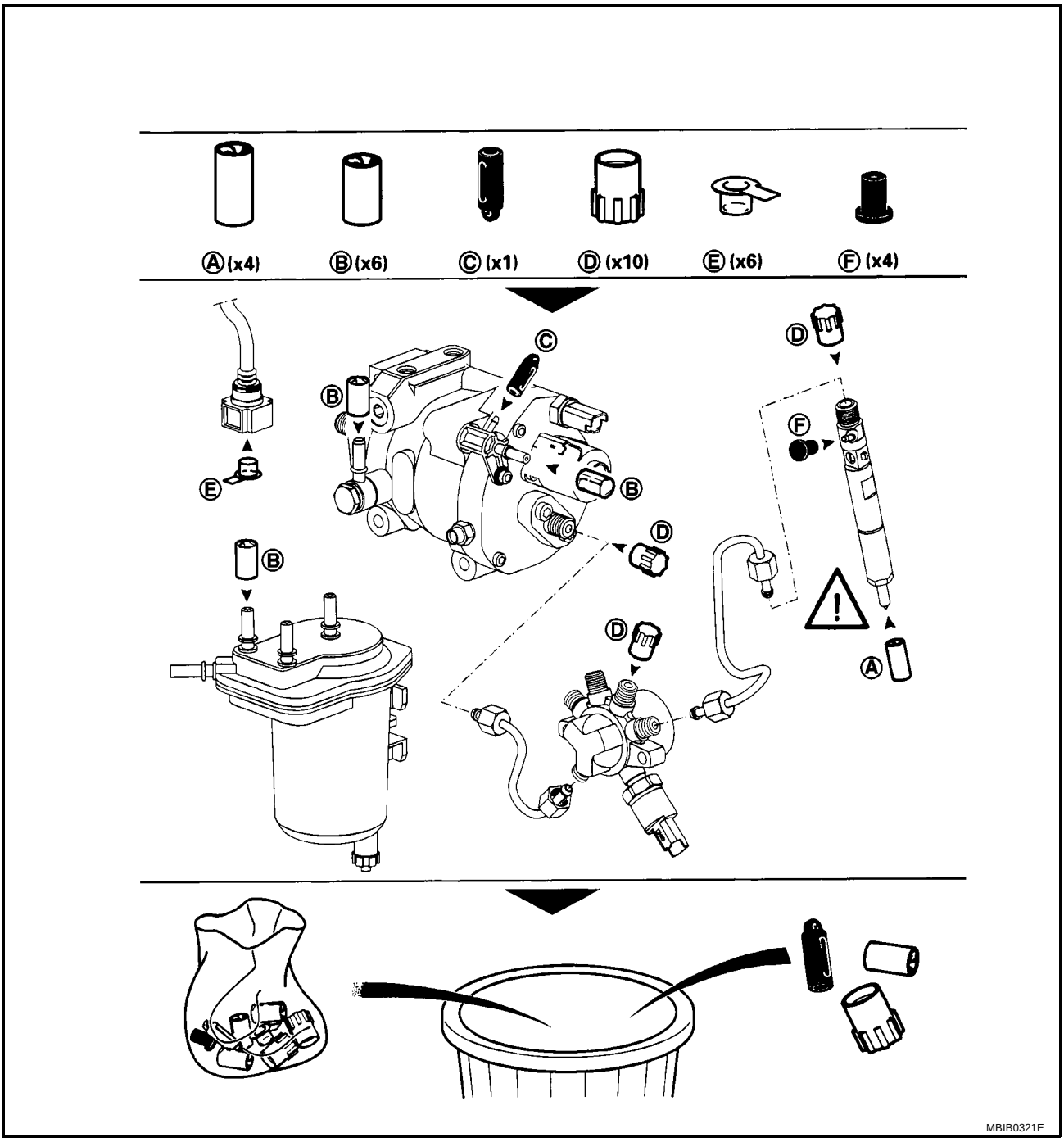
- As soon as the circuit is open, all openings must be plugged to prevent impurities from entering the system. The plugs to be used are available from the Parts Stores [Nissan Part No.: 16830 BN700 (Renault Part No.: 77 01 206 804)]. They must not be reused under any circumstances.
- Close the hermetically sealed bag, even if it has to be reopened shortly afterwards. Ambient air carries contamination.
- All components of the injection system that are removed must be stored in a hermetically sealed plastic bag once the plugs have been inserted.
- The use of a brush, thinner, bellows, sponge or normal cloth is strictly forbidden once the circuit has been opened. In fact, these items are likely to result in impurities entering the system.

- A new component replacing an old one must not be removed from its packaging until it is to be fitted to the vehicle.

Instructions For Fitting The Plugs

EBS01C69

NISSAN part number: 16830 BN700
(Renault part number: 77 01 206 804)



CAUTION:

- **The engine must not run with:**
  - **Diesel containing more than 10% diester**
  - **Petrol, even in very small amounts.**
- **The system can inject the diesel into the engine at a pressure of up to 140,000 kPa (1,400 bar, 1,428 kg/cm^2 , 20,300 psi). Before carrying out any work, check that the injector rail is no longer pressurized and that the fuel temperature is not too high.**
- **You must respect the cleaning and safety advice specified in this document for any work on the high pressure injection system.**

- **Removal of the interior of the pump and injectors is prohibited. Only the flow actuator, the diesel temperature sensor and the venturi may be changed on the pump.**
- **For safety reasons, it is strictly forbidden to undo a high pressure pipe union when the engine is running.**
- **It is forbidden to remove the pressure sensor from the fuel rail because this may cause contamination problems. If the pressure sensor develops a fault, the pressure sensor, fuel rail and the five high pressure pipes must be replaced.**
- **It is strictly forbidden to remove any fuel injection pump pulley bearing the Renault part No. 070 575. The pulley must be replaced when the high pressure pump is replaced.**
- **It is forbidden to repair the wiring connecting the accelerometer and the engine speed sensor. If the wiring should fail, it has to be replaced with new wiring.**
- **Applying 12 volts directly to any component in the system is prohibited.**
- **Ultrasonic decoking and cleaning are prohibited.**
- **Never start the engine if the battery is not connected correctly.**
- **Disconnect the injection system computer when carrying out any welding work on the vehicle.**
- **All disconnected plastic air inlet hoses must be replaced.**

A 16 character code called C2I (Individual Injector Corrector) is marked on the injectors. This code, specific to each injector, takes into account any manufacturing variations and specifies the flow injected by each injector.
The code of the new injector must be programmed into the computer when injector is replaced.
The code of the four injectors must be programmed into the computer when the computer is replaced.
There are two possibilities:

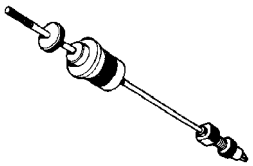
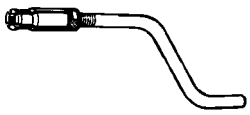
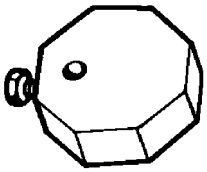
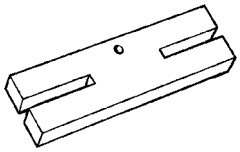
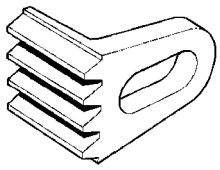
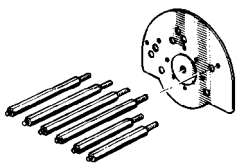
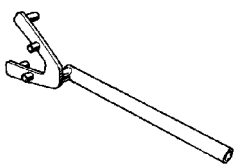
- If it is possible to communicate with the computer:
  - Upload the data from the computer into the diagnostic tool.
  - Change the computer.
  - Download the data from the diagnostic tool to the computer.
  - Using the diagnostic tool, ensure that the computer has not detected errors relating to the injector codes and check that the instrument panel warning light is off.
- If it is not possible to communicate with the computer:
  - Change the computer.
  - Read the data on the injectors.
  - Store the data in the computer using the diagnostic tool.
  - Using the diagnostic tool, ensure that the computer has not detected faults relating to the injector codes and check that the instrument panel warning light is off.

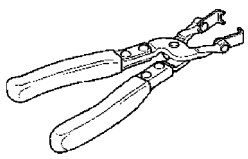
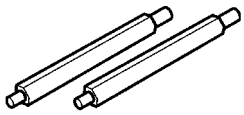
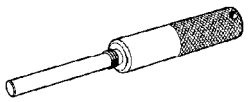
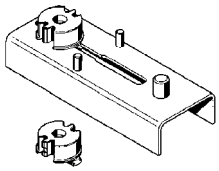
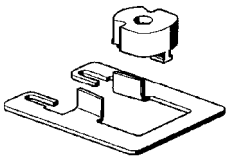
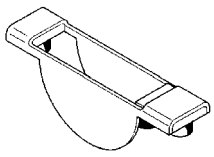
PREPARATION

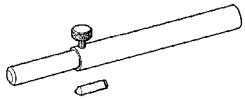
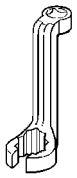
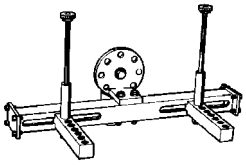
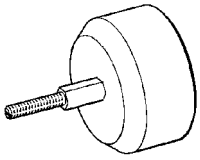
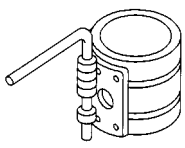
PFP:00002

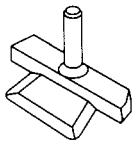
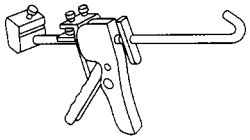
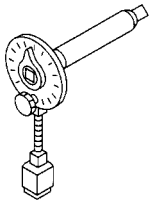
Special Service Tools

EBS01C6A

NISSAN tool number (RENAULT tool No.) Tool name		Description
KV113B0020 **(Emb. 880)** **Sliding hammer**	 MBIB0358E	Inertia extractor
KV113B0030 **(Mot. 11)** **Crankshaft bearing remover**	 MBIB0359E	Crankshaft bearing extractor
KV113B0040 **(Mot. 251-01)** **Dial gauge stand set**	 MBIB0360E	Gauge stand used with KV113B0050 (Mot. 252-01)
KV113B0050 **(Mot. 252-01)** **Dial gauge stand set**	 MBIB0361E	Thrust plate for measuring the protrusion of cylinder liners used with KV113B0040 (Mot. 251-01).
KV113B0060 **(Mot. 582-01)** **Ring gear stopper**	 MBIB0363E	Flywheel immobilizing tool.
KV113B0070 **(Mot. 792-03)** **Engine sub-attachment**	 MBIB0367E	Engine mounting plate for engine stand
KV113B0080 **(Mot. 799-01)** **Camshaft pulley holder**	 MBIB0368E	Tool for locking sprockets for toothed timing belt

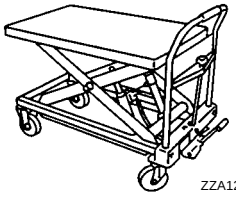
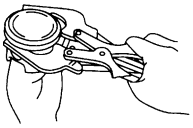
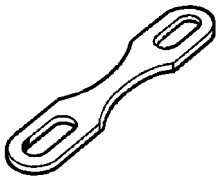
NISSAN tool number (RENAULT tool No.) Tool name	Description
KV113B0090 **(Mot. 1335)** **Valve seal remover**  MBIB0370E	Tool for removing valve stem seals
KV113B0100 **(Mot. 1378)** **Engine sub-attachment**  MBIB0371E	X and Y engine pins
KV113B0110 **(Mot. 1430)** **TDC set pin**	Set of TDC pins
KV113B0120 **(Mot. 1485-01)** **Oil jet remover**  MBIB0372E	Tool for removing the piston bottom oil jets
KV113B0130 **(Mot. 1489)** **TDC set pin**  MBIB0373E	TDC setting pin
KV113B0140 **(Mot. 1492)** **Bearing assembling set**  MBIB0374E	Tool for installing connecting rod bearing
KV113B0150 **(Mot. 1492-03)** **Bearing assembling adapter**  MBIB0375E	Adaptation kit for installing the detachable cap connecting rod bearing
KV113B0160 **(Mot. 1493-01)** **Bearing insert**  MBIB0376E	Tool for installing main bearing

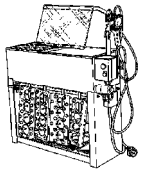
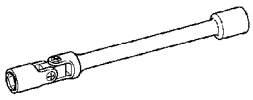
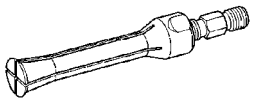
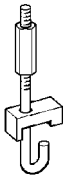
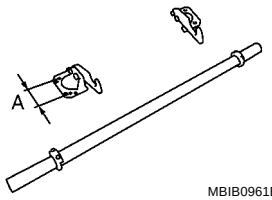
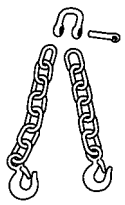
NISSAN tool number (RENAULT tool No.) Tool name	Description
KV113B0170 **(Mot. 1494)** **Oil jet remover plate**	Tool for removing oil jets
KV113B0180 **(Mot. 1511-01)** **Valve seal drift**  MBIB0378E	Tool for installing valve stem seals
KV113E0010 **(Mot. 1566)** **Fuel spill tube spanner**  MBIB0379E	Spanner for installing and removing high pressure pipes
KV113B0190 **(Mot. 1567)** **Clip pliers**	Pliers for exhaust gas recycling pipe clips
KV113B0200 **(Mot. 1573)** **Cylinder head stand**  MBIB0380E	Cylinder head support
KV113B0210 **(Mot. 1585)** **Front oil seal drift**  MBIB0381E	Tool for installing crankshaft seals, flywheel end
KV113B0220 **(Mot. 1586)** **Front oil seal drift set**	Tool for installing crankshaft seals, timing end
KV113B0230 **(Mot. 1632)** **Camshaft seal insert**	Tool for installing inlet camshaft seals
KV113B0240 **(Rou. 15-01)** **Shaft protector**	Internal shaft protector **16 mm (0.63 in) dia.**
EM03470000 **(—)** **Piston ring compressor**  NT044	Installing piston assembly into cylinder bore

NISSAN tool number (RENAULT tool No.) Tool name	Description
KV10111100 **(—)** **Seal cutter**  NT046	Removing oil pan
WS39930000 **(—)** **Tube presser**  NT052	Pressing the tube of liquid gasket
KV10112100 **(—)** **Angle wrench**  NT014	Tightening bolts for bearing cap, cylinder head, etc. in angle

Commercial Service Tools

EBS01C6B

(RENAULT tool No.) Tool name	Description
Manual lift table caddy  ZZA1210D	Removing and installing engine
Piston ring expander  NT030	Removing and installing piston ring
(Mot. 588)  MBIB0364E	Liner retaining strap

(RENAULT tool No.) Tool name	Description
(664000) Cylinder head test container  MBIB0383E	Tool for testing the cylinder head, including: a tray and the various kits suited for each model of cylinder head (plug, sealing plate, blanking plate).
Torx socket	Standard 1/2" (12.7 mm) square drive 8/12 / 14 female torx socket.
(Mot. 1505) (Mot. 1715) Belt tension setting tool  MBIB1423E	Tool for belt tension checking with frequency
Glow plug wrench  MBIB0387E	Articulated wrench for removing and installing the glow plugs
Main bearing wrench  MBIB0388E	Wrench for removing main bearings
(Mot. 1638) Belt tension gauge  MBIB0382E	Setting drive belt tension
Engine support bar  MBIB0961E	Using with engine support chain A: Approx. 12.5 mm (0.492in)
Engine support chain  MBIB0962E	Using with engine support bar

IDENTIFICATION INFORMATION

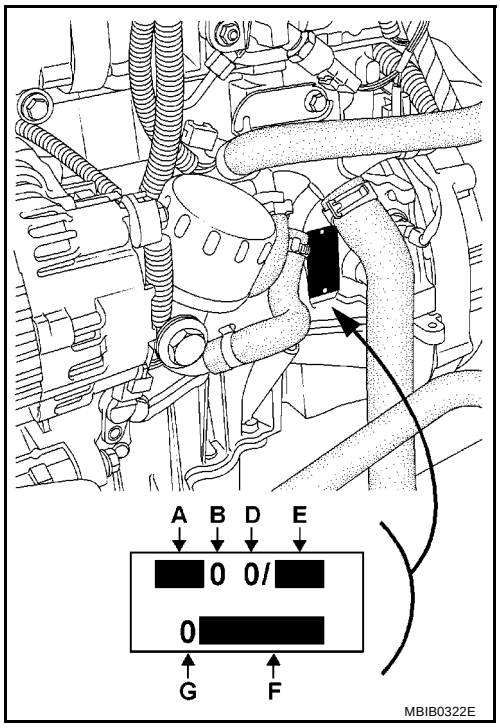
PFP:00010

Engine Identification

EBS01C6C

Identification is by means of an engraved plate on the cylinder block which carries:

- A: engine type
- B: engine type approval letter
- D: code
- E: engine suffix
- F: engine serial number
- G: engine assembly plant



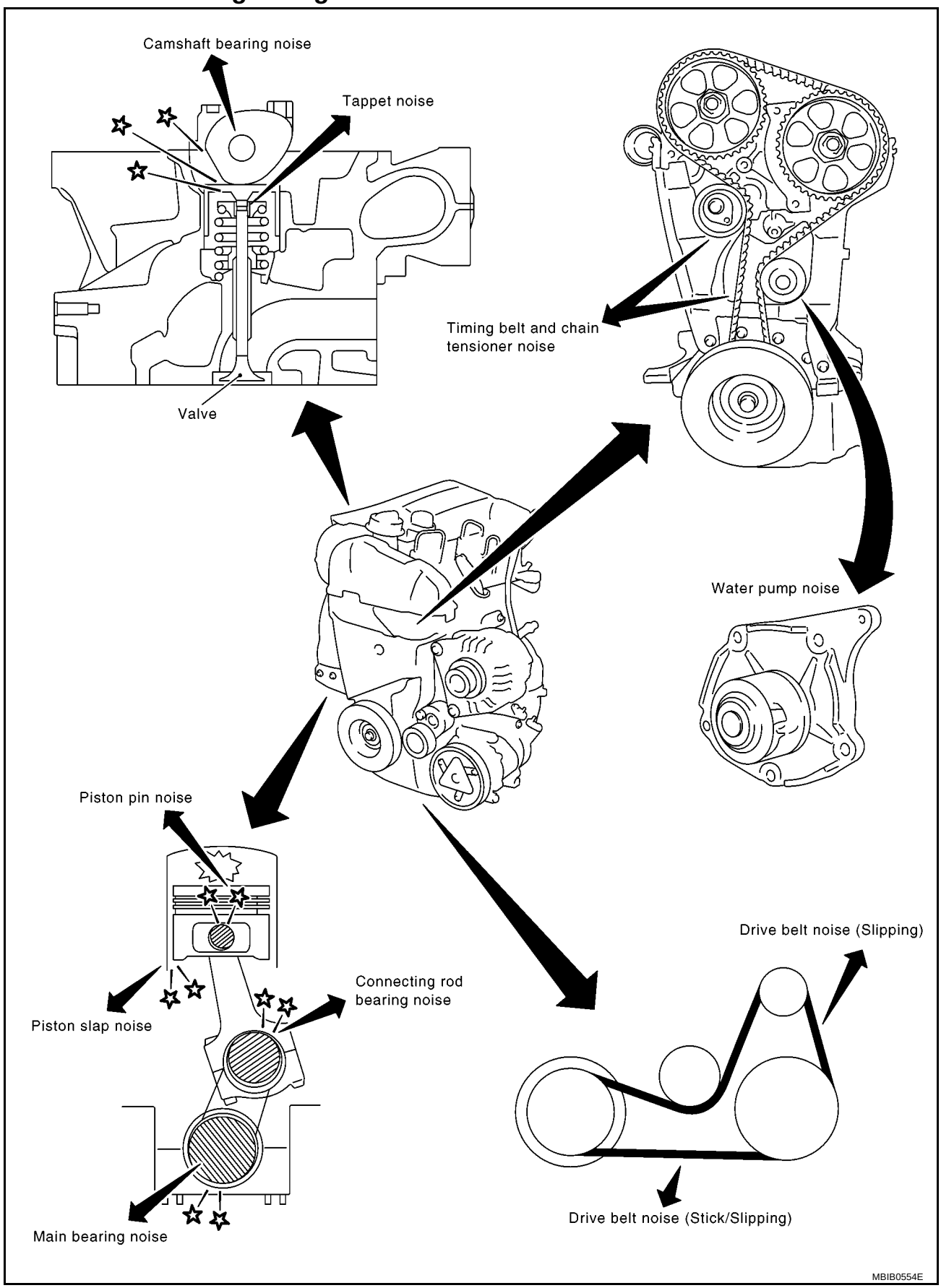
Engine	Compression ratio	Bore and stroke mm (in)	Displacement cm^3 (cu in)
K9K	18.25/1	76 x 80.5 (2.992 x 3.169)	1,461 (89.15)

NOISE, VIBRATION AND HARSHNESS (NVH) TROUBLESHOOTING

PFP:00003

NVH Troubleshooting —Engine Noise

EBS01C6D



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

EBS01C6E

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-327
Crankshaft pulley Cylinder block (Side of engine) Oil pan	Slap or rap	A	—	—	B	B	A	Piston slap noise	Piston ring end gap	EM-330
Front of engine Timing belt cover	Tapping or ticking	A	A	—	B	B	B	Timing belt tensioner noise	Timing belt tensioner operation	EM-273
Front of engine	Squeaking or fizzing	A	B	—	B	—	C	Drive belts (Sticking or slipping)	Drive belts deflection	EM-244
	Squall Creak	A	B	—	B	A	B	Water pump noise	Water pump operation	CO-69

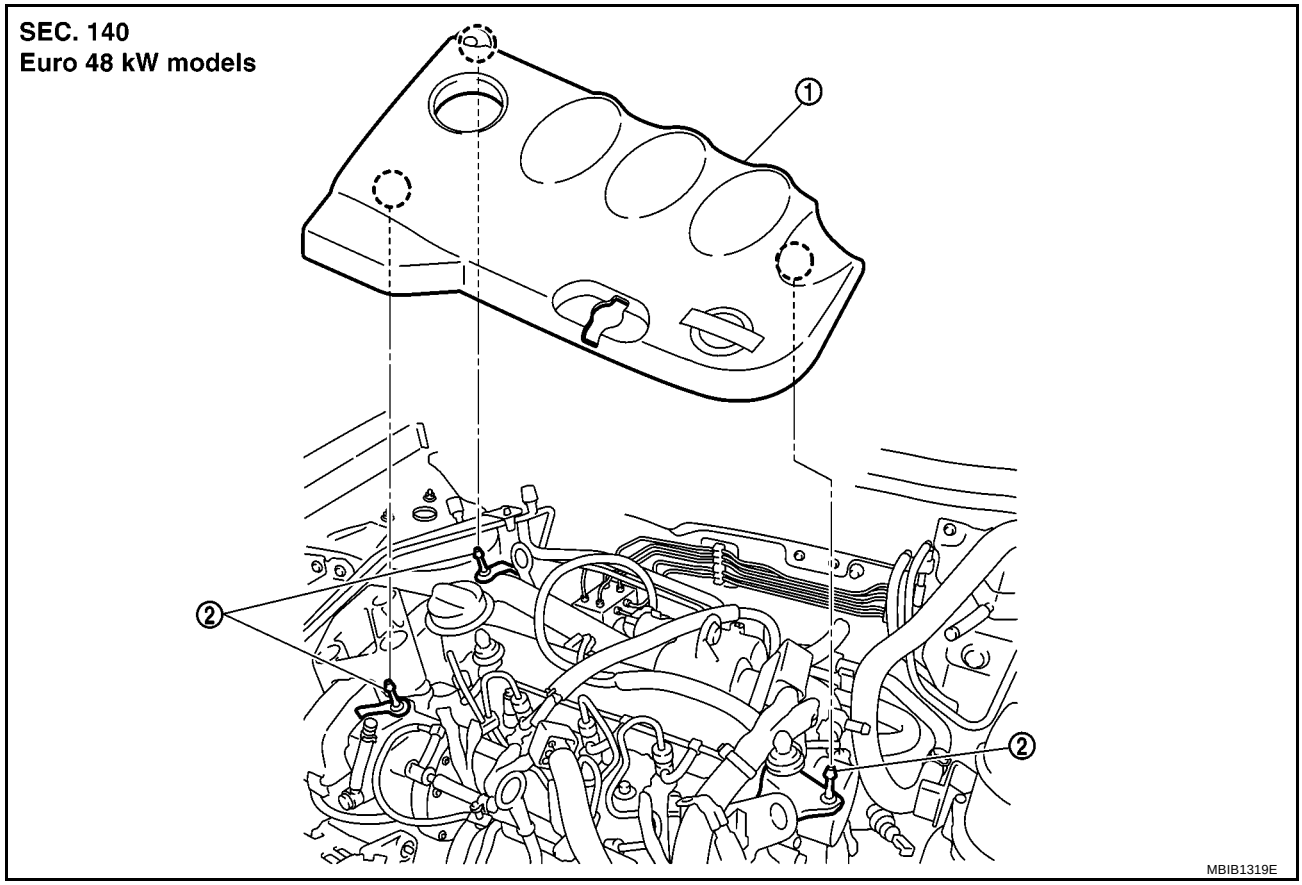
A: Closely related B: Related C: Sometimes related —: Not related

ENGINE ROOM COVER

PFP:14049

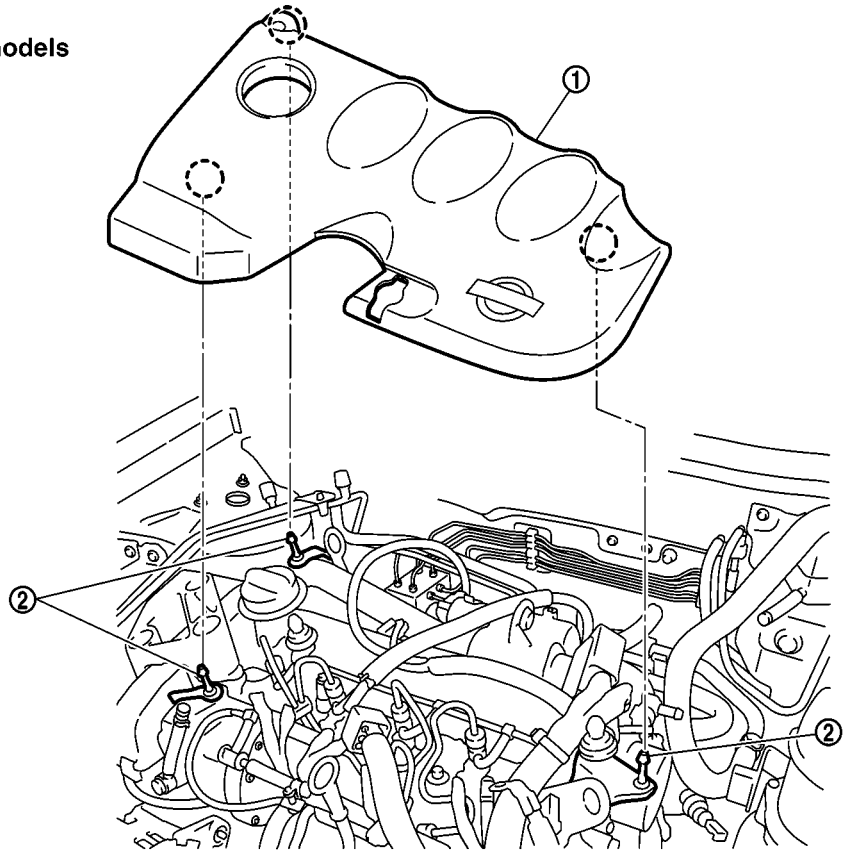
Removal and Installation

EBS01C6F



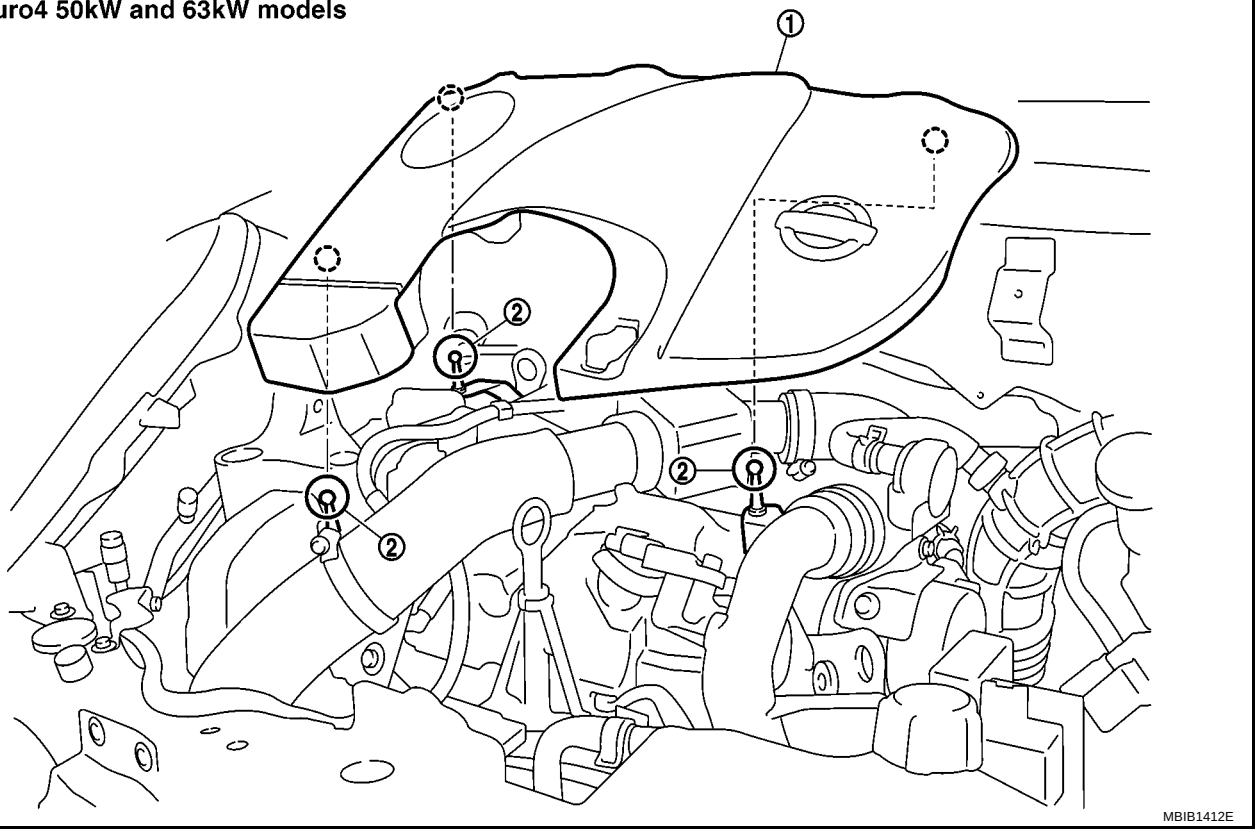
1. Engine room cover
2. Engine room cover bracket

SEC. 140
Euro 60 kW models



1. Engine room cover
2. Engine room cover bracket

SEC. 140
Euro4 50kW and 63kW models



1. Engine room cover
2. Engine room cover bracket

REMOVAL

- Remove engine room cover from engine room cover bracket.

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

INSTALLATION

- Install in the reverse order of removal.

NOTE:
Press engine room cover until hearing the “click”.

DRIVE BELTS

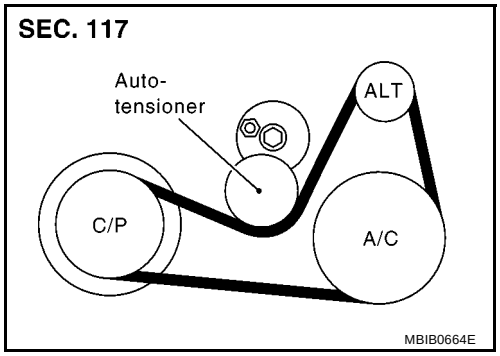
PFP:02117

Checking Drive Belts

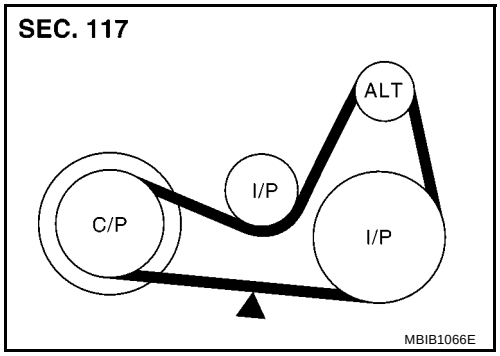
EBS01C6G

WARNING:
Be sure to perform when the engine is stopped.

1. Inspect belts for cracks, fraying, wear and oil. If necessary, replace.
2. Tighten auto-tensioner lock nut (models with A/C compressor) or idler pulley lock nut (models without A/C compressor) by hand and measure deflection or tension without looseness.



3. When measuring deflection, apply 98 N (10 kg, 22 lb) at the ▼ marked point as shown (models without A/C compressor).



Tension Adjustment

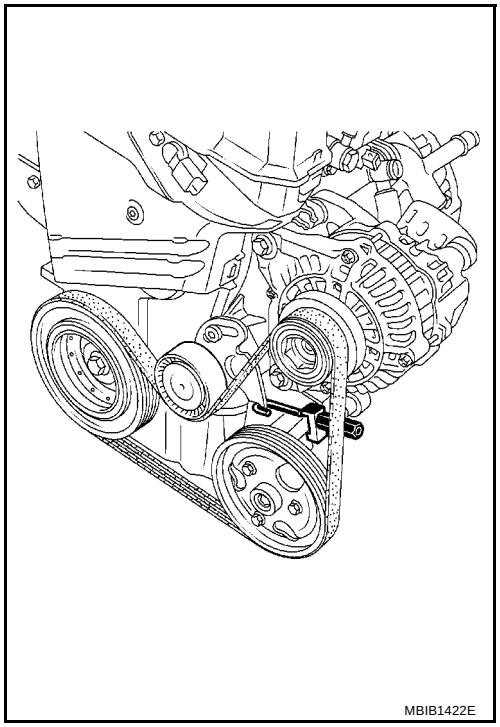
EBS01C6H

MODELS WITH A/C COMPRESSOR

Belt tensioning is not necessary, as it is automatically adjusted by auto-tensioner.

MODELS WITHOUT A/C COMPRESSOR

- Tighten the accessories belt using tool **(Mot. 1638)** by tightening the nut (both tension wheel mounting bolts are loosened).
- Check the belt tension using tools **(Mot. 1715)** and **(Mot. 1505)** .



Belt tightening method for adjustment	Adjusting bolt on idler pulley

- The tension value is 234±10 Hz.

NOTE:
The engine must be turned through two revolutions in order to position the belt correctly.

CAUTION:
- **When checking belt tension immediately after installation, first adjust it to the specified value. Then, after turning the crankshaft two turns or more, re-adjust to the specified value to avoid variation in deflection between pulleys.**
- **When installing belt, make sure that it is correctly engaged with pulley groove.**
- **Keep oil and water away from belt.**
- **Do not twist or bend belt excessively.**

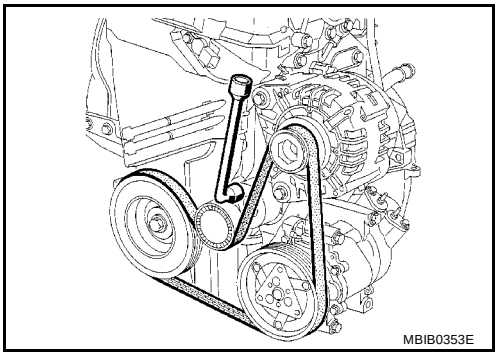
Removal and Installation

EBS01C6I

CAUTION:
- **Replace any belt that has been removed with a new one.**
- **Auto-tensioner and idle pulley must be replaced with a new one when the belt is replaced.**
- **Do not run the engine without the drive belts to avoid damaging the crankshaft pulley.**

REMOVAL

1. Remove engine undercover.
2. Remove RH front wheel.
3. Remove right side splash cover.
4. Remove RH head light assembly.
5. Remove drive belt.
   - Turn clockwise adjusting bolt.


MBIB0353E

6. If necessary, remove auto-tensioner (models with A/C compressor) or idler pulley (models without A/C compressor).

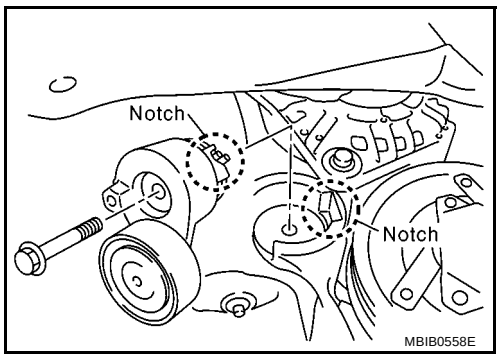
INSTALLATION

1. Install auto-tensioner mounting bolt (models with A/C compressor) or idler pulley mounting bolt (models without A/C compressor).

Auto-tensioner mounting bolt (models with A/C compressor) : **40 N·m (4.1 kg-m, 30 ft-lb)**

Idler pulley mounting bolt (models without A/C compressor) : **30 N·m (3.1 kg-m, 22 ft-lb)**

- The right figure is for example of models with A/C compressor. Align the notch and tighten mounting bolt.

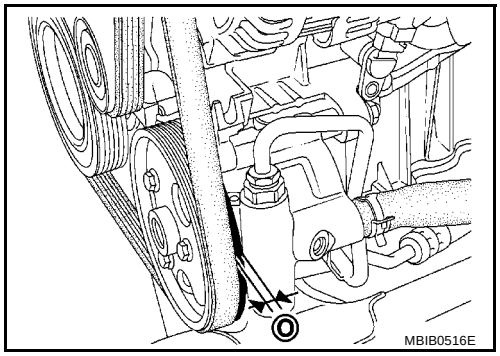


2. Install the drive belt.

CAUTION:

- **Make sure belt is correctly engaged with the pulley groove.**
- **Check for oil and coolant on belt and each pulley groove.**

NOTE:
The drive belt has five teeth as opposed to the pulleys which have six. It is therefore essential to ensure that tooth (O) remains free when installing the belt.



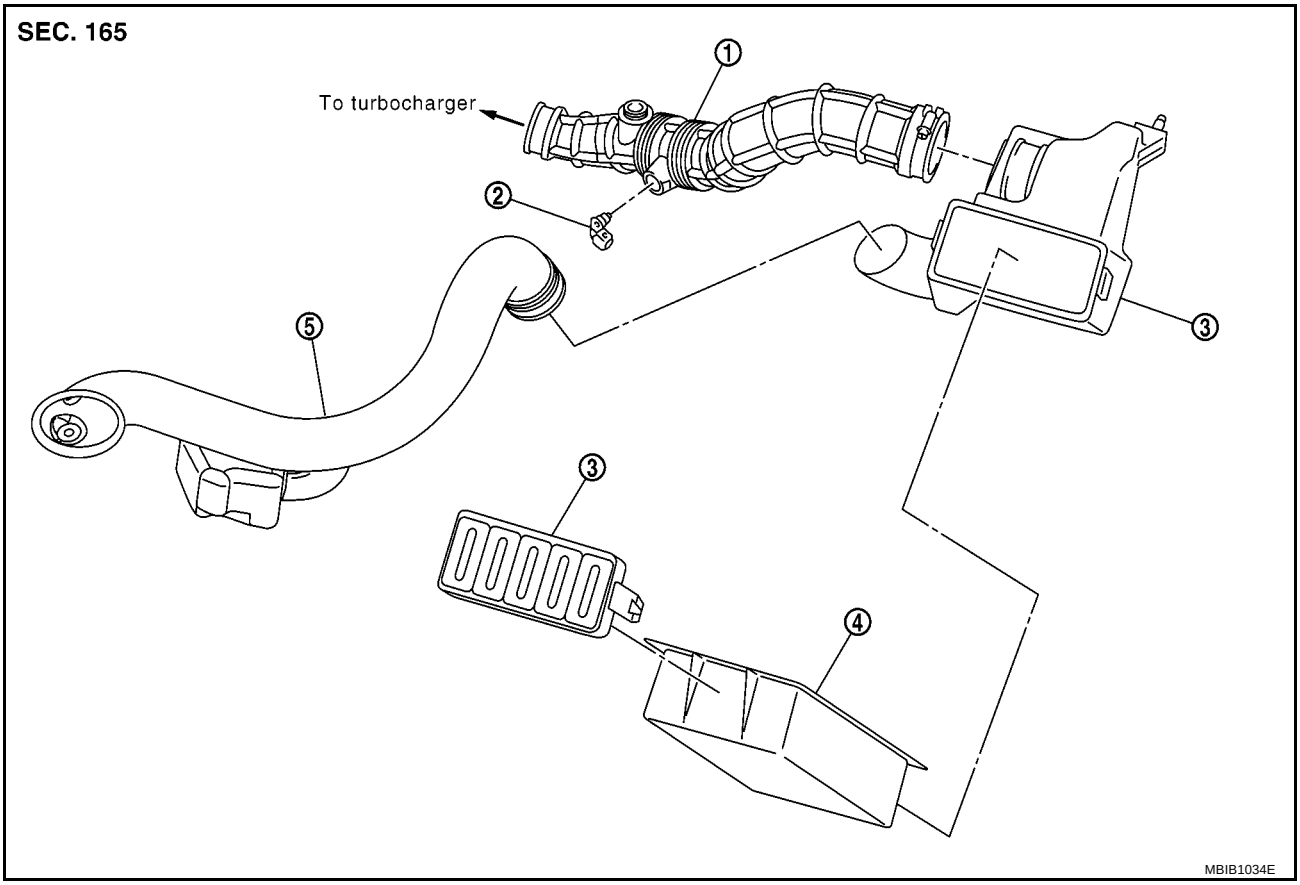
3. Adjust belt tension (models without A/C compressor). Refer to EM-244, "Tension Adjustment" .
4. Make sure that tension of each belt is within the standard.

AIR CLEANER AND AIR DUCT

PFP:16500

Removal and Installation (For Euro3 48kW/60kW)

EBS01C6J



1. Air duct (suction)
2. Intake air temperature sensor (Euro3 48kW engine models)
3. Air cleaner case
4. Air cleaner filter
5. Air duct (inlet)

REMOVAL

1. Disconnect battery ground cable.
2. Disconnect battery positive cable.
3. Remove engine room cover. Refer to EM-241, "ENGINE ROOM COVER" .
4. Remove air duct (suction) mounting clip and remove air duct (suction).
5. Remove battery.
6. Disconnect the harness connector from the temperature sensor. (Euro3 48kW engine models)
7. Remove air duct (inlet) by loosing clamp screw.
8. Remove temperature sensor from air duct (inlet). (Euro3 48kW engine models)
9. Remove air cleaner case by sliding the air cleaner case frontward.

CAUTION:

Handle temperature sensor with care.

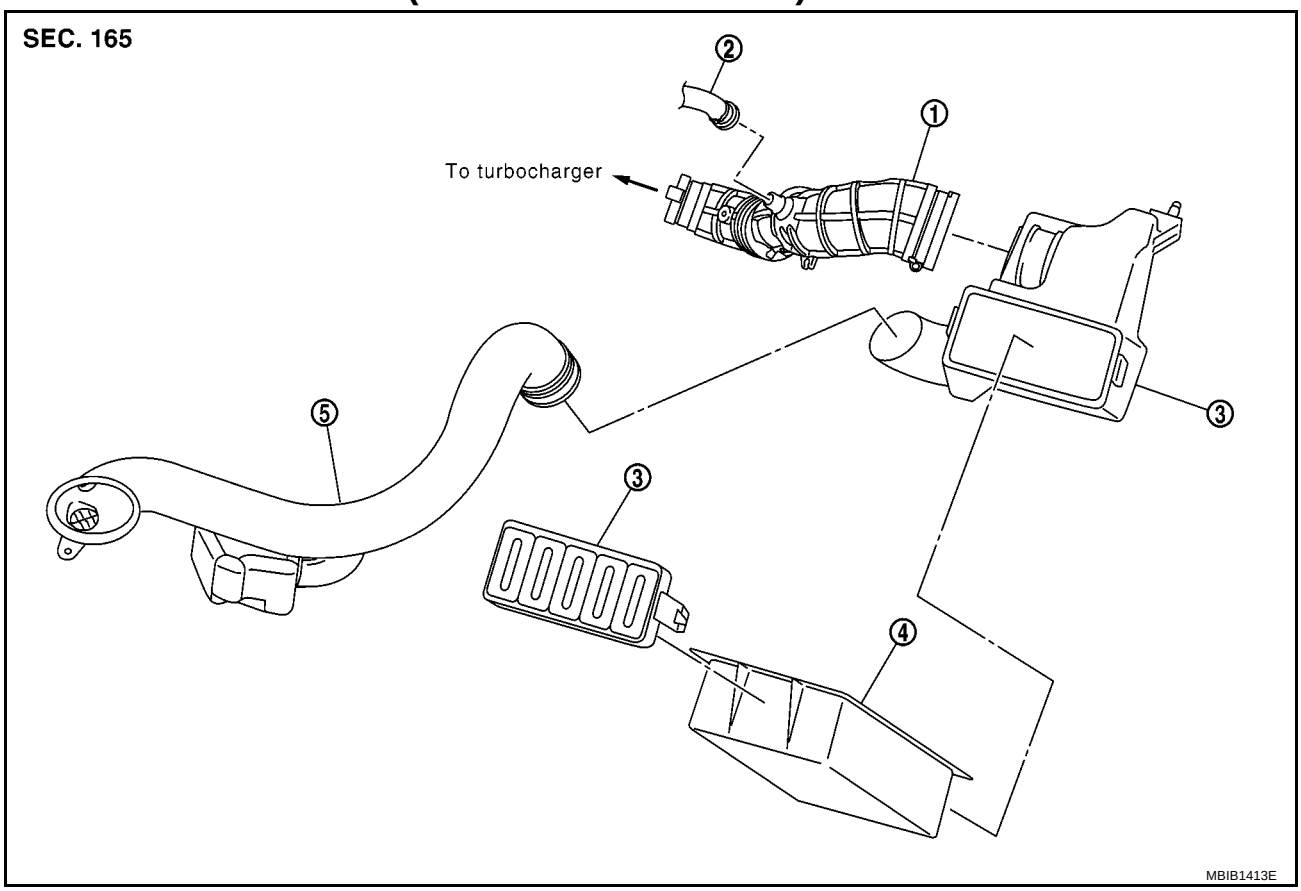
- **Do not shock it.**
- **Do not disassemble it.**
- **Do not touch its sensor.**

INSTALLATION

- Install in the reverse order of removal.

Removal and Installation (For Euro4 50kW/63kW)

EBS01LR2



1. Air duct (suction)
2. Blow-by hose
3. Air cleaner case
4. Air cleaner filter
5. Air duct (inlet)

REMOVAL

1. Disconnect battery ground cable.
2. Disconnect battery positive cable.
3. Remove engine room cover. Refer to EM-241, "ENGINE ROOM COVER" .
4. Disconnect blow-by hose.
5. Remove air duct (suction) mounting clip and remove air duct (suction).
6. Remove battery.
7. Remove air duct (inlet) by loosing clamp clip.
8. Remove air cleaner case by sliding the air cleaner case frontward.

   CAUTION:
   Slide the air cleaner case carefully so as not to damage it on the air cleaner case and harness bracket.

INSTALLATION

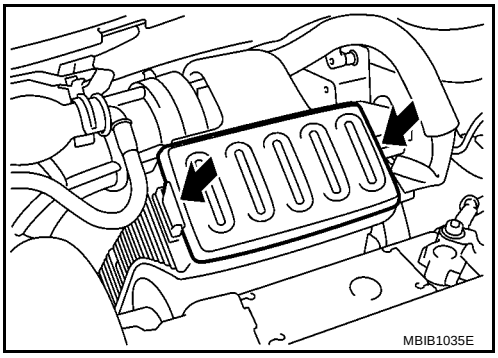
- Install in the reverse order of removal.

Changing Air Cleaner Filter

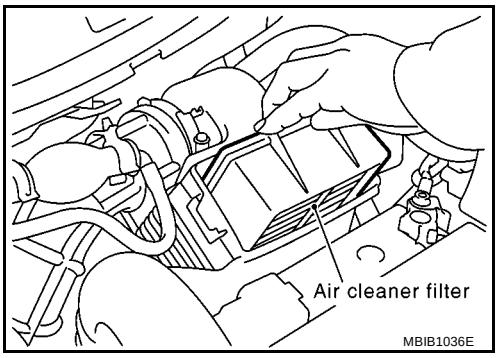
EBS01C6K

REMOVAL

1. Open air cleaner case.



2. Remove air cleaner filter.



INSTALLATION

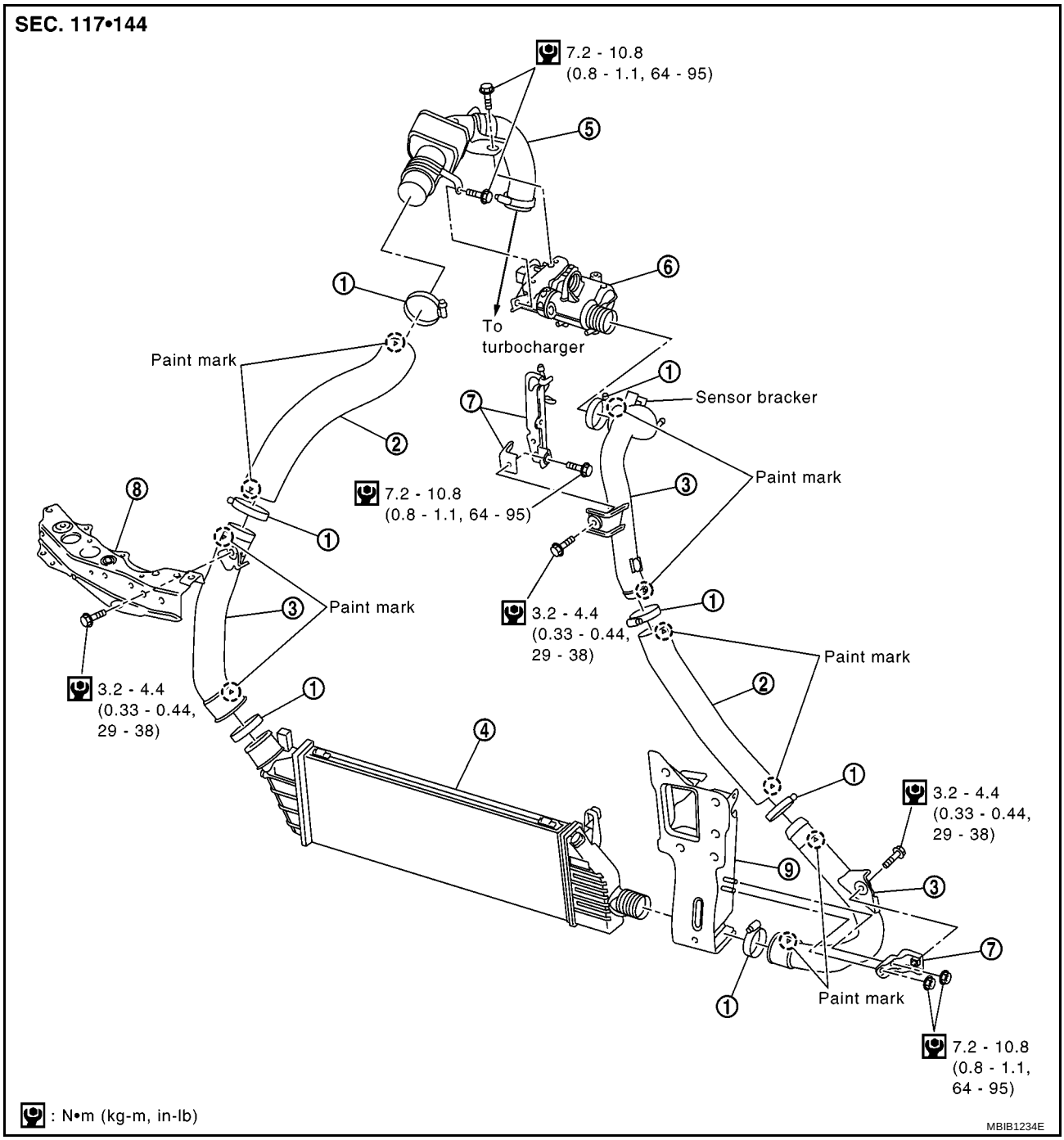
Install in the reverse order of removal.

CHARGE AIR COOLER

PFP:14461

Removal and Installation (For Euro3 48kW/60kW)

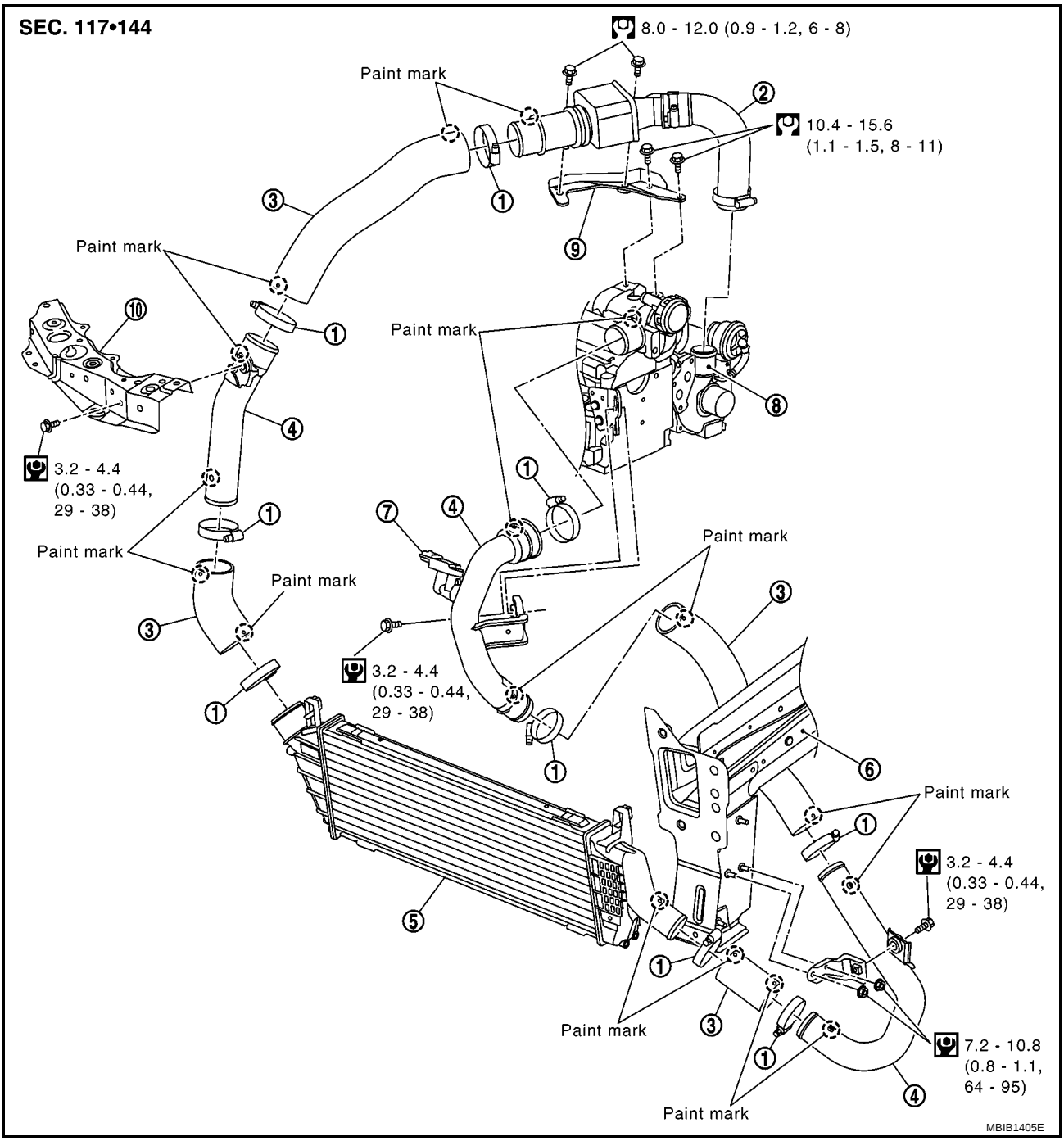
EBS01LR3



1. Hose clamp
2. Air inlet hose
3. Air inlet hose
4. Charge air cooler
5. Inlet pipe assembly
6. EGR control solenoid
7. Bracket
8. Radiator core support upper
9. Reinforcement

Removal and Installation (For Euro4 50kW)

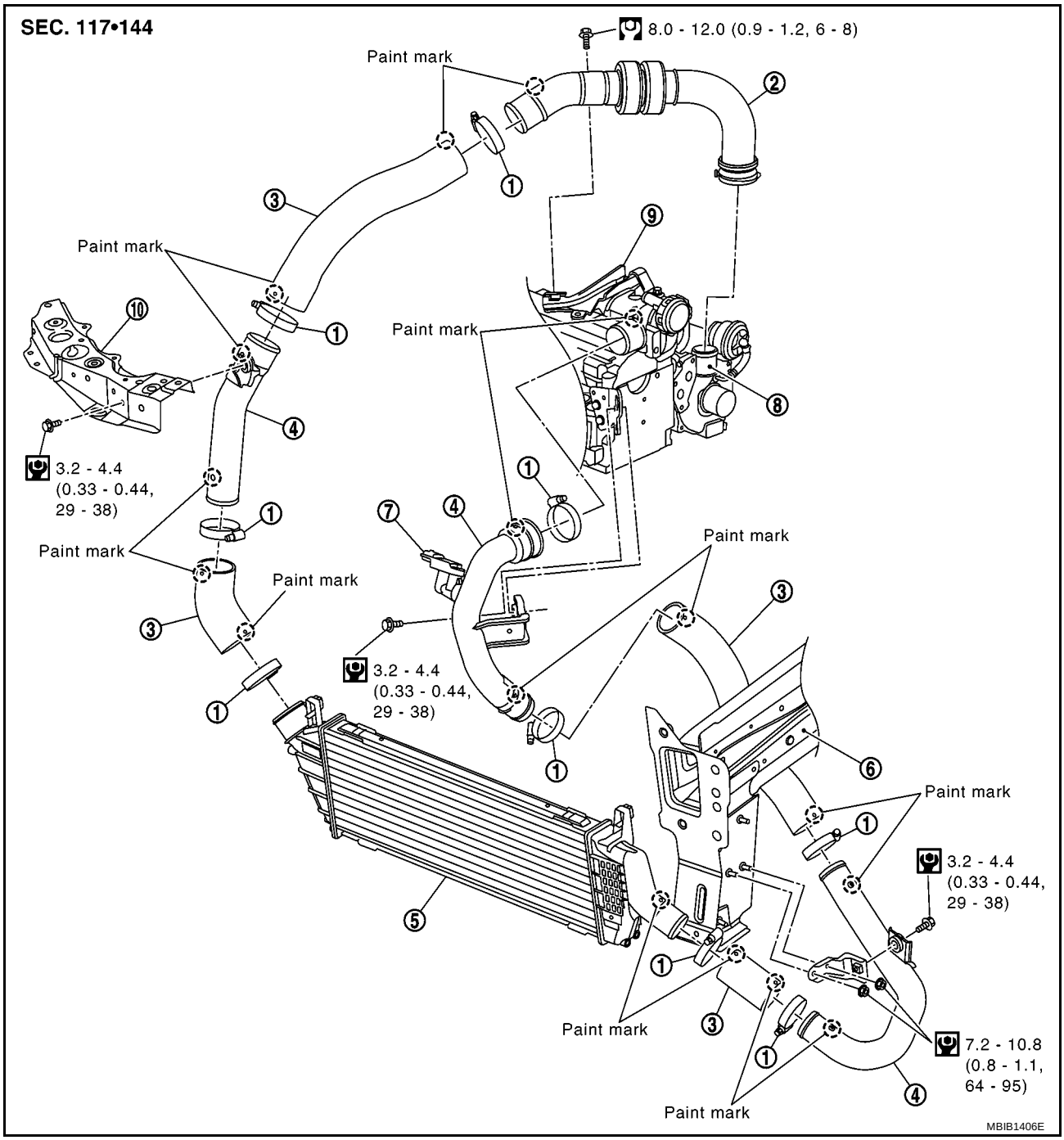
EBS01LPT



1. Hose clamp
2. Inlet pipe assembly
3. Air inlet hose
4. Air inlet tube
5. Charge air cooler
6. Front side member
7. Boost presser sensor
8. Tube charger
9. Air damper bracket
10. Radiator core

Removal and Installation (For Euro4 63kW)

EBS01C6L

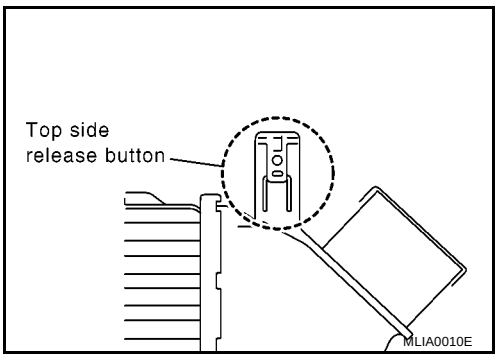


1. Hose clamp
2. Inlet pipe assembly
3. Air inlet hose
4. Air inlet tube
5. Charge air cooler
6. Front side member
7. Boost presser sensor
8. Tube charger
9. Air damper bracket
10. Radiator core

REMOVAL

1. Remove the front bumper. Refer to EI-5, "FRONT BUMPER" .
2. Remove the engine room cover.
3. Remove air inlet hose and tube between inlet pipe assembly and charge air cooler.

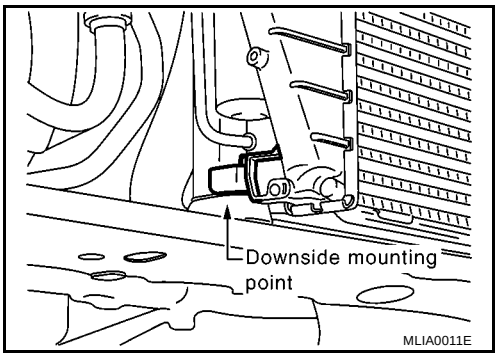
4. Push releases buttons on each topside of the charge air cooler and release it from downside mounting points.



5. Pull the charge air cooler to right side to disconnect it from the air inlet tube.

CAUTION:

- **Avoid interference between the charge air cooler and radiator.**
- **When removing charge air cooler, close opening on turbo charger and intake manifold with shop cloth or other suitable material.**



INSPECTION AFTER REMOVAL

1. Check that the charge air cooler is not full of oil. In that case, clean it with cleaning agent and then let it dry.
2. Check air passages of charge air cooler core and fins for clogging, leaks or deformation. Clean or replace charge air cooler in necessary.

- Be careful not to deform core fins.
- For cleaning procedure of charge air cooler core, refer to CO-68, "Checking Radiator" .

INSTALLATION

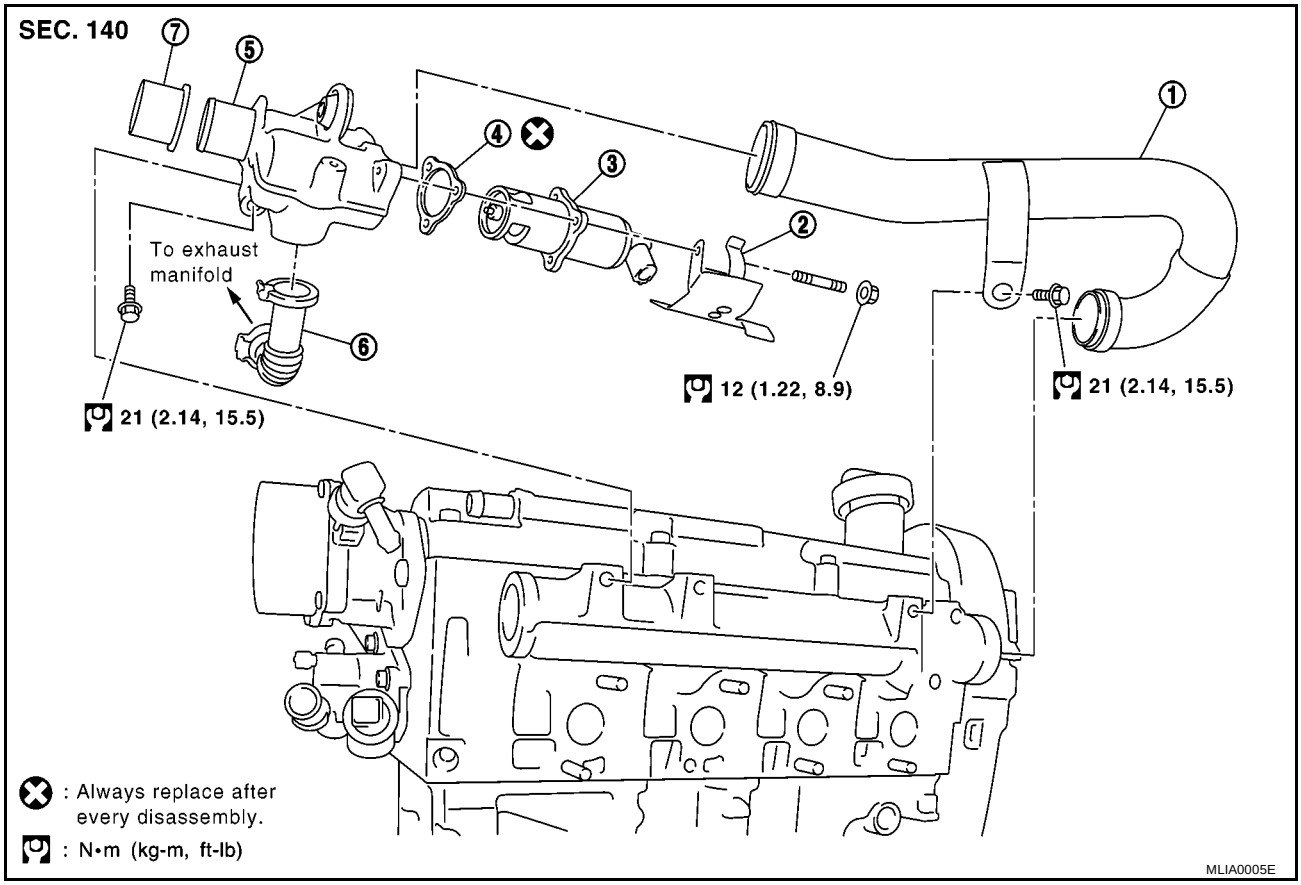
Apply a neutral detergent (fluid) to the joint between hoses and pipes (oil is not permissible).
Pay attention to identification mark and direction.
When installing air inlet hoses and tubes. Refer to EM-250, "CHARGE AIR COOLER" .

EGR UNIT

PFP:14710

Removal and Installation (For Euro3 48kW/60kW)

EBS01C6M

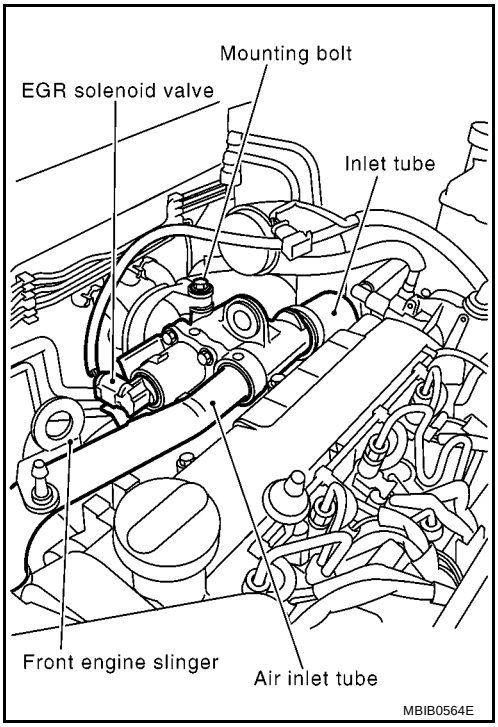


1. Air inlet tube
2. Heat insulator
3. EGR solenoid valve
4. Gasket
5. EGR unit housing
6. EGR tube
7. Joint

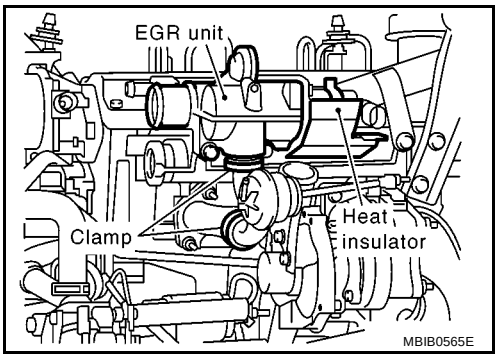
REMOVAL

1. Remove battery ground cable.
2. Remove engine room cover. Refer to EM-241, "ENGINE ROOM COVER" .
3. Remove air cleaner case and air duct (inlet). Refer to EM-247, "AIR CLEANER AND AIR DUCT" .
4. Remove wiper assembly.
5. Remove bulk head cover.

6. Disconnect EGR solenoid valve connector.
7. Remove mounting bolt.
8. Loosen turbocharger inlet tube.
9. Remove front engine slinger. Refer to EM-280, "ENGINE ASSEMBLY" .
10. Remove air inlet tube.



11. Remove heat insulator.
12. Remove EGR tube clamp.
13. Remove air duct assembly.
14. Remove EGR unit housing and EGR tube.

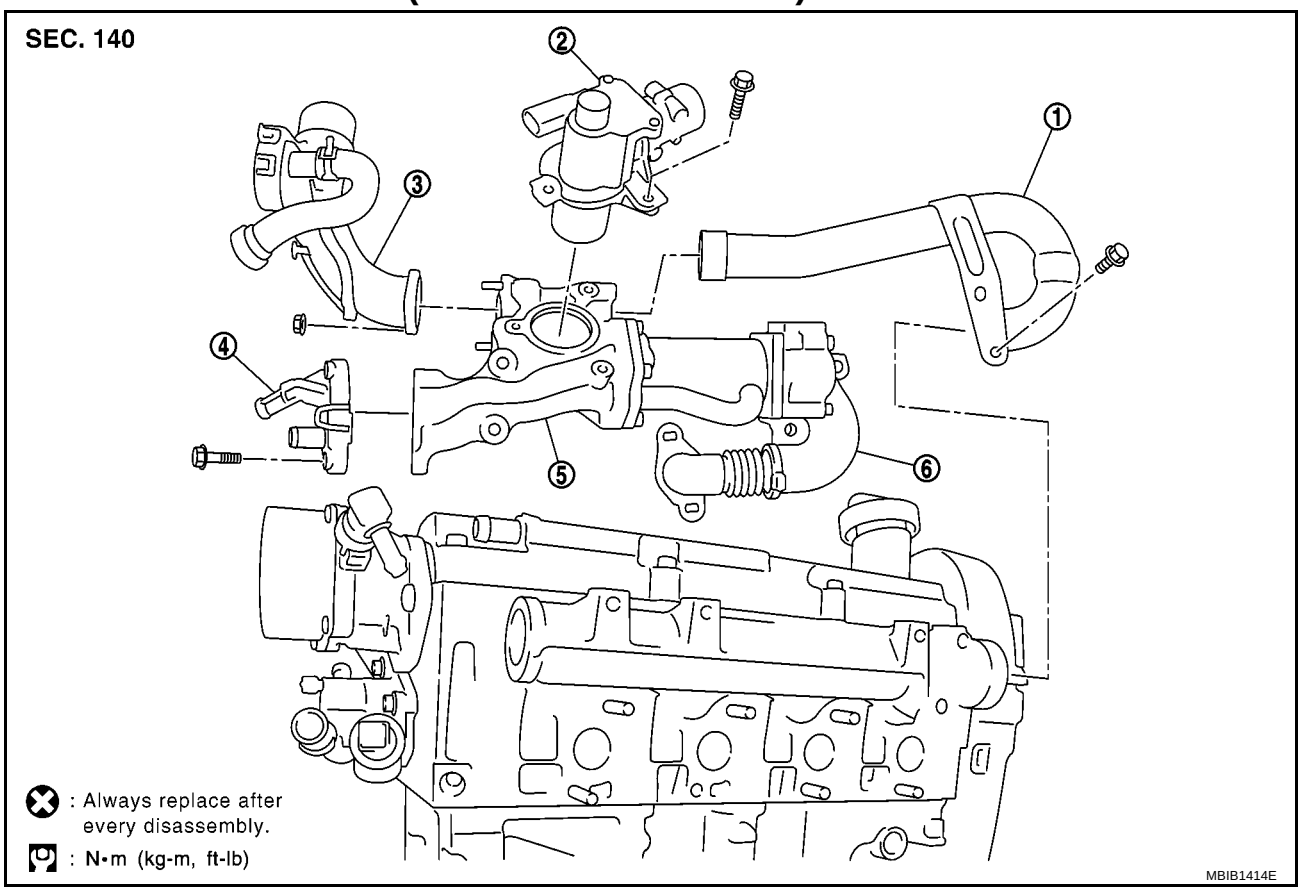


INSTALLATION

- Install in the reverse order of removal.

Removal and Installation (For Euro4 50kW/63kW)

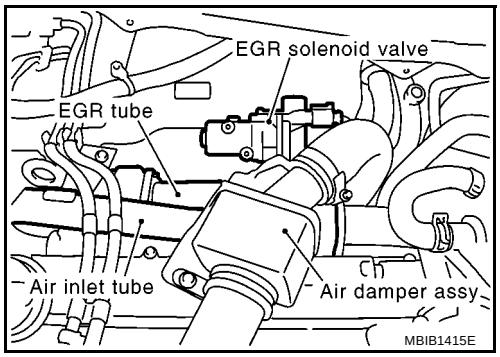
EBS01LR4



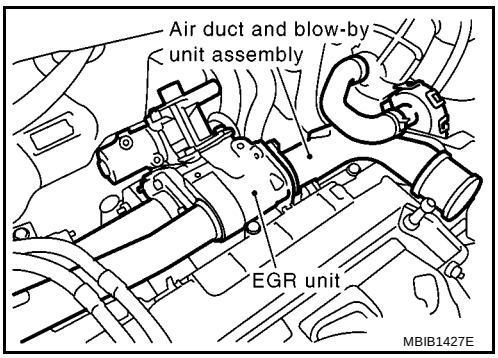
1. Air inlet tube
2. EGR solenoid valve
3. Air duct and blow-by unit assembly
4. Water port
5. EGR unit housing
6. EGR tube

REMOVAL

1. Remove battery ground cable.
2. Remove engine room cover. Refer to EM-241, "ENGINE ROOM COVER" .
3. Remove air cleaner case and air duct (inlet). Refer to EM-247, "AIR CLEANER AND AIR DUCT" .
4. Remove wiper assembly.
5. Remove bulk head cover.
6. Disconnect EGR solenoid valve connector.
7. Remove mounting bolts.
8. Drain engine coolant and water hose.
9. Loosen turbocharger inlet tube.
10. Remove front engine slinger. Refer to EM-280, "ENGINE ASSEMBLY" .
11. Remove air inlet tube.



12. Remove air duct and blow-by unit assembly.
13. Remove EGR tube mounting bolts.
14. Remove EGR unit housing and EGR tube.



INSTALLATION

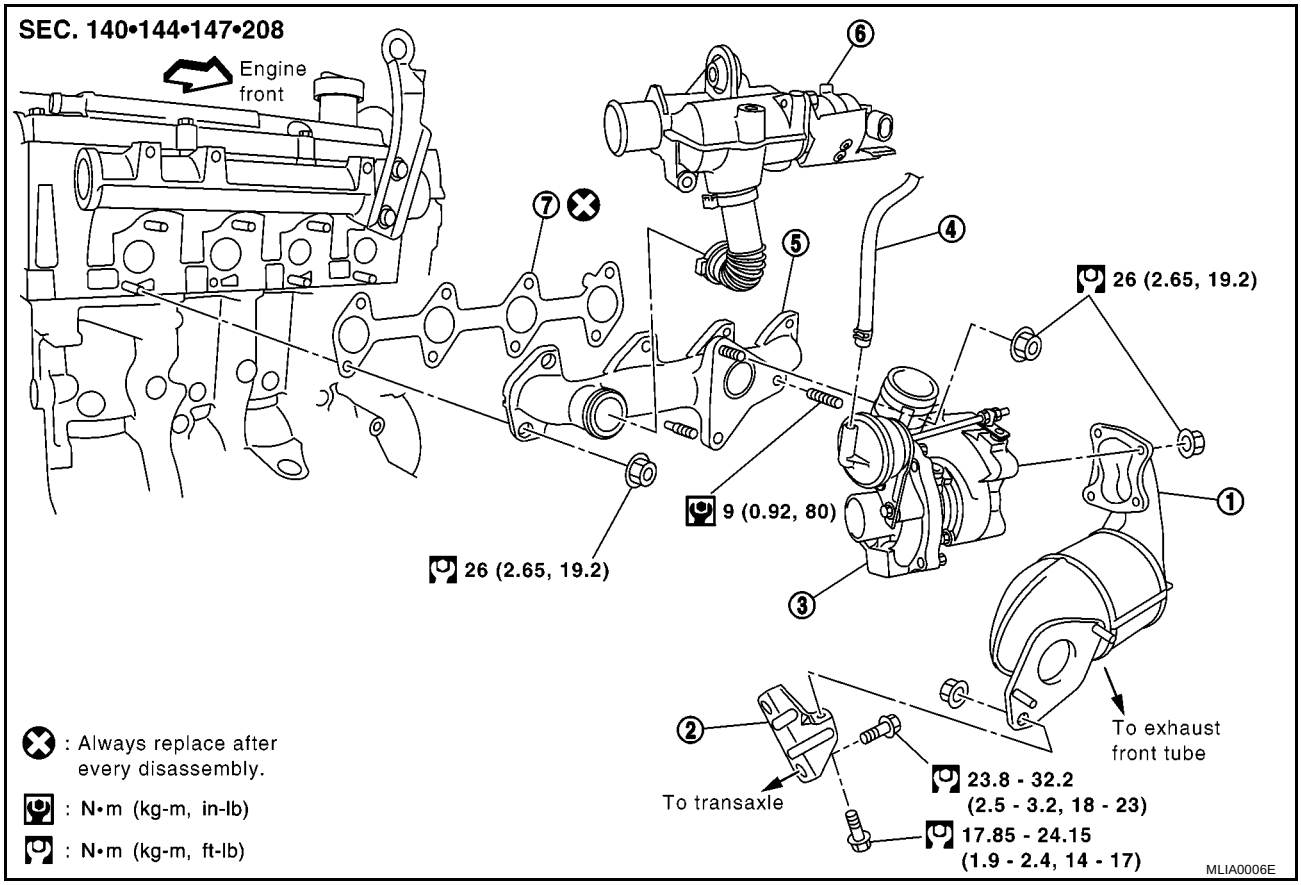
- Install in the reverse order of removal.

EXHAUST MANIFOLD, TURBOCHARGER, CATALYST

PFP:14004

Removal and Installation (For Euro3 48kW/60kW)

EBS01C6N



1. Catalyst
2. Bracket
3. Turbocharger assembly
4. Hose
5. Exhaust manifold
6. EGR unit
7. Gasket

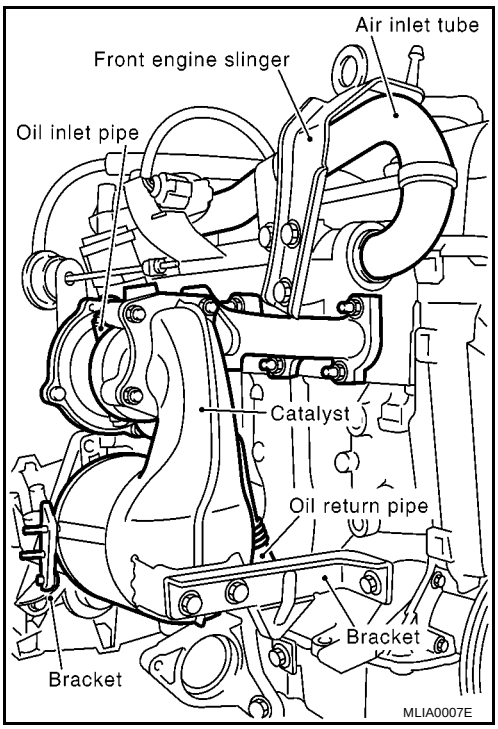
REMOVAL

1. Remove battery ground cable.
2. Remove engine undercover.
3. Remove air cleaner case and air duct (inlet). Refer to EM-247, "AIR CLEANER AND AIR DUCT" .
4. Remove wiper assembly.
5. Remove bulk head cover.
6. Remove EGR unit assembly. Refer to EM-254, "EGR UNIT" .
7. Remove turbocharger assembly as follows:

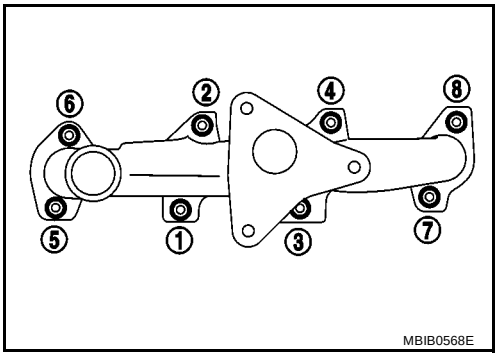
a. Remove catalyst mounting bolts and brackets.
b. Remove exhaust front tube. Refer to EX-4, "Removal and Installation" .

CAUTION:
Temporarily fix on vehicle side with rope or so to avoid putting stress on exhaust center tube.

c. Remove catalyst.



8. Each wiring and piping (disconnect/move).
9. Loosen exhaust manifold mounting nuts in the reverse order as shown.

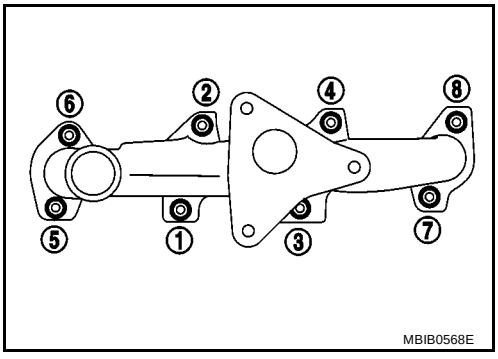


10. Rotate the exhaust manifold and turbocharger assembly so that the rear side (EGR tube mounting side) faces upward. And then pull out the assembly from between the engine and the air conditioning piping.

CAUTION:
Be careful not to deform each turbocharger piping when pulling out the assembly.

INSTALLATION

1. Tighten the mounting nuts in numerical order as shown.



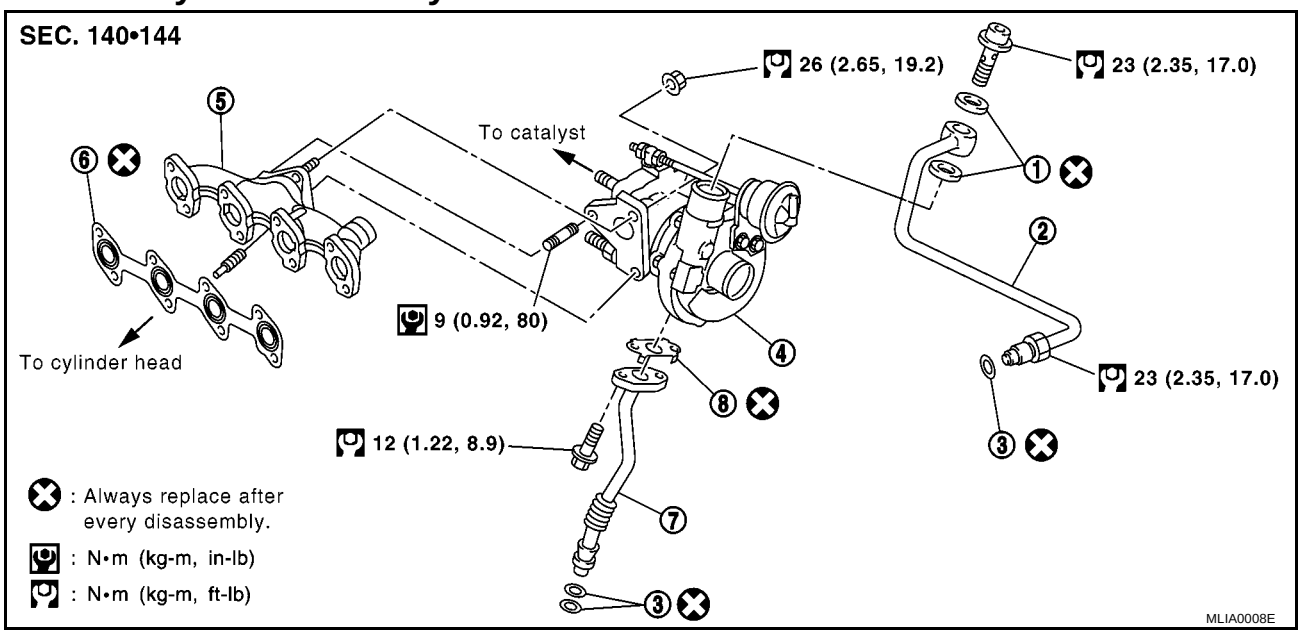
2. Install in reverse order of removal after this step.

INSPECTION AFTER INSTALLATION

Start engine and raise engine speed to check no exhaust emission leaks.

Disassembly and Assembly

EBS01C6O



1. Washer
2. Oil tube
3. O-ring
4. Turbocharger
5. Exhaust manifold
6. Gasket
7. Turbocharger oil outlet pipe
8. Gasket

DISASSEMBLY

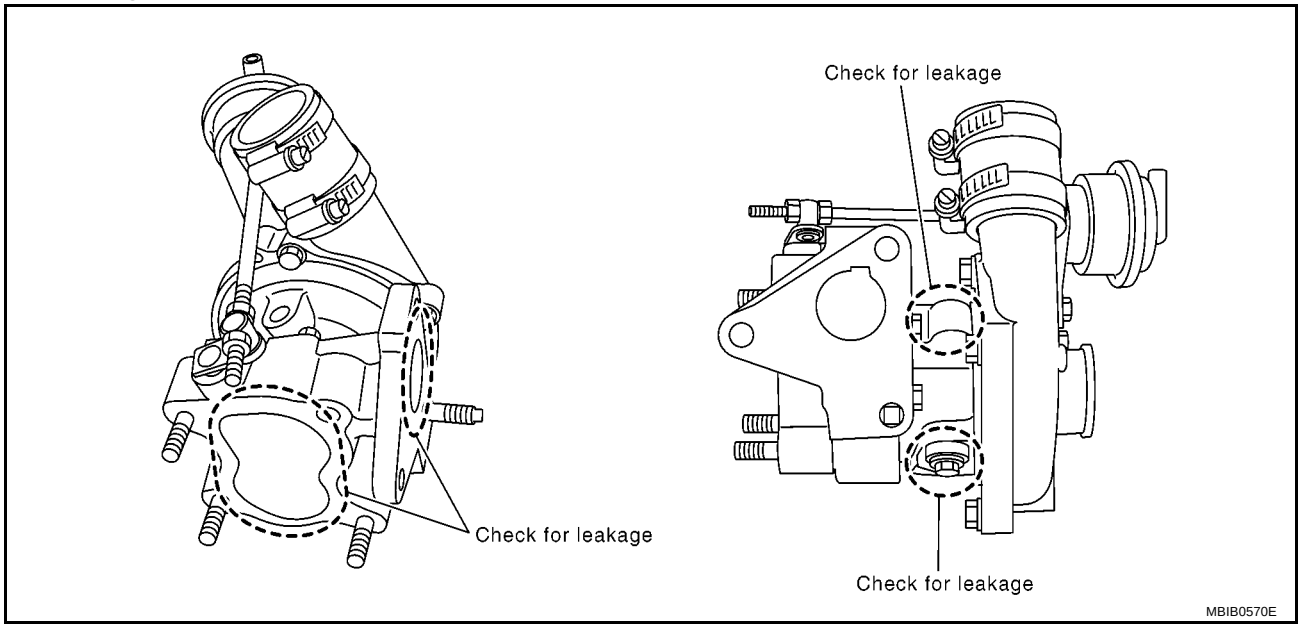
- After applying penetrative lubricant to the mounting nuts, check for the penetration of the lubricant, and then loosen the nuts to remove.

CAUTION:

Do not disassemble or adjust the turbocharger body.

INSPECTION AFTER DISASSEMBLY

Turbocharger



CAUTION:

When the compressor wheel turbine wheel or rotor shaft is damaged, remove all the fragments and foreign matter left in the following passages in order to prevent a secondary failure:

Suction side : Between turbocharger and air cleaner

Exhaust side : Between turbocharger and catalyst

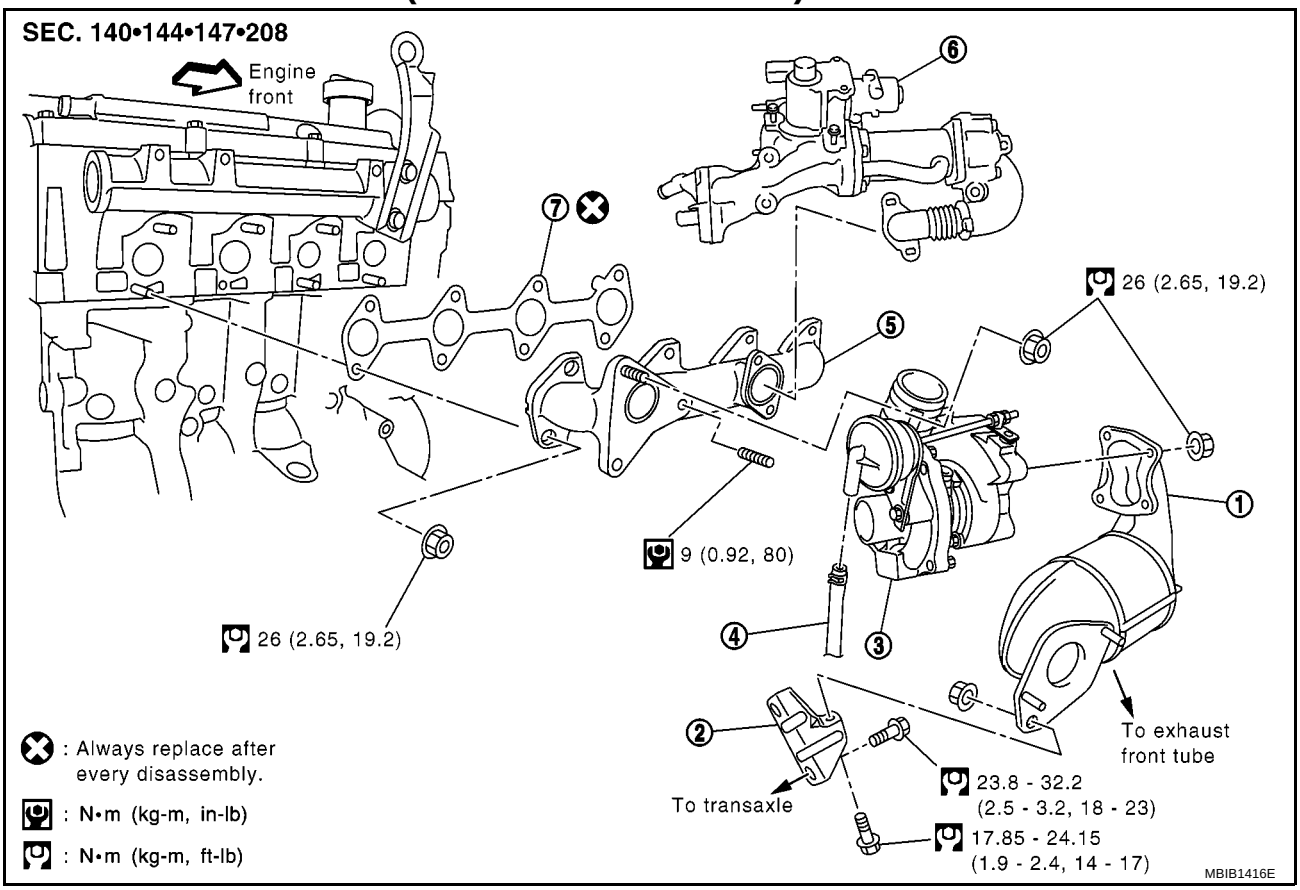
ASSEMBLY

- Install in the reverse order of removal.

NOTE:
Apply LOCTITE FRENETANCH or equivalent to the threads of the turbocharger oil inlet pipe union to the cylinder head.

Removal and Installation (For Euro4 50kW/63kW)

EBS01LR5



1. Catalyst
2. Bracket
3. Turbocharger assembly
4. Hose
5. Exhaust manifold
6. EGR unit
7. Gasket

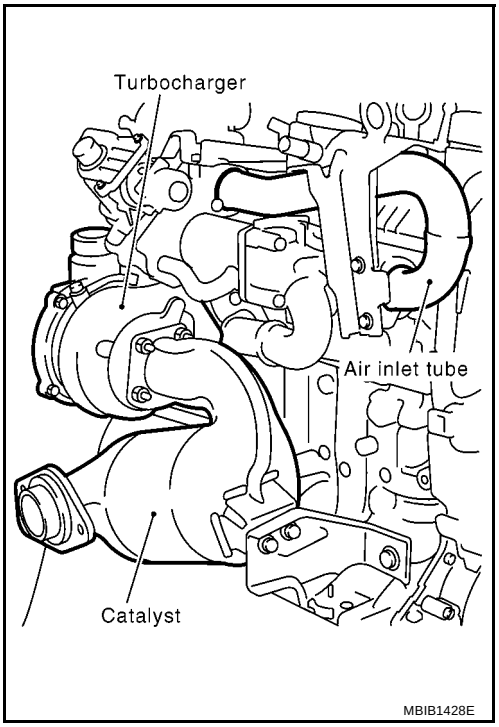
REMOVAL

1. Remove battery ground cable.
2. Remove engine undercover.
3. Remove air cleaner case and air duct (inlet). Refer to EM-247, "AIR CLEANER AND AIR DUCT" .
4. Remove wiper assembly.
5. Remove bulk head cover.
6. Remove EGR unit assembly. Refer to EM-254, "EGR UNIT" .
7. Remove turbocharger assembly as follows:

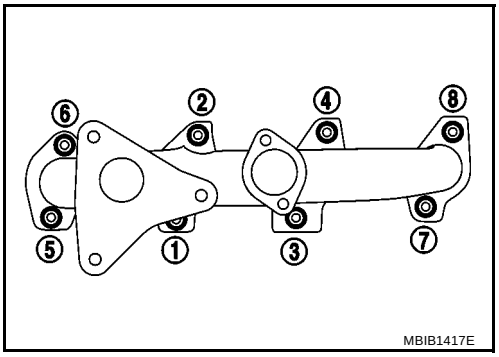
a. Remove catalyst mounting bolts and brackets.
b. Remove exhaust front tube. Refer to EX-4, "Removal and Installation" .

CAUTION:
Temporarily fix on vehicle side with rope or so to avoid putting stress on exhaust center tube.

c. Remove catalyst.



8. Each wiring and piping (disconnect/move).
9. Loosen exhaust manifold mounting nuts in the reverse order as shown.

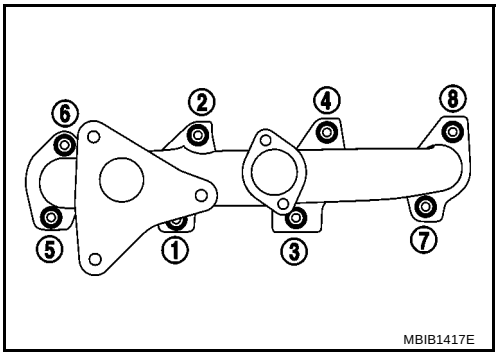


10. Rotate the exhaust manifold and turbocharger assembly so that the rear side (EGR tube mounting side) faces upward. And then pull out the assembly from between the engine and the air conditioning piping.

CAUTION:
Be careful not to deform each turbocharger piping when pulling out the assembly.

INSTALLATION

1. Tighten the mounting nuts in numerical order as shown.



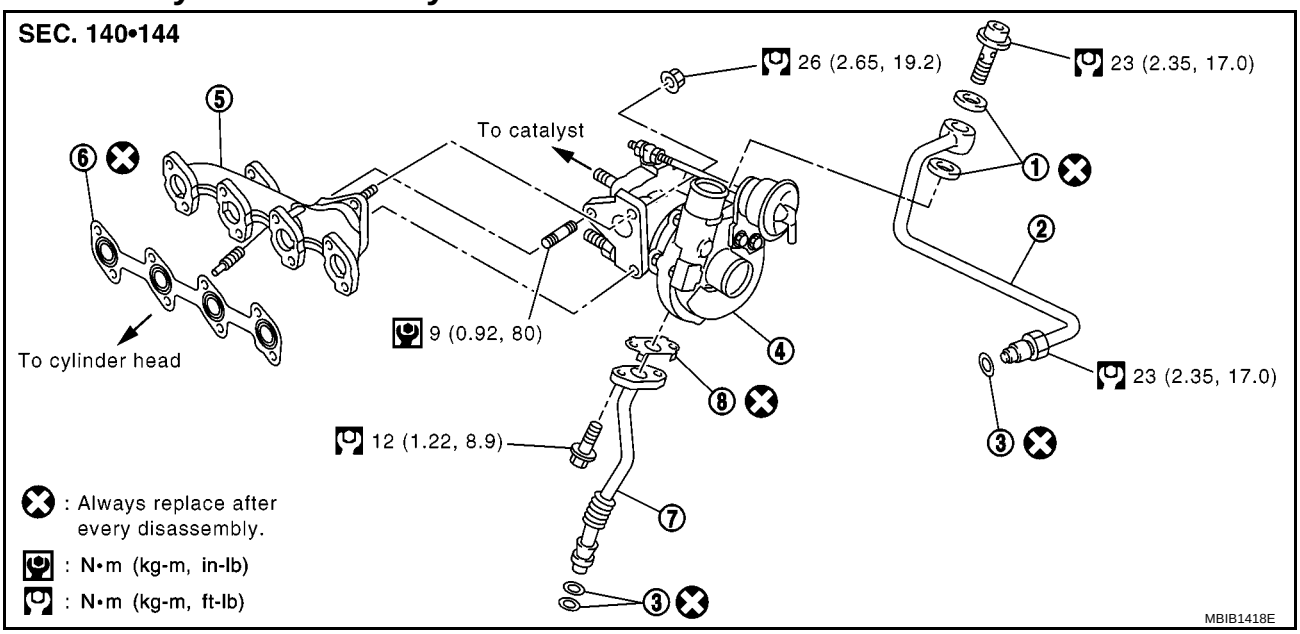
2. Install in reverse order of removal after this step.

INSPECTION AFTER INSTALLATION

Start engine and raise engine speed to check no exhaust emission leaks.

Disassembly and Assembly

EBS01LR6



1. Washer
2. Oil tube
3. O-ring
4. Turbocharger
5. Exhaust manifold
6. Gasket
7. Turbocharger oil outlet pipe
8. Gasket

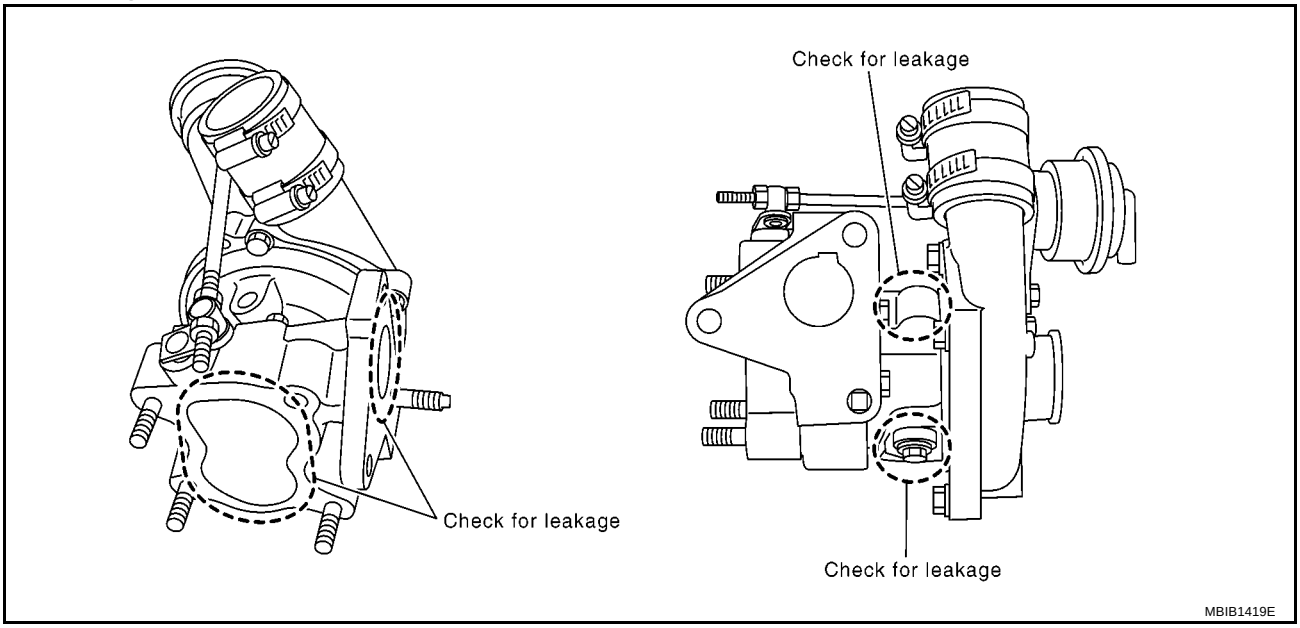
DISASSEMBLY

- After applying penetrative lubricant to the mounting nuts, check for the penetration of the lubricant, and then loosen the nuts to remove.

CAUTION:
Do not disassemble or adjust the turbocharger body.

INSPECTION AFTER DISASSEMBLY

Turbocharger



CAUTION:
When the compressor wheel turbine wheel or rotor shaft is damaged, remove all the fragments and foreign matter left in the following passages in order to prevent a secondary failure:

Suction side : Between turbocharger and air cleaner
Exhaust side : Between turbocharger and catalyst

ASSEMBLY

- Install in the reverse order of removal.

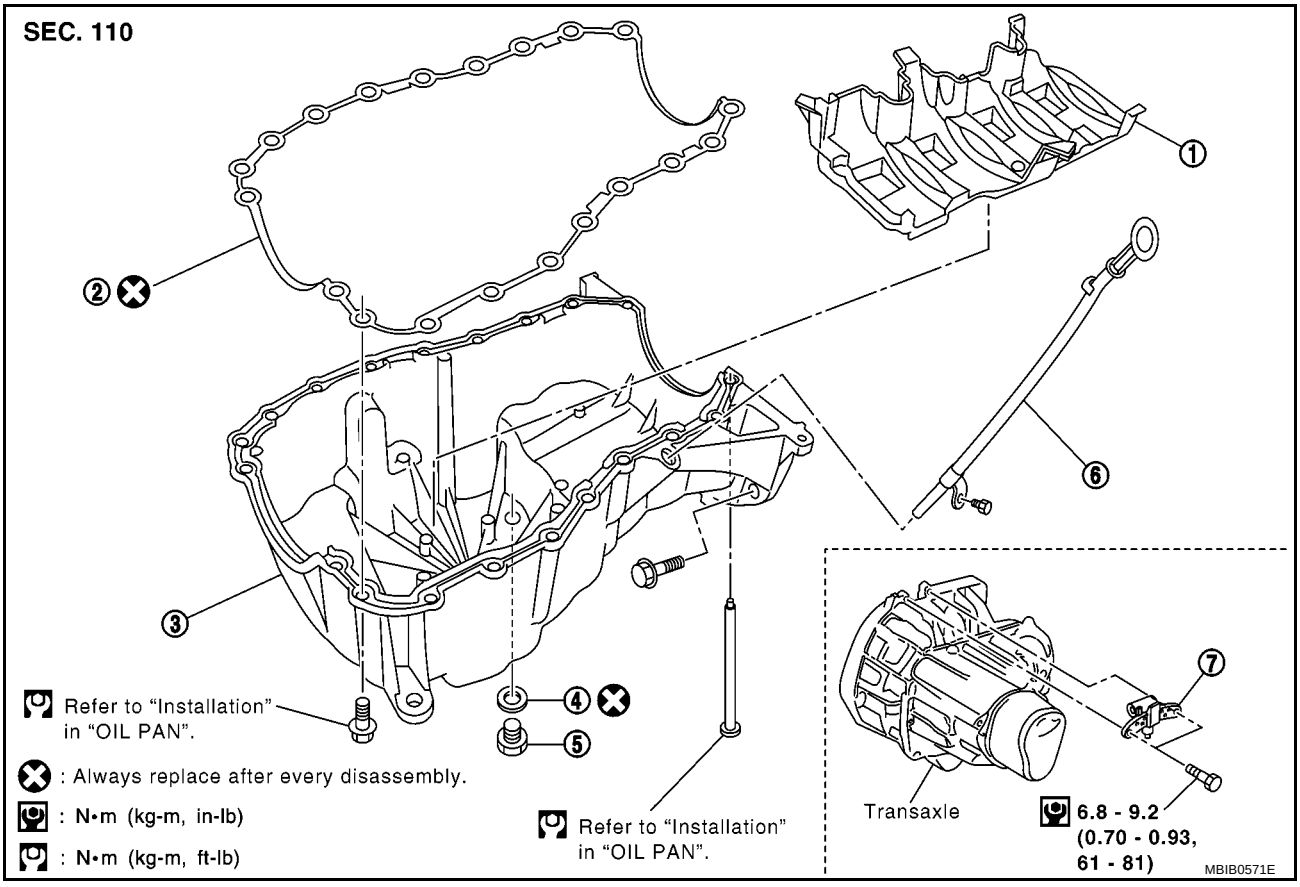
NOTE:
Apply LOCTITE FRENETANCH or equivalent to the threads of the turbocharger oil inlet pipe union to the cylinder head.

OIL PAN

PFP:11110

Removal and Installation

EBS01C6P



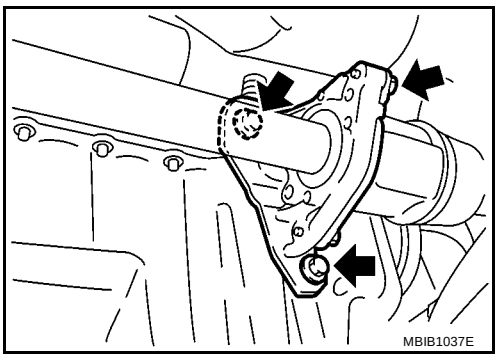
1. Baffle plate
2. Gasket
3. Oil pan
4. O-ring
5. Drain plug
6. Oil level gauge
7. Crankshaft position sensor (POS)

CAUTION:

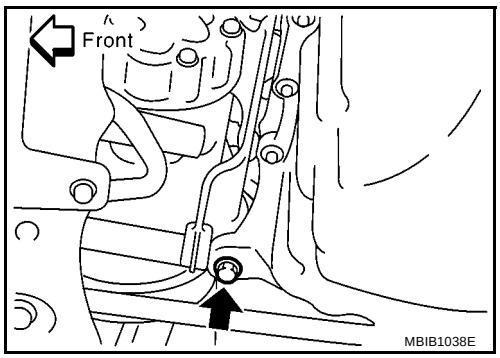
To avoid the danger of being scalded, never drain the engine oil when the engine is hot.

REMOVAL

1. Remove engine undercover.
2. Remove RH front wheel.
3. Remove right side splash cover.
4. Remove drive shaft assembly RH side. Refer to FAX-10, "FRONT DRIVE SHAFT" .
5. Remove center bearing bracket as shown.



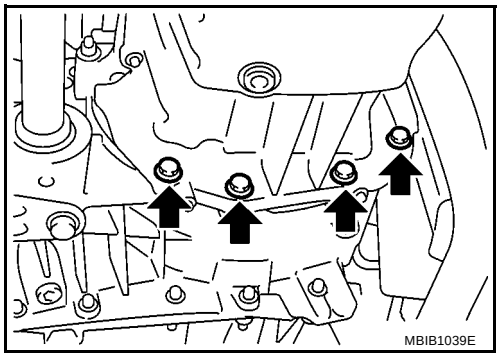
6. Remove A/C compressor bracket mounting bolt as shown.



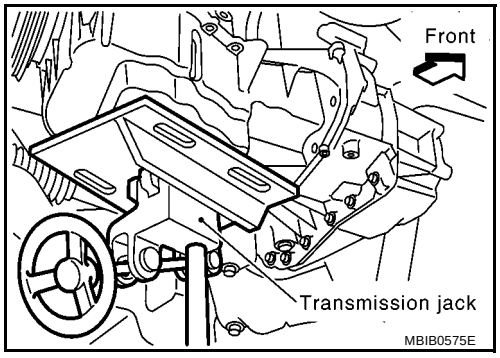
7. Remove oil level gauge guide.
8. Drain engine oil. Refer to LU-25, "Changing Engine Oil" .

CAUTION:
Perform when engine is cold.

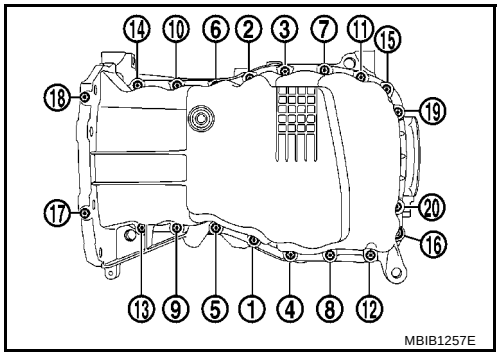
9. Remove oil pan and transaxle joint bolts.



10. Support the engine bottom of the oil pan with a transmission jack etc.

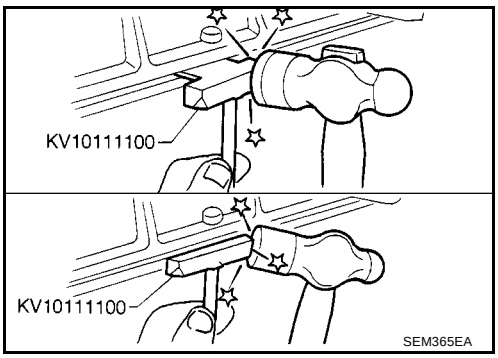


11. Remove oil pan bolt reverse order as shown.



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

CAUTION:
Exercise care not to damage mating surface.



12. Remove oil pan and baffle plate.

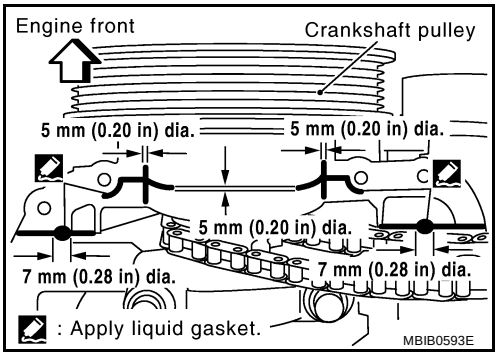
INSPECTION AFTER REMOVAL

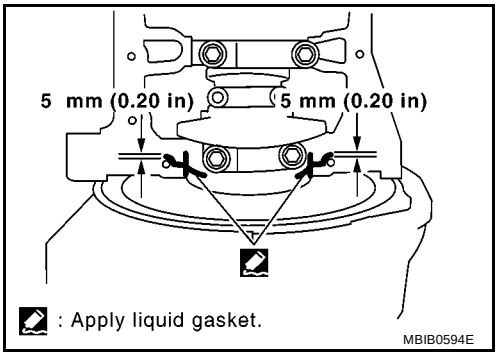
Clean oil pump assembly if any object attached.

INSTALLATION

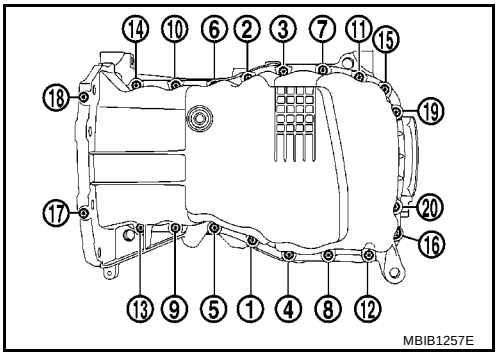
- Install in the reverse order of removal paying attention to the following.

1. Apply liquid gasket as shown.
   - Use Genuine Liquid Gasket or equivalent.





2. Install baffle plate.
3. Install oil pan bolts in numerical order as shown.
   - Tighten the bolts in the numerical order shown in the figure to a torque of 8 N·m (0.8 kg-m, 71 in-lb).
   - Tighten the mounting bolts of oil pan on the clutch housing without locking.
   - Tighten the bolts in the numerical order shown in the figure to a torque of 15 N·m (1.5 kg-m, 11 ft-lb).
   - Tighten the mounting bolts of oil pan on the clutch housing to a torque of 44 N·m (4.5 kg-m, 32 ft-lb).
4. At least 30 minutes after oil pan is installed, pour engine oil.



INSPECTION AFTER INSTALLATION

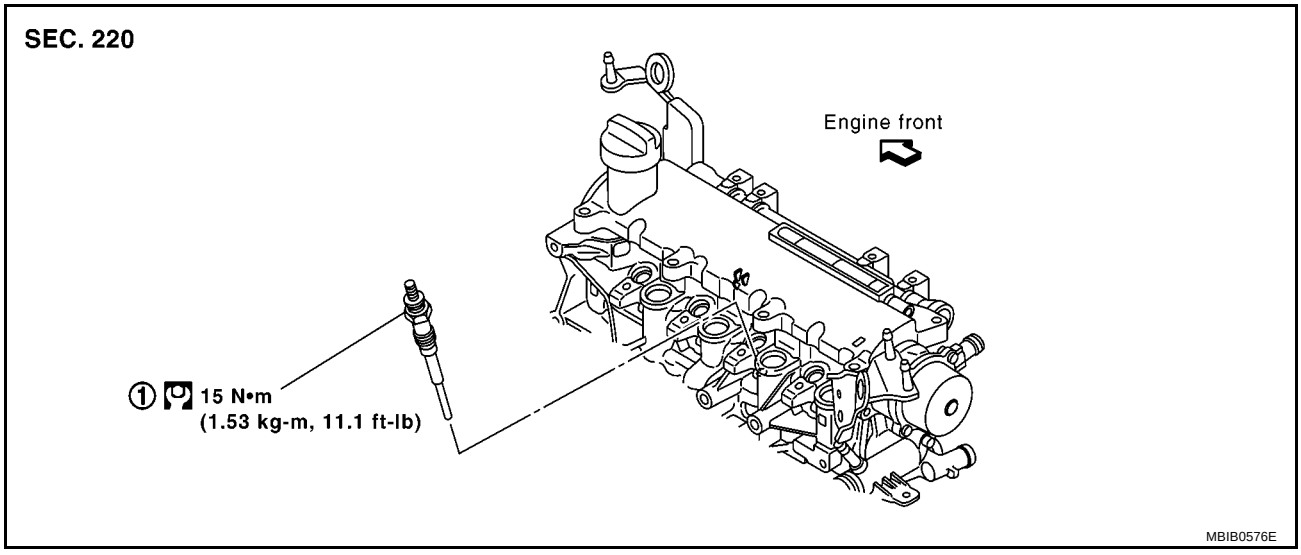
- Inspection the engine oil level. Refer to LU-24, "ENGINE OIL" .
- Start the engine, and make sure there is no leak of engine oil. Refer to LU-24, "ENGINE OIL" .

GLOW PLUG

PFP:22401

Removal and Installation

EBS01C6Q



1. Glow plug

REMOVAL

CAUTION:

Remove glow plug only if necessary. If carbon adheres, it may be stuck and broken.

1. Disconnect battery ground cable.
2. Remove engine room cover. Refer to EM-241, "ENGINE ROOM COVER" .
3. Disconnect harness connector from glow plug.
4. Remove glow plug.

CAUTION:

- **When removing or installing, do not use such tools as an air impact wrench.**
- **Handle it carefully without giving any impact, even after removal. [As a guide, if it drops from height of 10 cm (3.94 in) or higher, always replace it.]**

INSTALLATION

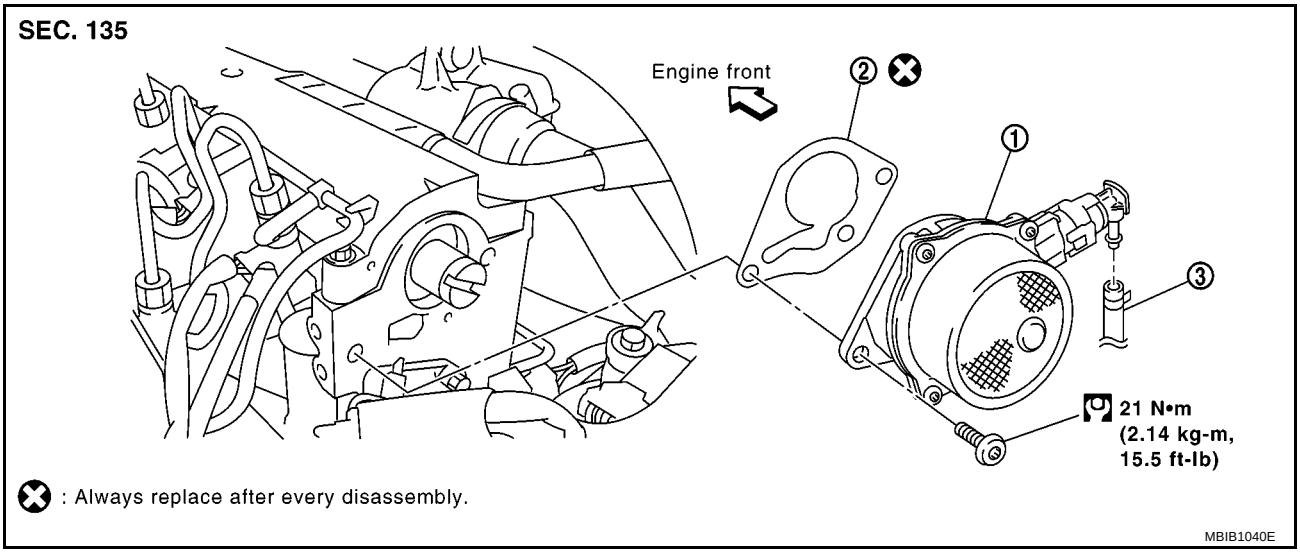
1. Remove adhered carbon from glow plug installation hole with a reamer.
2. Install glow plug.
3. Install remaining parts in reverse order of removal.

VACUUM PUMP

PFP:41920

Removal and Installation (For Euro3 48kW/60kW)

EBS01C6R



1. Vacuum pump
2. Gasket
3. Vacuum hose

INSPECTION BEFORE REMOVAL

1. Disconnect vacuum hose, and connect a vacuum gauge via 3-way connector.
   - Disconnect point where vacuum from vacuum pump can be measured directly and install 3-way connector.
2. Start engine and measure generated vacuum at idle speed.

Standard **: – 86.6 to – 101.3 kPa (– 866 to – 1,013 mbar, – 650 to – 760 mmHg, – 25.59 to – 29.92 inHg)**

REMOVAL

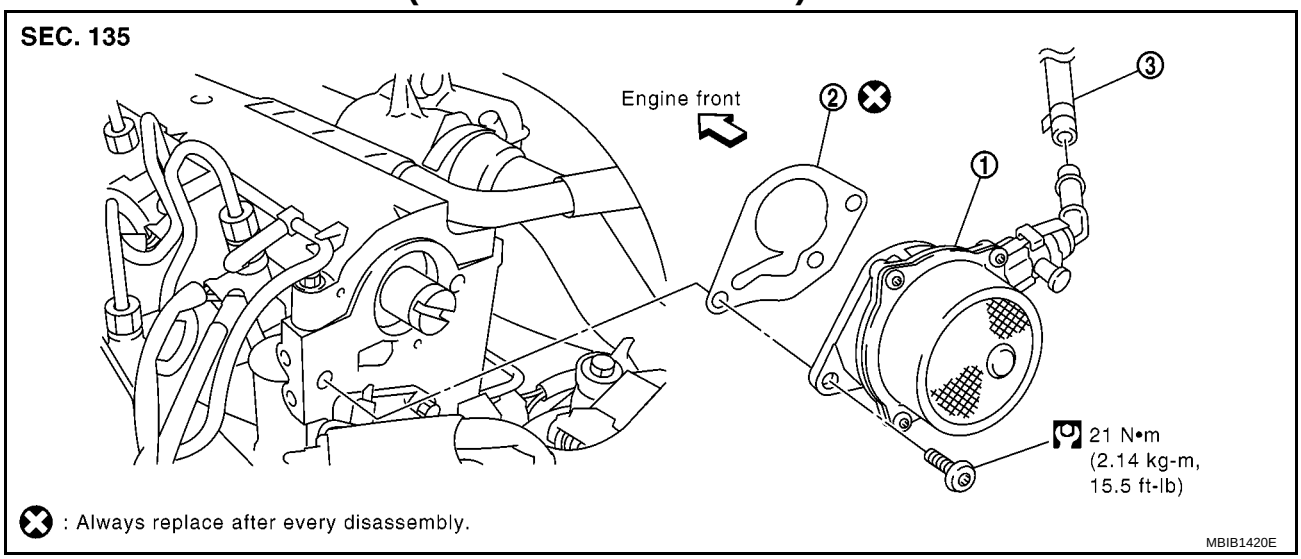
1. Remove engine room cover. Refer to EM-241, "ENGINE ROOM COVER" .
2. Remove battery.
3. Remove air cleaner case and air duct (suction). Refer to EM-247, "AIR CLEANER AND AIR DUCT" .
4. Remove rear engine slinger. Refer to EM-280, "ENGINE ASSEMBLY" .
5. Disconnect vacuum hose from vacuum pump side.
6. Remove vacuum pump.

INSTALLATION

- Install in the reverse order of removal.

Removal and Installation (For Euro4 50kW/63kW)

EBS01LR7



1. Vacuum pump
2. Gasket
3. Vacuum hose

INSPECTION BEFORE REMOVAL

1. Disconnect vacuum hose, and connect a vacuum gauge via 3-way connector.
   - Disconnect point where vacuum from vacuum pump can be measured directly and install 3-way connector.
2. Start engine and measure generated vacuum at idle speed.

Standard : – 86.6 to – 101.3 kPa (– 866 to – 1,013 mbar, – 650 to – 760 mmHg, – 25.59 to – 29.92 inHg)

REMOVAL

1. Remove engine room cover. Refer to EM-241, "ENGINE ROOM COVER" .
2. Remove battery.
3. Remove air cleaner case and air duct (suction). Refer to EM-247, "AIR CLEANER AND AIR DUCT" .
4. Remove rear air inlet tube bracket. Refer to EM-280, "ENGINE ASSEMBLY" .
5. Disconnect vacuum hose from vacuum pump side.
6. Remove vacuum pump.

INSTALLATION

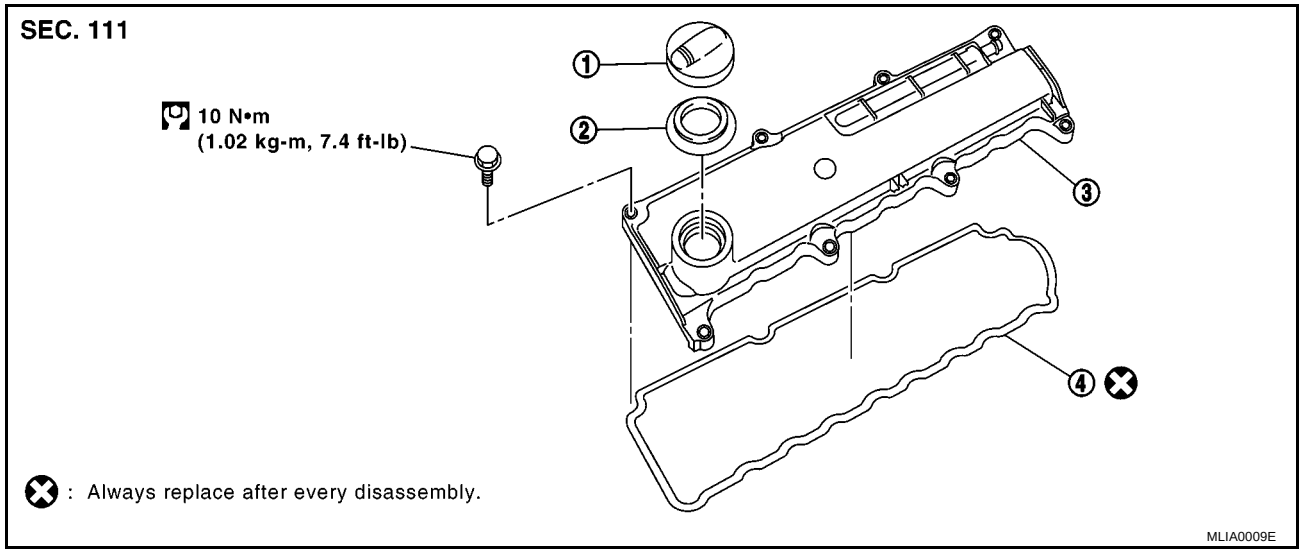
- Install in the reverse order of removal.

ROCKER COVER

PFP:13264

Removal and Installation

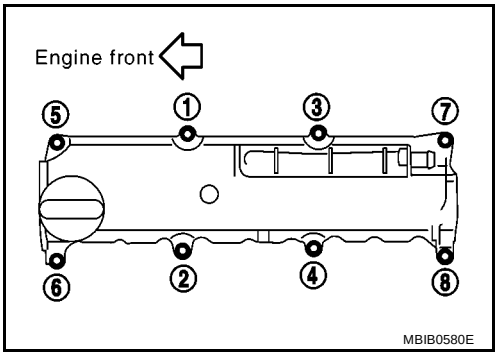
EBS01C6S



1. Oil filler cap
2. Oil catcher
3. Rocker cover
4. Gasket

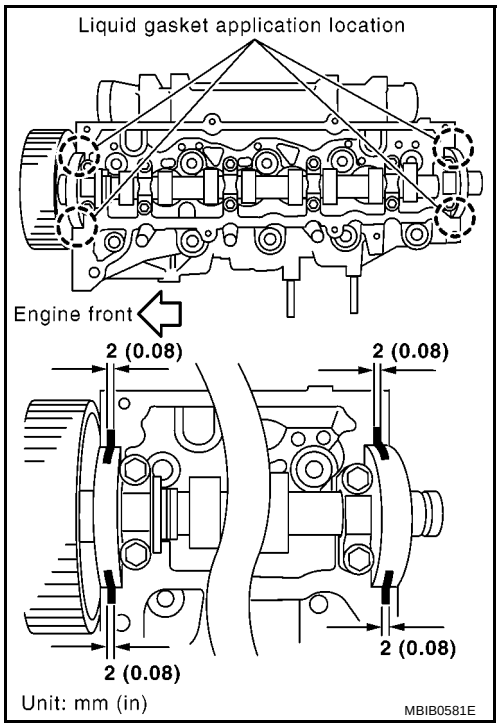
REMOVAL

1. Remove engine room cover. Refer to EM-241, "ENGINE ROOM COVER" .
2. Remove battery.
3. Remove air cleaner case and air duct (suction). Refer to EM-247, "AIR CLEANER AND AIR DUCT" .
4. Remove rocker cover.
   - Loosen holding bolts in the reverse order as shown in the figure and remove.



INSTALLATION

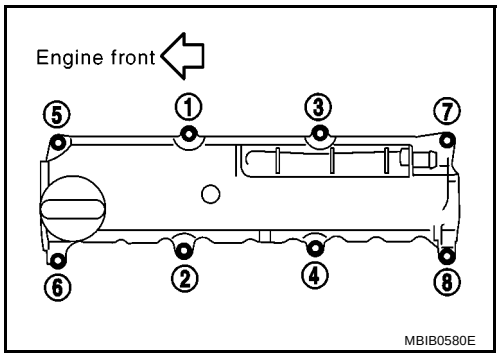
1. Apply liquid gasket on locations shown in the figure.
   - Use Genuine Liquid gasket or equivalent.



2. Tighten holding bolts in the numerical order as shown in the figure.

   : 10 N·m (1.02 kg-m, 7.4 ft-lb)

3. Install in the reverse order of removal after this steps.

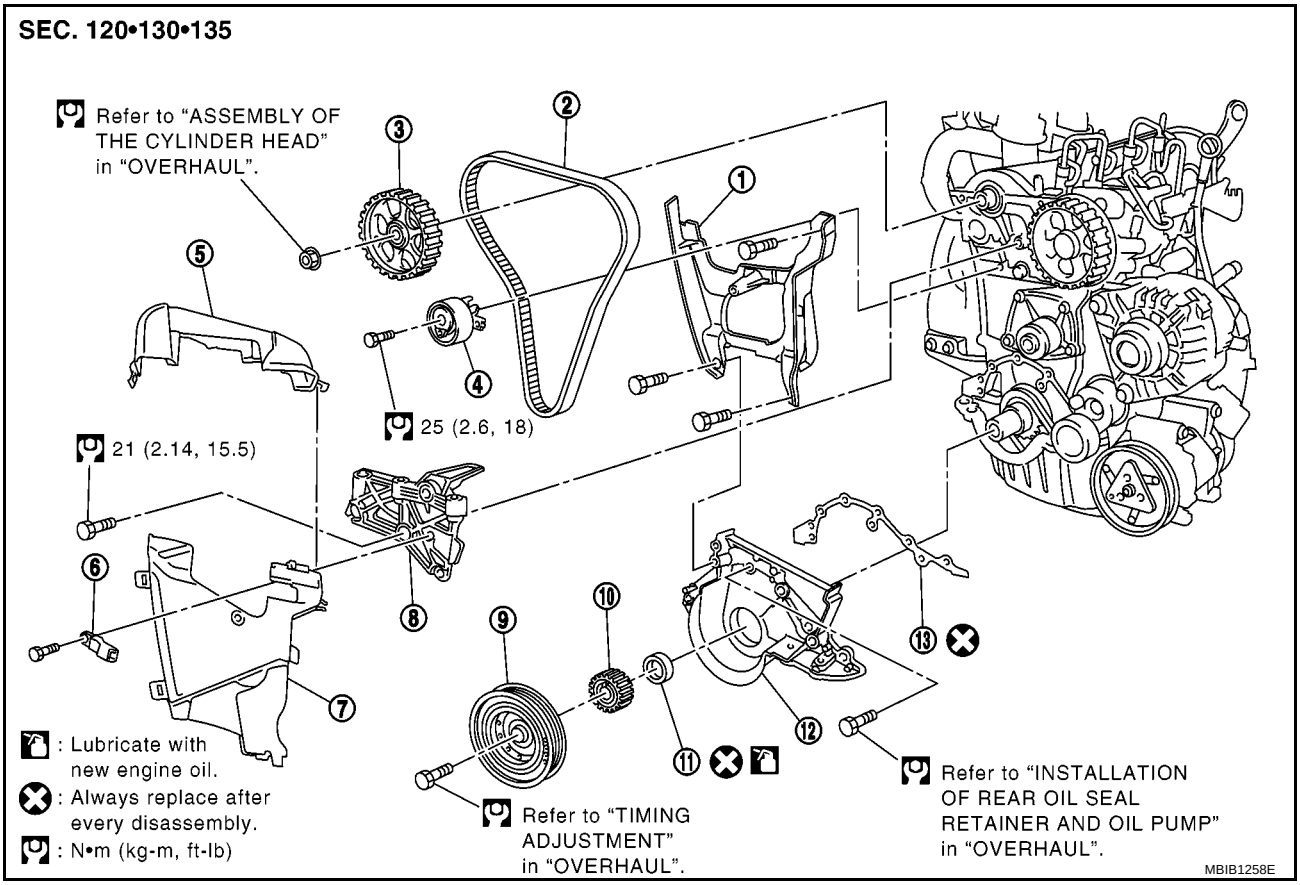


TIMING BELT

PFP:13028

Removal and Installation

EBS01C6T



1. Timing belt inner cover
2. Timing belt
3. Camshaft sprocket
4. Timing belt tensioner
5. Timing belt upper cover
6. Camshaft position sensor
7. Timing belt lower cover
8. Cylinder head suspended bracket
9. Crankshaft pulley
10. Crankshaft sprocket
11. Rear oil seal
12. Rear oil seal retainer
13. Gasket

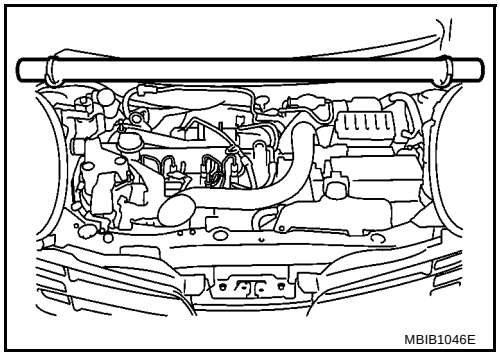
CAUTION:

- **Apply new engine oil to parts marked in illustration before installation.**
- **Replace any belt that has been removed.**
- **Never turn the engine in the direction opposite to that of normal operation.**
- **When replacing the timing belt, be sure to replace the timing belt tensioner.**
- **Do not run the engine without the drive belts to avoid damaging the crankshaft pulley.**

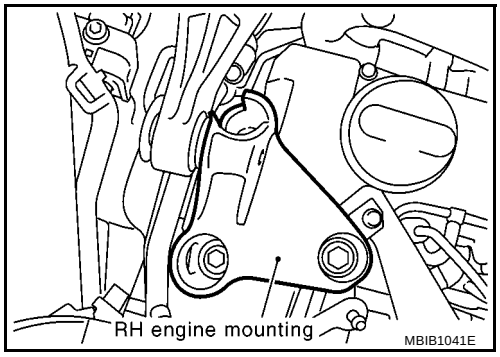
REMOVAL

1. Remove the following parts.
   - Battery ground cable
   - Undercover
   - RH front wheel
   - RH head light assembly
2. Remove right side splash cover.
3. Remove engine room cover. Refer to EM-241, "ENGINE ROOM COVER" .
4. Remove air cleaner case and air duct (suction). Refer to EM-247, "AIR CLEANER AND AIR DUCT" .
5. Remove drive shaft lock pin and lock nut. Refer to FAX-10, "FRONT DRIVE SHAFT" .
6. Remove ABS sensor from brake caliper.
7. Remove strut lower bolts.

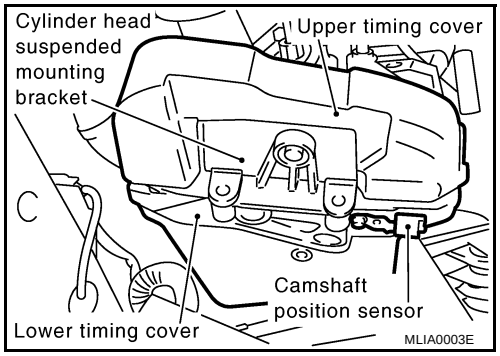
8. Remove drive shaft assembly RH side.
9. Remove drive belt. Refer to EM-244, "DRIVE BELTS" .
10. Remove oil pan. Refer to EM-265, "OIL PAN" .
11. Install engine slingers. Refer to EM-280, "ENGINE ASSEMBLY" .
12. Set the engine support bar (commercial service tool) or suitable tool, and secure the engine in position.



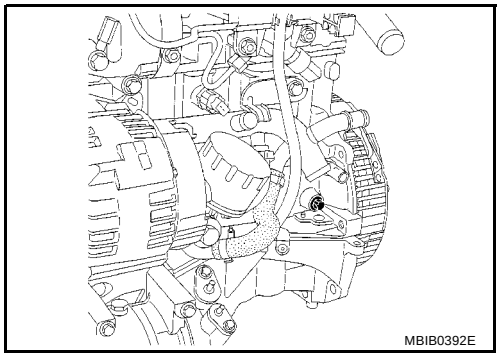
13. Remove RH engine torque rod.
14. Remove RH engine mounting.



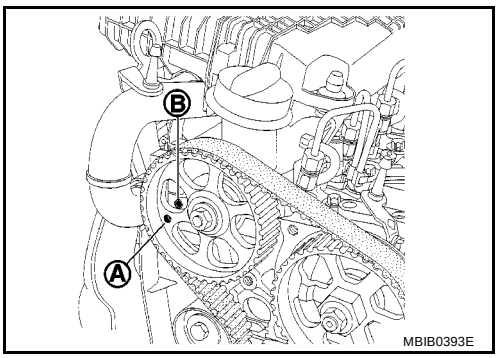
15. Remove RH engine mounting support bracket, RH engine mounting insulator and reservoir tank.
16. Remove upper timing cover, camshaft position sensor and cylinder head suspended mounting bracket.



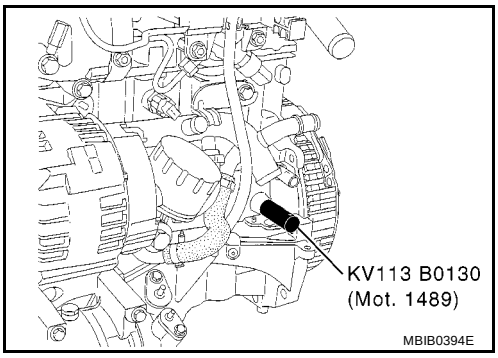
17. Remove the TDC pin cap.



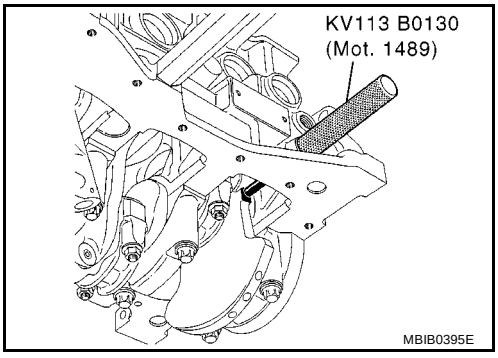
18. Position the hole (A) of the camshaft pulley almost opposite the hole (B) of the cylinder head.



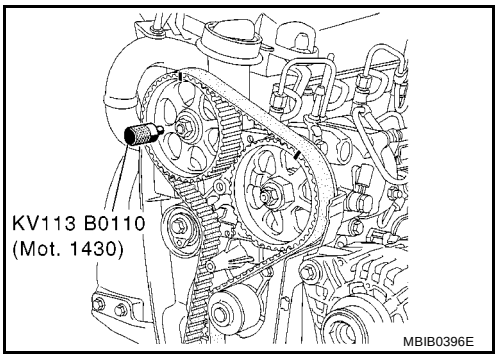
19. Screw in the TDC pin (special service tool).



20. Turn the engine clockwise (timing side) until the crankshaft touches the TDC pin (special service tool).



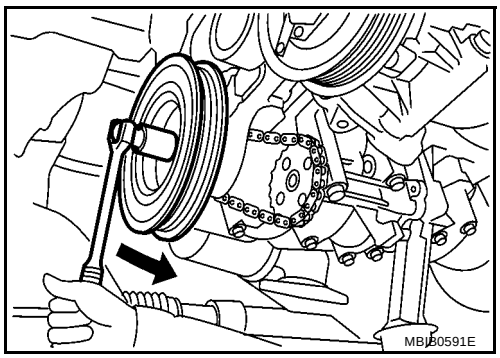
21. The pin (special service tool) must engage in the camshaft pulley and cylinder head holes.
22. Remove TDC pin (special service tool).



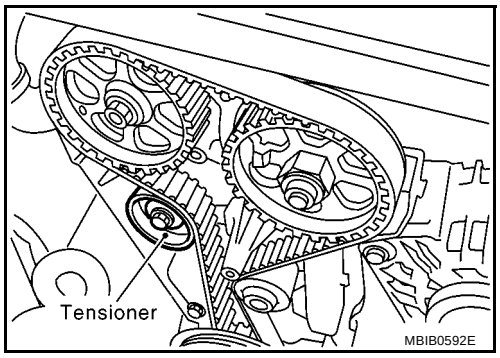
23. Remove crankshaft pulley as follows:

- Loosen the crankshaft pulley fixing bolts by locking the flywheel with a screwdriver and pull crankshaft pulley with both hands to remove it.

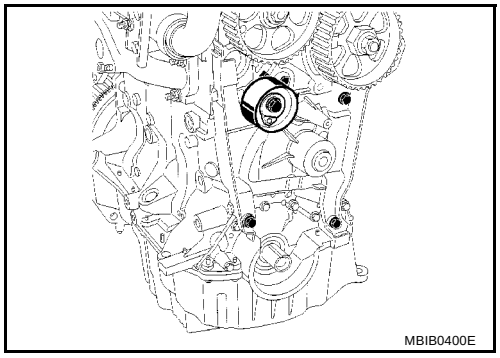
  CAUTION:
  Do not remove fixing bolts. Keep loosened fixing bolts in place to protect removed crankshaft pulley from dropping.



24. Slacken the timing belt by loosening the bolt of tensioner, then remove timing belt.



25. Remove crankshaft sprocket.
26. Remove timing belt tensioner and inner timing cover.



27. If necessary, remove rear oil seal retainer.

INSTALLATION

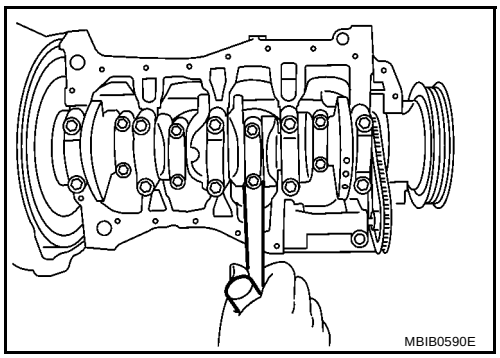
- Install in the reverse order of removal paying attention to the following.

Rear Oil Seal Retainer

- Refer to EM-313, "INSTALLATION OF REAR OIL SEAL RETAINER AND OIL PUMP" .

Timing Belt

- Refer to EM-319, "TIMING ADJUSTMENT" .
- When install crankshaft pulley, lock crankshaft with a hammer handle or similar tool.

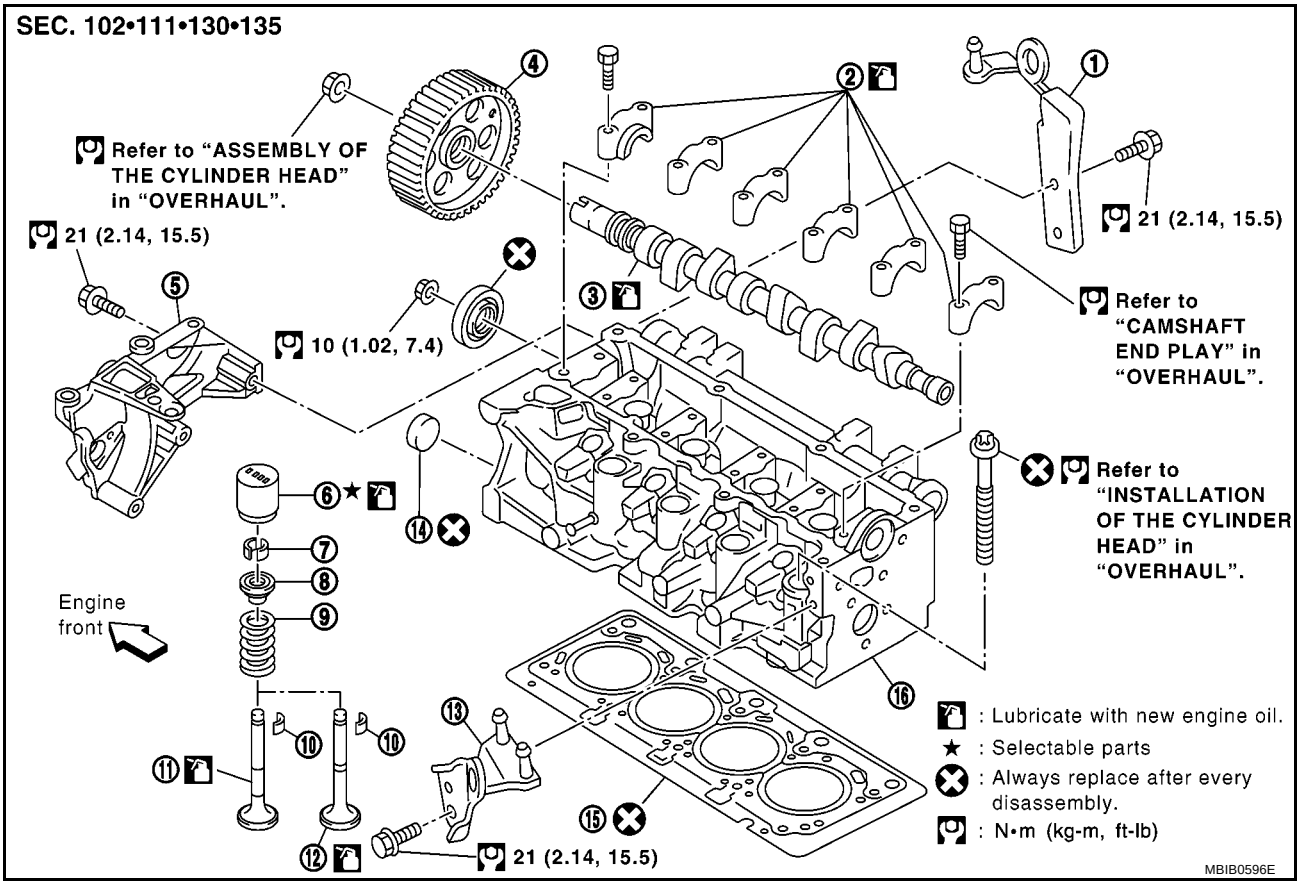


CYLINDER HEAD

PFP:11041

Removal and Installation

EBS01C6U



1. Front engine slinger
2. Camshaft bracket
3. Camshaft
4. Camshaft sprocket
5. Cylinder head suspended bracket
6. Shim
7. Valve rotator
8. Valve spring retainer
9. Valve spring
10. Valve cotter
11. Exhaust valve
12. Intake valve
13. Rear engine slinger
14. Cap
15. Cylinder head gasket
16. Cylinder head

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

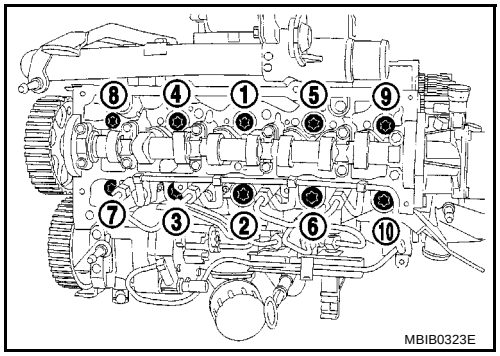
REMOVAL

1. Remove the following parts.
   - Battery ground cable
   - Undercover
   - RH front wheel
   - RH head light assembly
2. Remove right side splash cover.
3. Remove engine room cover. Refer to EM-241, "ENGINE ROOM COVER" .
4. Drain engine coolant. Refer to CO-62, "DRAINING ENGINE COOLANT" .
   CAUTION:
   Perform when engine is cold.
5. Remove air cleaner case and air duct (suction). Refer to EM-247, "AIR CLEANER AND AIR DUCT" .
6. Remove radiator upper hose. Refer to CO-64, "RADIATOR" .
7. Disconnect fuel feed tube and return tube from fuel injection pump. Refer to EC-K9K-36, “Injector rail”, “DIESEL EQUIPMENT” in EC section.
8. Remove oil level gauge guide.

9. Remove harnesses and connectors.
10. Remove heater hoses.
11. Remove turbocharger assembly. Refer to EM-258, "EXHAUST MANIFOLD, TURBOCHARGER, CATALYST" .
12. Remove drive belt. Refer to EM-244, "DRIVE BELTS" .
13. Remove rocker cover. Refer to EM-271, "ROCKER COVER" .
14. Support underneath of engine by setting a manual lift table caddy (commercial service tool) or equivalent tool.

    CAUTION:
    Put a piece of wood or something similar as supporting surface, secure a completely stable condition.
15. Remove timing belt. Refer to EM-273, "TIMING BELT" .
16. Remove engine support bar.

    CAUTION:
    During the removal operation, always be careful to prevent engine moves downward from the vehicle.
17. Remove cylinder head bolt in the reverse order as shown.



18. Remove cylinder head assembly.

INSTALLATION

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

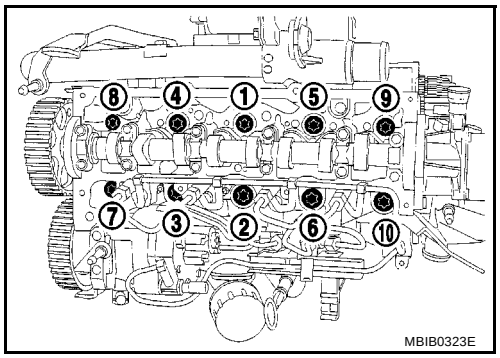
Cylinder Head Bolts

NOTE:
Use a syringe to remove any oil which may have entered the cylinder head mounting bolt holes to achieve correct tightening of the bolts.

CAUTION:
All bolts must always be changed after removal. Do not oil the new bolts.

- Tighten all the bolts in the numerical order as shown.

  : 25 N·m (2.6 kg-m, 18 ft-lb)



- Check that all the bolts are correctly tightened to 25 N·m (2.6 kg-m, 18 ft-lb), then angle tightening of 245 to 265 degrees.

  CAUTION:
  - **Use an angle wrench (special service tool) to check tightening angle.**
  - **Do not retighten the cylinder head bolts after preforming this procedure.**

Disassembly and Assembly

EBS01C6V

DISASSEMBLY

- Refer to EM-291, "DISASSEMBLY OF THE CYLINDER HEAD" .

INSPECTION AFTER DISASSEMBLY

- Refer to EM-294, "Inspection" .

- Refer to EM-295, "Valve Clearance" .
- Refer to EM-324, "Cylinder Head" .

ASSEMBLY

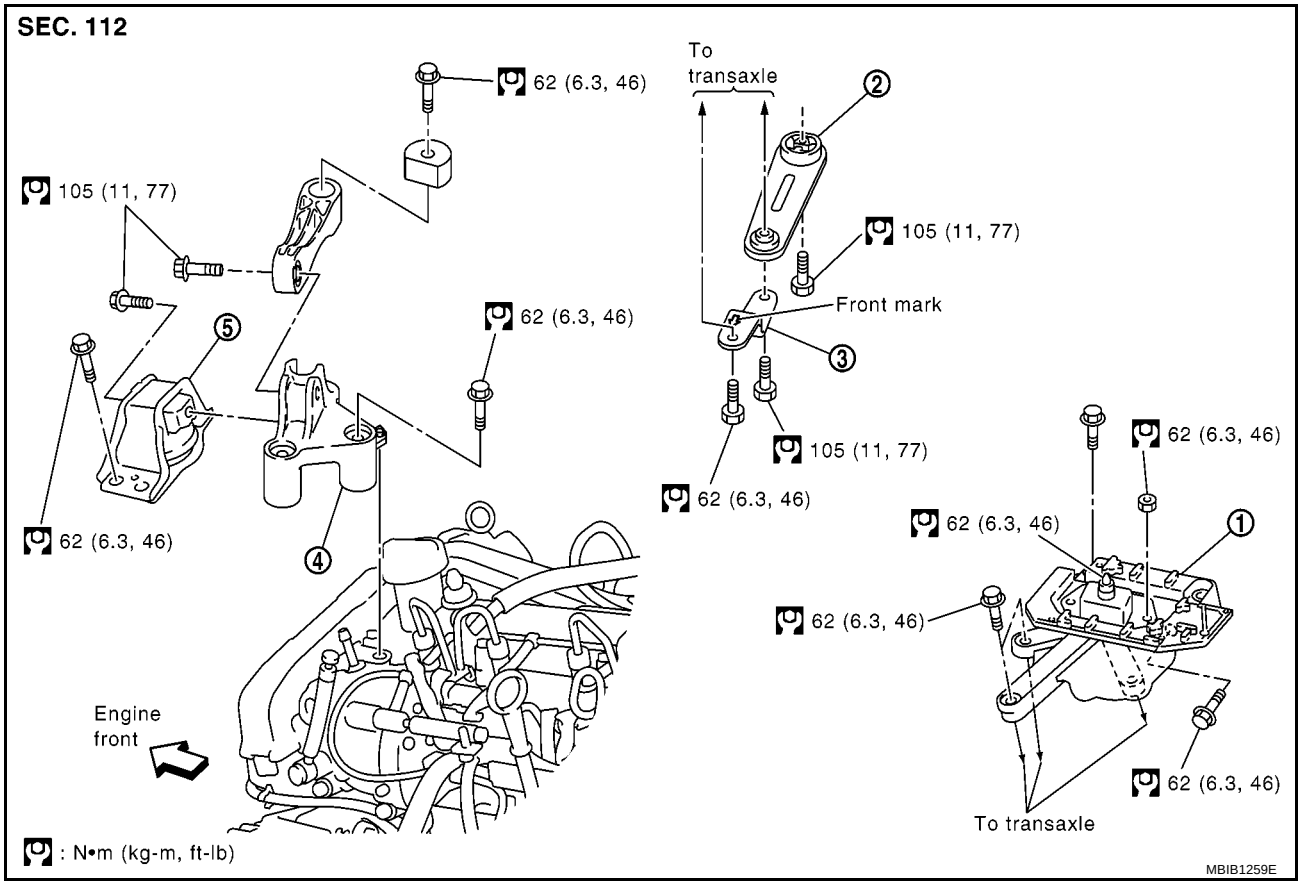
- Refer toEM-304, "Assembly" .

ENGINE ASSEMBLY

PFP:10001

Removal and Installation (For Euro3 48kW/60kW)

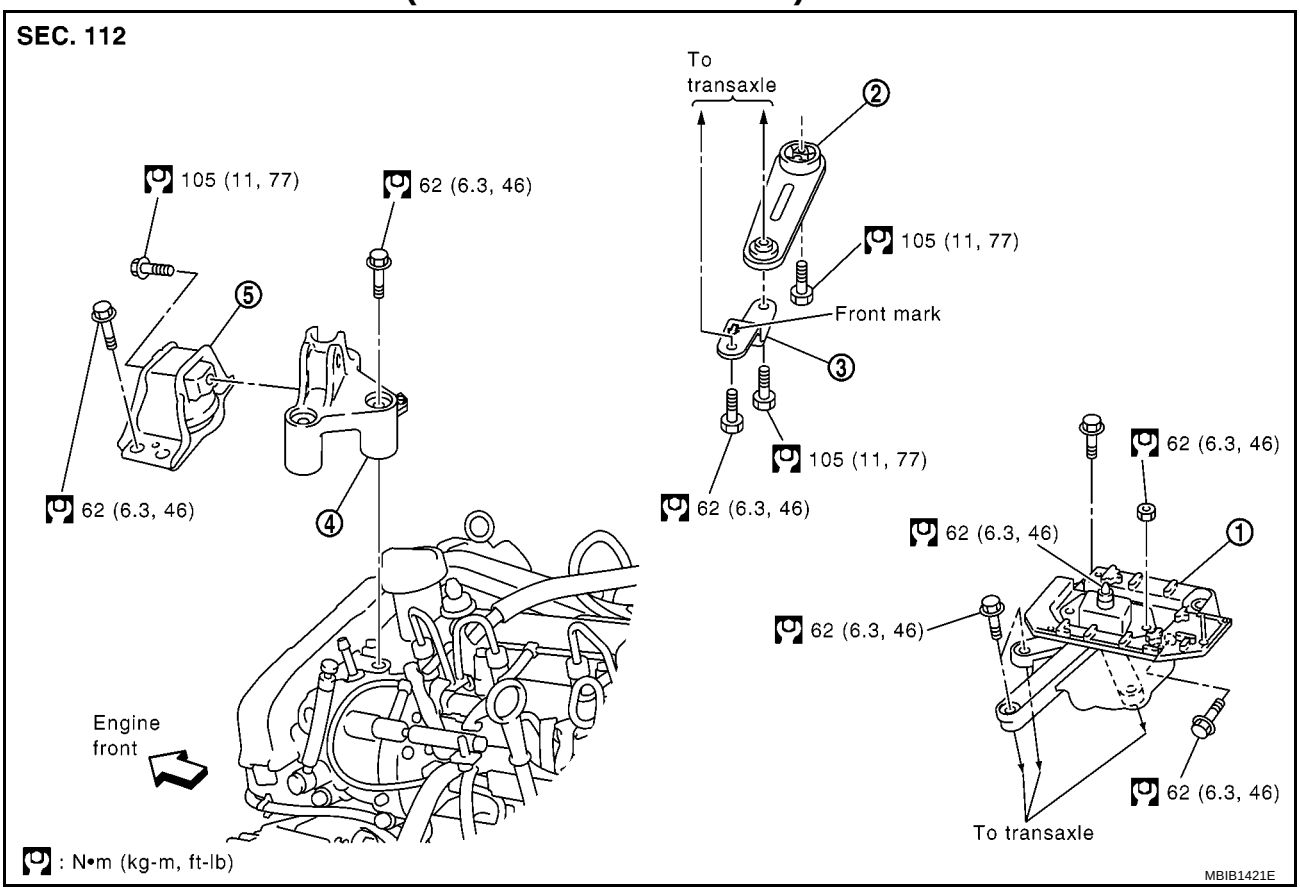
EBS01LR8



1. LH engine mounting
2. Rear torque rod
3. Engine rear mounting bracket
4. RH engine mounting
5. RH engine mounting insulator

Removal and Installation (For Euro4 50kW/63kW)

EBS01C6W



1. LH engine mounting
2. Rear torque rod
3. Engine rear mounting bracket
4. RH engine mounting
5. RH engine mounting insulator

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 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-38, "LIFTING POINT" .**

REMOVAL

Description of work

Remove engine and transaxle assembly from vehicle down ward. Separate engine and transaxle.

Preparation

1. Remove the following parts.
   - Battery ground cable
   - Undercover
   - Right side splash cover
   - LH/RH front wheel

- RH head light assembly

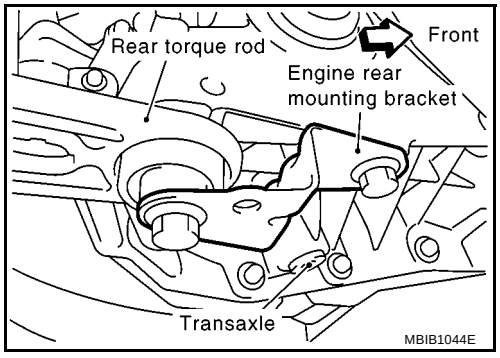
Engine room

2. Drain engine coolant. Refer to LU-25, "Changing Engine Oil" .

   CAUTION:
   Perform when engine is cold.
3. Remove engine room cover. Refer to EM-241, "ENGINE ROOM COVER" .
4. Remove air cleaner case and air duct (suction). Refer to EM-247, "AIR CLEANER AND AIR DUCT" .
5. Remove radiator upper hose. Refer to CO-64, "RADIATOR" .
6. Remove reservoir tank and hoses. Refer to CO-64, "RADIATOR" .
7. Remove fuel feed and return tubes. Refer to EC-K9K-36, “Injection rail”, “DIESEL EQUIPMENT”.
8. Remove vacuum hose. Refer to EM-269, "VACUUM PUMP" .
9. Remove turbocharger air duct. Refer to EM-258, "EXHAUST MANIFOLD, TURBOCHARGER, CATALYST" .
10. Disconnect heater hoses.
11. Disconnect engine room harness from the engine side and set it aside for easier work.
12. Disconnect transaxle side harness and clutch hose. Refer to CL-12, "CLUTCH DISC, CLUTCH COVER AND FLYWHEEL" .
13. Disconnect drain hose transaxle side.
14. Disconnect shift cable and select cable. Refer to MT-12, "CONTROL LINKAGE" (with JH3 transaxle) or MT-42, "CONTROL LINKAGE" (with JR5 transaxle).
15. Loosen wire bracket.
16. Disconnect all the body-side vacuum hoses and air hoses at engine side.
17. Disconnect fuel feed and return hoses, and plug it to prevent fuel from draining.

Vehicle underbody

18. Remove drive shaft lock pin and lock nut. Refer to FAX-10, "FRONT DRIVE SHAFT" .
19. Remove ABS sensor from brake caliper.
20. Remove strut lower bolts.
21. Remove drive shaft assembly RH and LH.
22. Remove drive belt. Refer to EM-244, "DRIVE BELTS" .
23. Remove A/C compressor with piping connected from engine (with A/C compressor models). Temporarily secure it on body with a rope to avoid putting load on it.
24. Remove exhaust front tube. Refer to EX-4, "Removal and Installation" .
25. Remove engine rear mounting bracket.

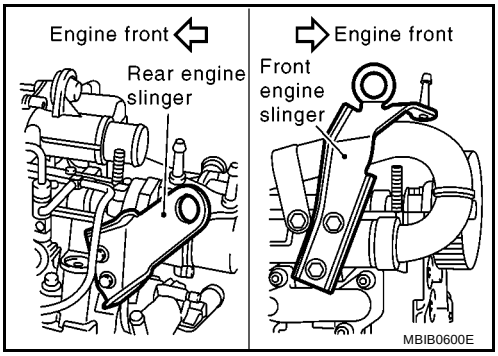


Removal

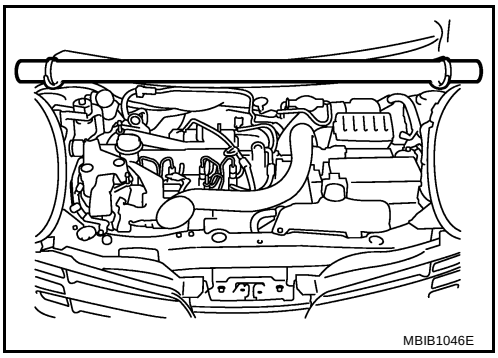
26. Install engine slingers into front right of cylinder head and rear left of cylinder head.

Slinger bolts:

: 21 N·m (2.14 kg-m, 15.5 ft-lb)

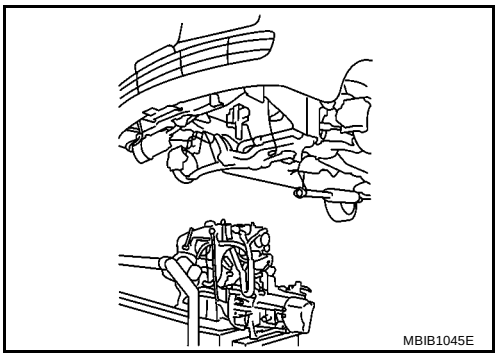


27. Set the engine support bar (commercial service tool) or suitable tool, and secure the engine in position.



- Use a manual lift table caddy (commercial service tool) or equivalently rigid tool such as a jack or trestle. Securely support bottom of engine and transaxle.

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



28. Remove RH and LH engine mounting bolts.
29. Remove engine and transaxle assembly from vehicle downward by carefully operating supporting tools.

CAUTION:

- **During the operation, make sure that no part interferes with body side.**
- **Before and during this lifting, always check if any harnesses are left connected.**
- **During the removal operation, always be careful to prevent vehicle from falling off the lift due to changes in the center of gravity.**
- **If necessary, support vehicle by setting a jack or equivalent tool at the rear.**

Separation Work

CAUTION:
During the operation, secure support the engine by placing a piece of wood under the engine oil pan, transaxle oil pan and suspended the engine slinger by baby crane (movable hoist) etc.

30. Remove starter motor.
31. Separate engine and transaxle.

INSTALLATION

Install in the reverse order of removal.

- Do not allow oil to get on mounting insulator. Be careful not to damage mounting insulator.
- When installation directions are specified, install parts according to the direction marks on them referring to components illustration.
- Make sure that each mounting insulator is seated properly, and tighten mounting bolts and nuts.

INSPECTION AFTER INSTALLATION

- Before starting engine check the levels of coolant, lubrications and working oils. If less than required quantity, fill to the specified level.

- Before starting engine, bleed air from fuel piping. Refer to FL-26, "Bleeding Fuel Filter" .
- Run engine to check for unusual noise and vibration.
- Warm up engine thoroughly to make sure there is no leakage of coolant, lubricants, working oil, fuel and exhaust gas.
- Bleed air from passages in pipes and tubes of applicable lines.

OVERHAUL

PFP:00000

Tightening Torques

EBS01C6X

UPPER ENGINE

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

Tightening torque	Cylinder head	: *1
	Camshaft bearing	: 10 (1.0, 7)
	Camshaft pulley	: 30 (3.1, 22) + 84° (Angle tightening)
	Vacuum pump	: 21 (2.1, 15)
	Cylinder head coolant outlet unit	: 10 (1.0, 7)
	Exhaust manifold	: 26 (2.7, 19)
	Glow plug	: 15 (1.5, 11)
	Rocker cover	: 10 (1.0, 7)
	Turbocharger-manifold mounting	: 26 (2.7, 19)
	Turbocharger oil return pipe	: 9 (0.9, 80)*2
	Turbocharger oil delivery pipe	: 23 (2.3, 17)
	Timing tensioner	: 25 (2.6, 18)
	TDC cap	: 20 (2.0, 15)
	Cylinder head suspended mounting bracket	: 21 (2.1, 15)

*1: Refer to tightening procedure in the text.

BOTTOM ENGINE

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

Tightening torque	Oil cooler connector bolt	: 45 (4.6, 33)
	Oil filter bracket	: 45 (4.6, 33)
	Main bearing cap	: 27 (2.8, 20) + 47°±5° (Angle tightening)
	Connecting rod	: 20 (2.0, 15) + 45°±6° (Angle tightening)
	Knock sensor	: 20 (2.0, 15)
	Oil level sensor	: 25 (2.6, 18)
	Oil pump	: 25 (2.6, 18)
	Oil pan	: *1
	Water pump	: 11 (1.1, 8)
	Flywheel	: 50 - 55 (5.1 - 5.6, 37 - 40)
	Crankshaft pulley	: 20 (2.0, 15) + 130°±15° (Angle tightening)
	Water pump inlet pipe	: 20 (2.0, 15)
	Alternator bracket	: 44 (4.5, 32)
	Alternator	: 25 (2.6, 18)
	A/C compressor	: 21 (2.1, 15)

*1: Refer to tightening procedure in the text.

Standard Replacement

EBS01C6Y

PREPARING USED ENGINE

The engine should be cleaned and drained (oil and water).

Leave on the used engine or include in the return box:

- Oil filter
- Oil pressure switch
- Water pump
- Fuel injection pump
- Rail
- Injectors
- Glow plugs
- Oil level gauge
- Vacuum pump
- Flywheel

Remember to remove:

- All coolant pipes
- Exhaust manifold
- Alternator
- Power steering pump
- A/C compressor
- Alternator bracket
- Oil level sensor
- Cylinder head coolant outlet unit

The used engine should be secured to the base under the same conditions as the overhauled engine:

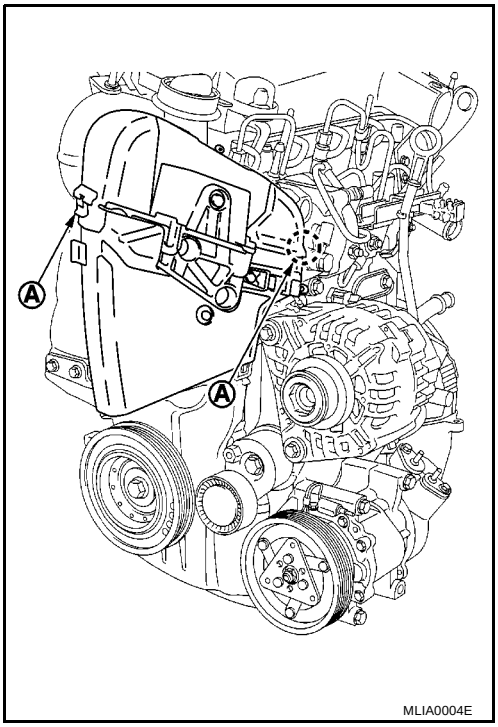
- Plastic plugs and covers fitted
- Cardboard cover over the assembly

Disassembly

EBS01C6Z

REMOVING THE UPPER ENGINE

1. Remove the upper timing cover by unclipping the two tabs (A).



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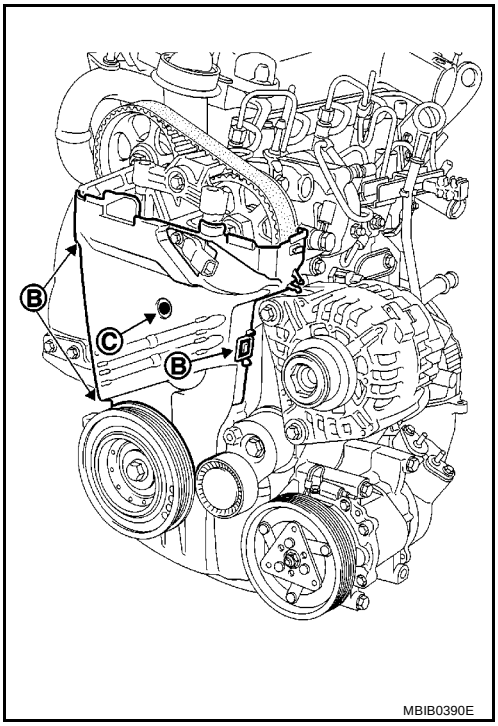
2. Remove the lower timing cover by unclipping the three tabs (B) and pulling out the plastic bolt (C).



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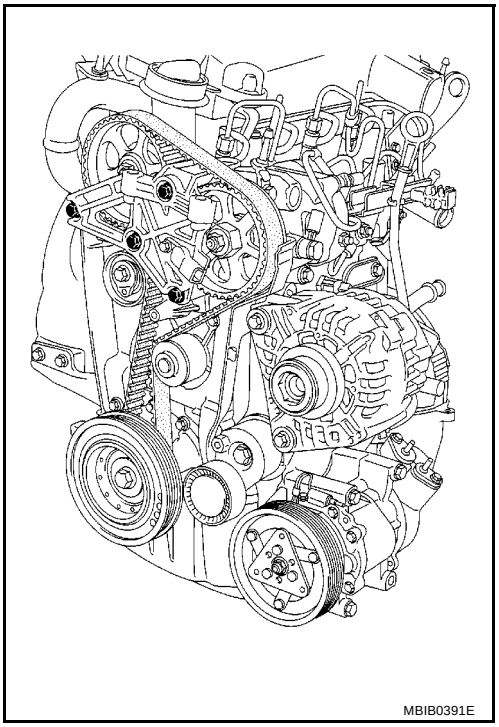
3. Remove the cylinder head suspended mounting bracket.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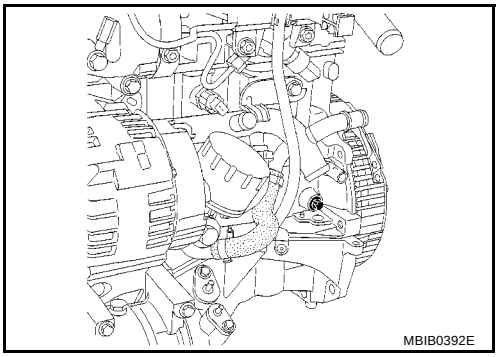
4. Remove the TDC pin cap.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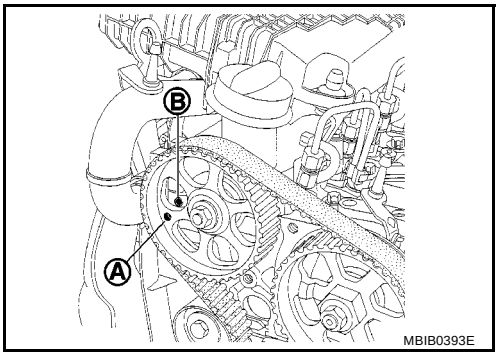
POSITIONING THE BELT AT THE TIMING POINT

1. Position the hole (A) of the camshaft pulley almost opposite the hole (B) of the cylinder head.



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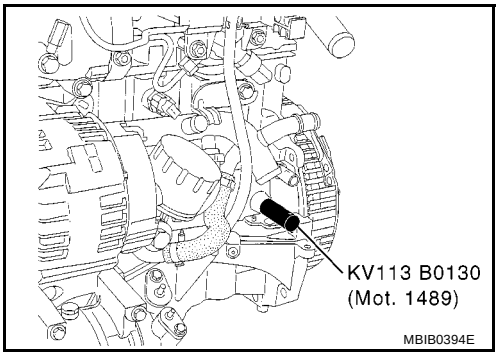
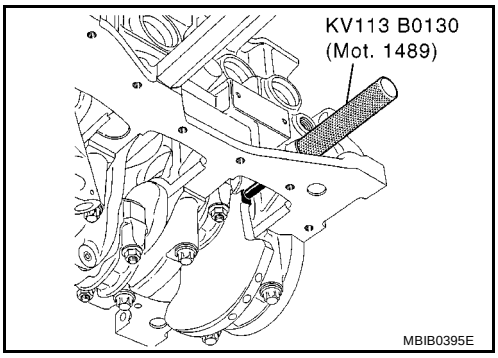
2. Screw in the Tool KV113B0130 (Mot. 1489).

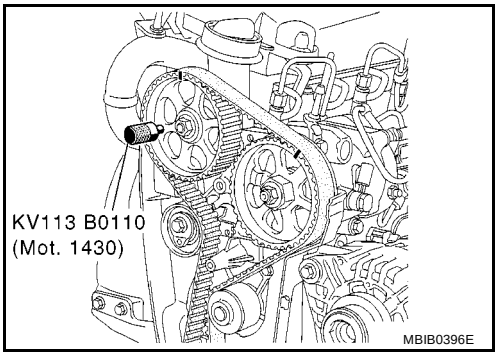


MBIB0394E

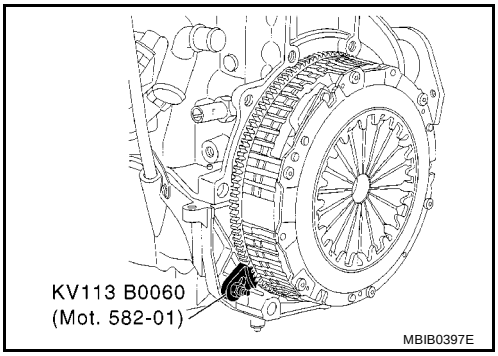
3. Turn the engine clockwise (timing side) until the crankshaft touches the Tool KV113B0130 (Mot. 1489).



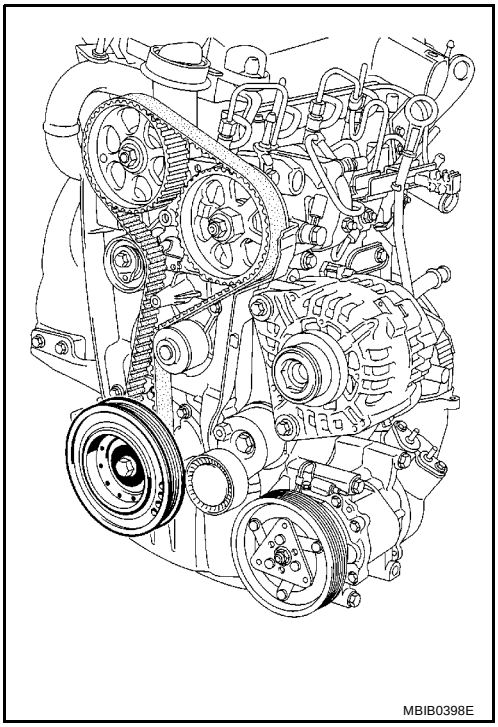
4. The Tool KV113B110 (Mot. 1430) must engage in the camshaft pulley and cylinder head holes.
5. Remove Tool KV113B0130 (Mot. 1489).



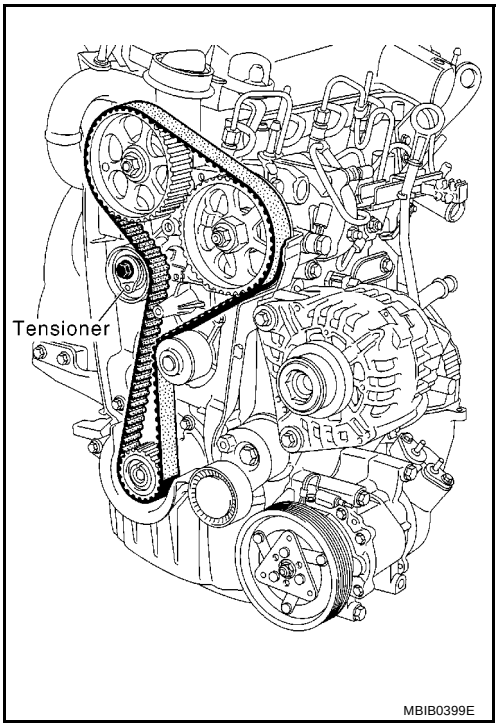
6. Install the Tool KV113B0060 (Mot. 582-01).



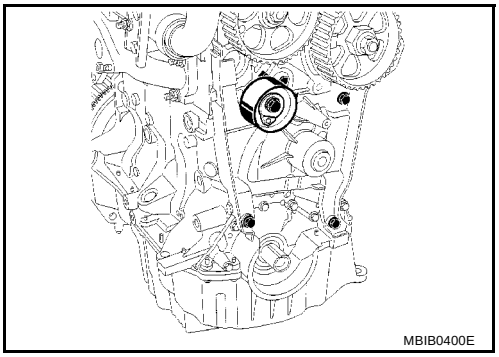
7. Remove the crankshaft pulley.



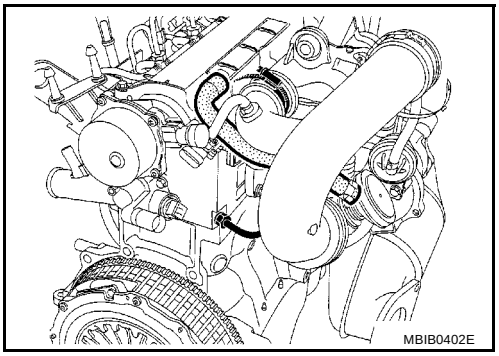
8. Slacken the timing belt by loosening the bolt of the tensioner, then remove the timing belt.



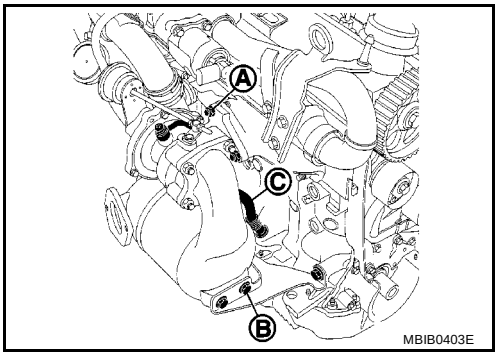
9. Remove the timing belt tensioner and inner timing cover.



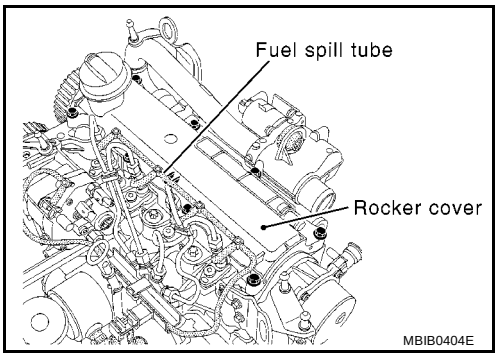
10. Remove air cleaner case. Refer to EM-247, "AIR CLEANER AND AIR DUCT" .
11. Remove the clamp, oil vapor rebreathing pipe and turbocharger oil supply pipe on the cylinder head side.



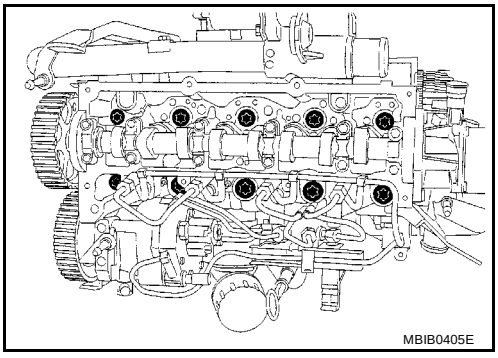
12. Remove the turbocharger oil supply pipe on the turbocharger side, nuts (A) and the torx bolt of the turbocharger flange, bolts (B) of the catalytic converter bracket, and turbocharger oil return pipe (C).



13. Unclip the fuel return pipe from the cylinder head cover at the fuel spill tube, then remove the rocker cover.



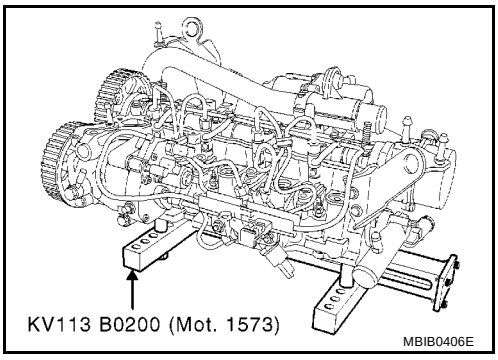
14. Remove the oil level gauge guide and cylinder head.



DISASSEMBLY OF THE CYLINDER HEAD

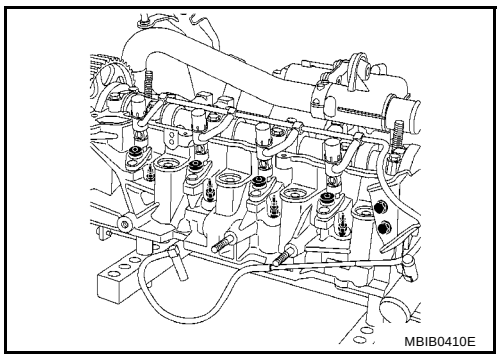
1. Place the cylinder head on Tool KV113B0200 (Mot. 1573).

CAUTION:
Pay strict attention to the rules regarding cleanliness. Refer to EM-227, "PRECAUTIONS" .

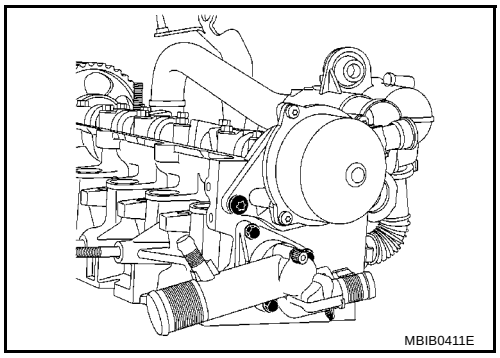


2. Remove fuel injection pump and related parts. Refer to EC-K9K-25, “High pressure pump”, “DIESEL EQUIPMENT” in EC section.

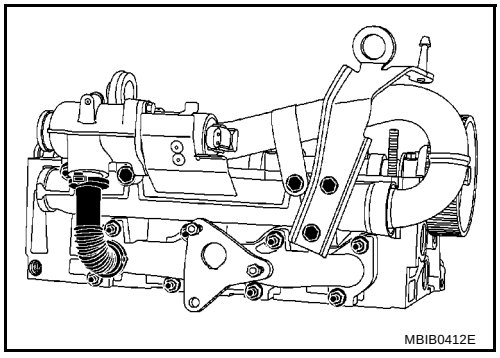
3. Remove the injectors (by marking them in relation to their cylinder), glow plugs using Tool KV113E0010 (Mot. 1566), and rear engine slinger.


MBIB0410E

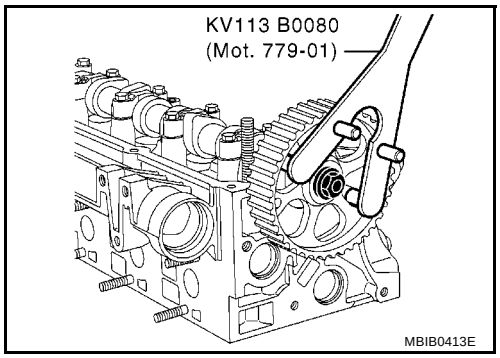
4. Remove the vacuum pump and water outlet.


MBIB0411E

5. Remove the front engine slinger, EGR unit, air inlet pipe and exhaust manifold.

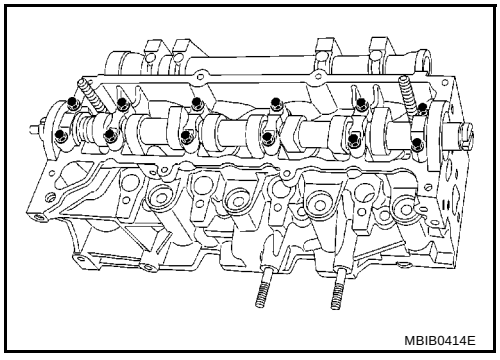

MBIB0412E

6. Remove the camshaft pulley using Tool KV113B0080 (Mot. 799-01).

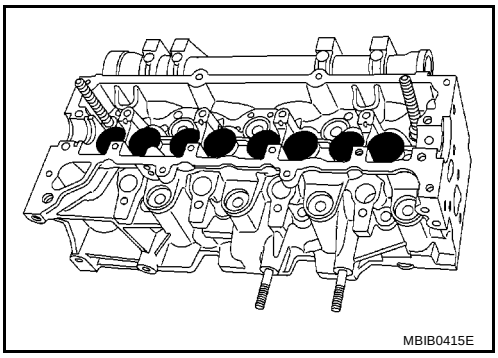


MBIB0413E

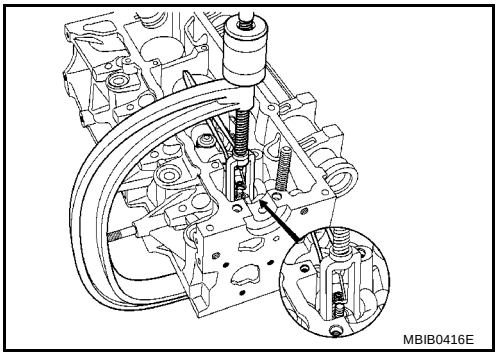
7. Remove the camshaft brackets.


MBIB0414E

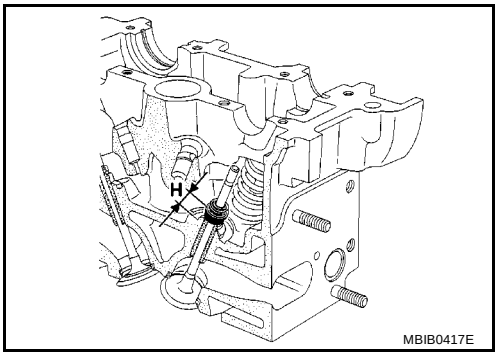
8. Remove the tappets, noting their position.


MBIB0415E

9. Compress the valve springs using the valve lifter. Remove the keys, upper cups and springs.


MBIB0416E

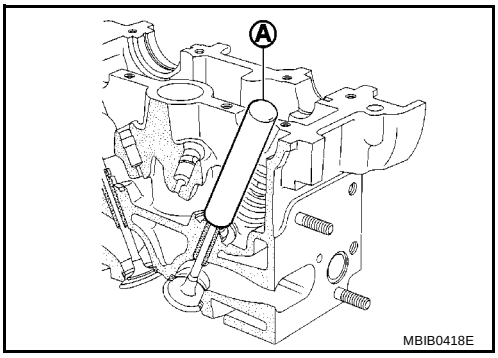
NOTE:
Before removing the valves and the valve stem seals, it is vital to measure position "H" of one of the old seals in relation to the cylinder head using Tool KV113B0180 (Mot. 1511-01) or suitable tool.



MBIB0417E

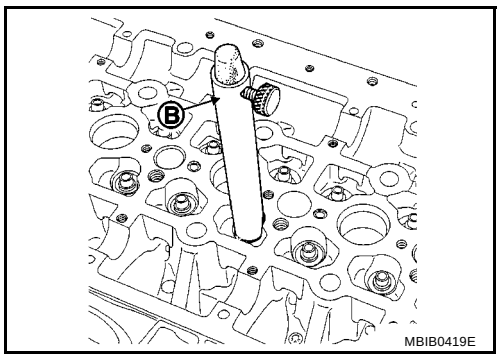
10. Install the push rod (A) of Tool KV113B0180 (Mot. 1511-01) on the valve stem seal.

NOTE:
The inner diameter of the push rod must be identical to that of the valve. In addition, the bottom of the push rod must come into contact with the metal upper section of the valve stem seal.



MBIB0418E

11. Install the guide tube (B) over the push rod until the guide tube comes into contact with the cylinder head, locking the push rod with the knurled wheel.
12. Remove the guide tube assembly plus push rod, being careful not to loosen the knurled wheel.
13. Remove the valves and valve guide seals using the Tool KV113B0090 (Mot. 1335).



Cleaning

EBS01C70

- It is very important not to scratch the gasket faces of any aluminium components.
- Use suitable tool to dissolve any part of the seal which remains stuck to the metal surface.
- Apply the dissolving product to the part to be cleaned, wait approximately 10 minutes, then remove it using a wooden spatula.
- Wear gloves while carrying out this operation.
- Do not allow this dissolving product to drip on to the paintwork.
- **Great care should be taken when performing this operation, to prevent foreign objects from entering the pipes taking oil under pressure to the camshafts (pipes in both the cylinder head and its cover) and the oil return pipes.**
- **Failure to follow these instructions could lead to the blocking of the oilways, resulting in rapid and serious damage to the engine.**

Inspection

EBS01C71

GASKET FACE

- Inspect mating surface bow using a ruler and a set of shims.

Maximum bow : 0.05 mm (0.0020 in)

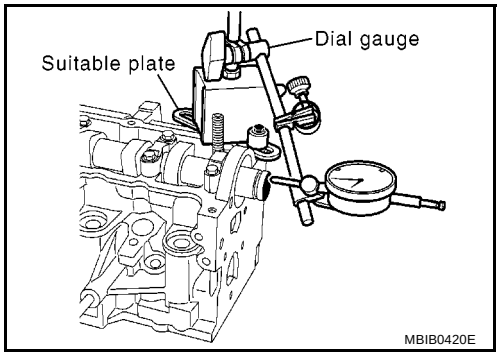
- Test the cylinder head to detect possible cracks using the cylinder head test tools (comprising a tray and a kit suited to the cylinder head, plug, sealing plate and blanking plate). The approval number of the cylinder head test container (commercial service tool) is 664000.

CAMSHAFT END PLAY

NOTE:
Set the dial gauge to the cylinder head and inspect following dimensions:

Outer diameter : 18 mm (0.71 in)
Height : 15 mm (0.59 in)

1. Install the camshaft.
2. Install the camshaft brackets (positioning them correctly with bracket 1 on the flywheel end), then tighten the bolts to a torque of 10 N·m (1.0 kg-m, 7 ft-lb).
   Check the end play, which must be between 0.08 mm (0.0031 in) and 0.178 mm (0.0070 in).
   Remove the camshaft brackets and the camshaft.



Valve Clearance

EBS01C72

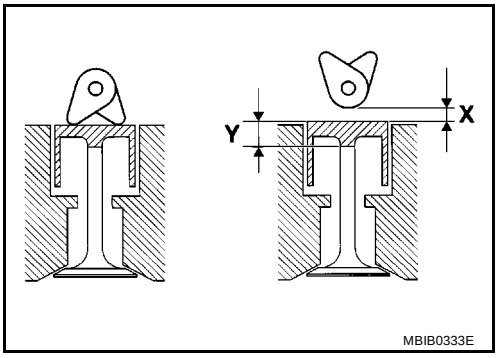
CHECKING AND ADJUSTING THE VALVE CLEARANCE

1. Install the tappet.
2. Install the camshaft.
3. Install the camshaft brackets.

   : 10 N·m (1.0 kg-m, 7 ft-lb)

4. Place the valves of the cylinder concerned at the “end of exhaust - beginning of inlet” position and check the clearance (X).

   NOTE:
   Dimension (Y) corresponds to the tappet thickness sizes (there are 25 sizes at the service parts).



1	4
3	2
4	1
2	3

5. Compare the values recorded with the values specified, then replace the tappets which are not within tolerance.

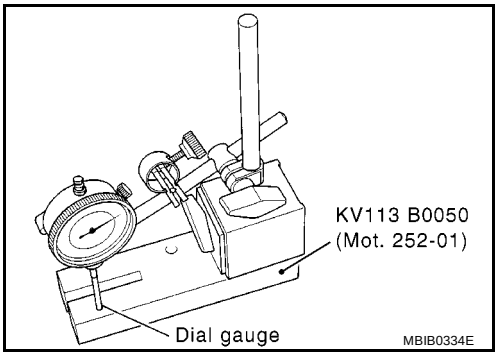
   Clearance, under cold condition:

   Intake : 0.125 - 0.25 mm (0.0049 - 0.0098 in)

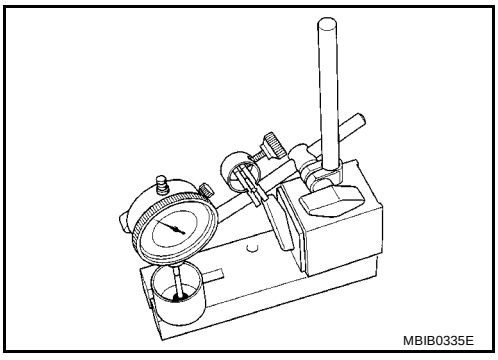
   Exhaust : 0.325 - 0.45 mm (0.0128 - 0.0177 in)

6. Remove the camshaft brackets.
7. Remove the camshaft.
8. Remove the tappet not within tolerance.

   Determining dimension Y.
   Set up the following assembly using KV113B0050 (Mot. 252-01) and dial gauge, then calibrate the gauge.

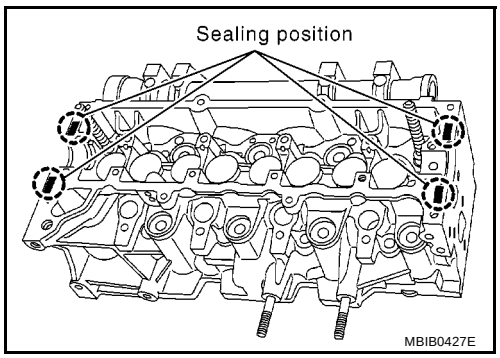


9. Raise the gauge extension (without modifying the position of the magnetic support/gauge assembly), then slide in the tappet to be measured.
   - Note dimension (Y) and repeat the operation for the tappets where the valve clearance is not within tolerance.
   - Refer to the Replacement Parts Catalogue for the vehicle concerned to select the various thicknesses of the tappet(s).
10. Check the valve clearance again.
11. Remove the camshaft brackets.
12. Remove the camshaft.
13. Remove the tappet(s) not within tolerance.



14. Grease the underside of the tappets and the camshaft brackets.
15. Degrease the gasket faces (of the cylinder head and brackets 1 and 6). They should be clean, dry and free from grease (in particular, remove finger marks).
16. Lay four beads of Loctite with a width of 1 mm (0.04 in) on brackets 1 and 6 of the cylinder head.
17. Install the camshaft.
18. Install the camshaft brackets (these are numbered from 1 to 6 and bearing (1) should be positioned on the flywheel end).

: 10 N·m (1.0 kg-m, 7 ft-lb)



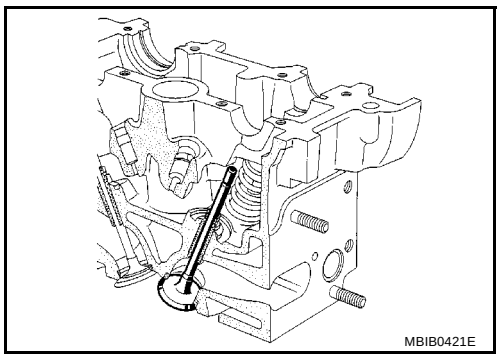
Assembly

EBS01C73

ASSEMBLY OF THE CYLINDER HEAD

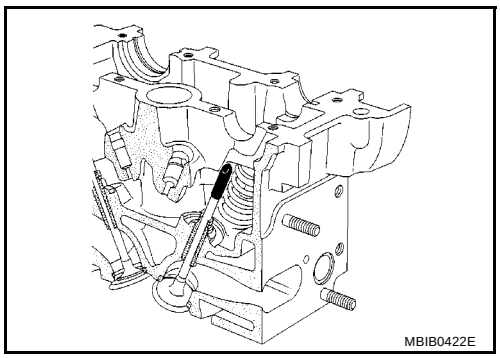
1. Install new valves and grind them gently into their respective seats. Clean all the parts thoroughly, mark them for identification purposes, then carry out the refitting operation.
   Lubricate the inside of the valve guide.
   - It is imperative to fit the valve stem seals using Tool KV113B0180 (Mot. 1511-01) or suitable tool.

   NOTE:
   Do not lubricate the valve stem seals before fitting them.

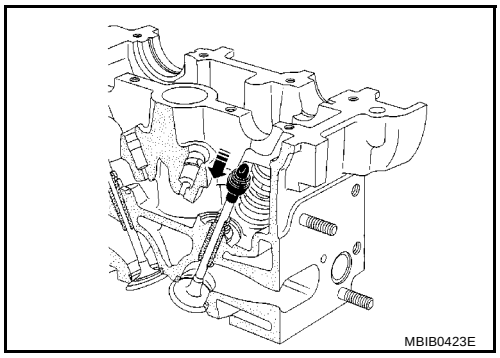


New Valve Stem Seals

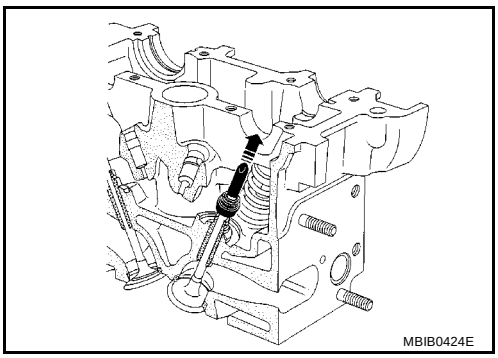
1. Place the valve in the cylinder head.
2. Place the barrel of Tool KV113B0180 (Mot. 1511-01) over the valve stem (the inner diameter of the barrel must be identical to the diameter of the valve stem).



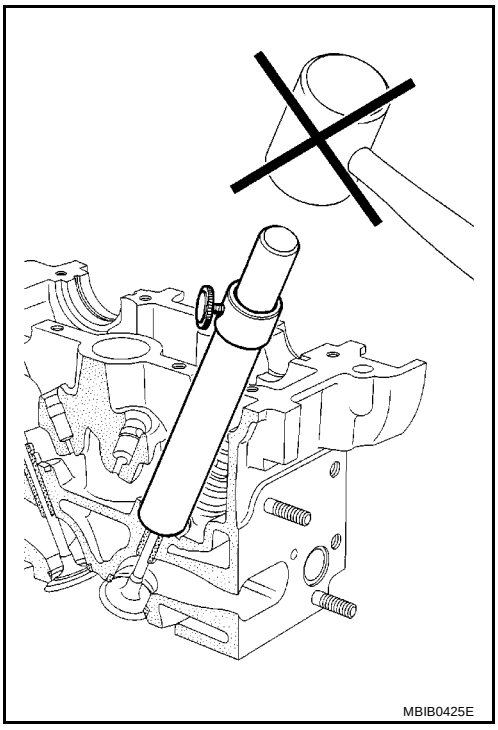
3. Keep the valve pressed against its seat.
4. Place the valve stem seal (not lubricated) over the tool barrel.



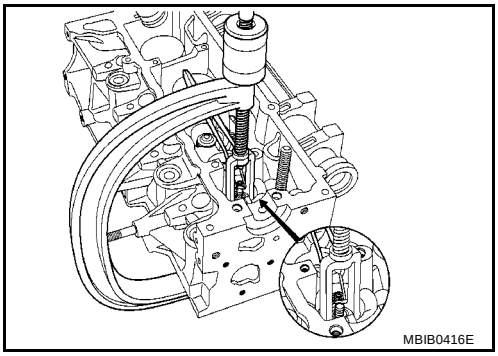
5. Push the valve stem seal past the tool barrel, then withdraw the barrel.


MBIB0424E

6. Place the guide tube plus push rod assembly on the valve stem seal.
7. Push the valve stem seal down by tapping the top of the sleeve with the palm of your hand until the guide tube touches the cylinder head.
8. Repeat these operations for all the valves.

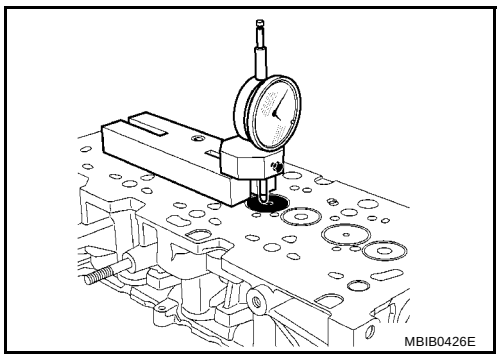

MBIB0425E

9. Install the valve springs and upper cups using valve spring compressor.
10. Install the keys using tweezers.


MBIB0416E

11. Check the valve protrusion using KV113B0040 (Mot. 251-01) and KV113B0050 (Mot. 252-01) as shown.

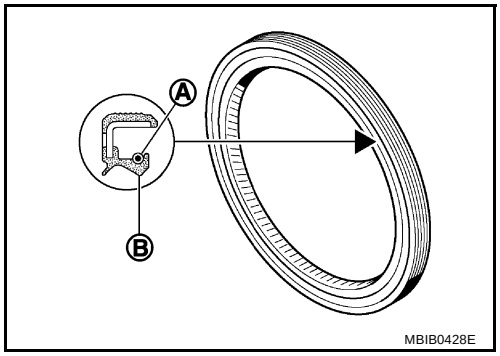
Valve protrusion : –0.07 to 0.07 mm (–0.0028 to 0.0028 in)


MBIB0426E

Camshaft Seal

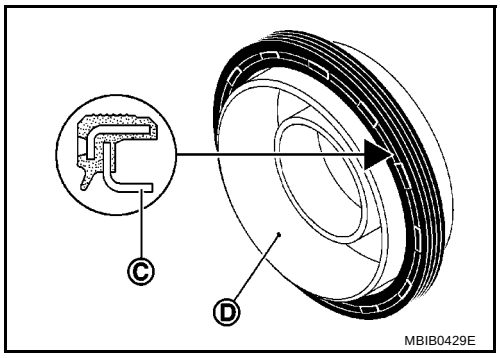
- This engine can be fitted with two different types of seals. Old and new seals are easily recognized.

1. The old rubber seal is installed with a spring (A) and has a “V”-shaped sealing lip (B).



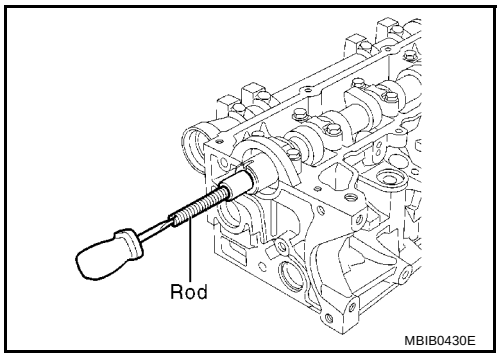
MBIB0428E

2. The new rubber seal has a flat sealing lip (C) and a protector (D) which also assists in installing the seal to the engine.



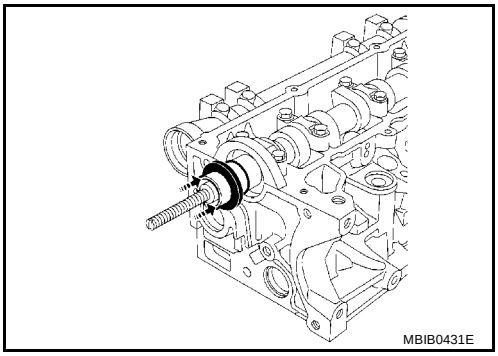
MBIB0429E

3. Screw the shouldered rod of Tool KV113B0230 (Mot. 1632) onto the stud of the camshaft.
4. Install the old seal on the camshaft.

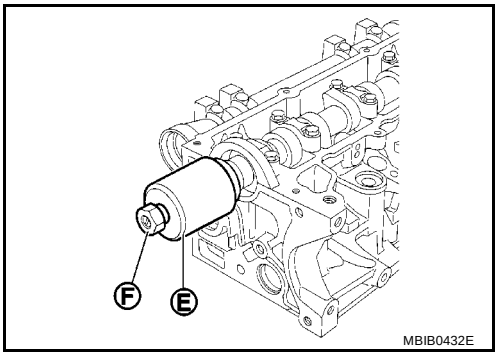


MBIB0430E

5. For the new seal, put the protector with the seal on the camshaft, taking care not to touch the seal.

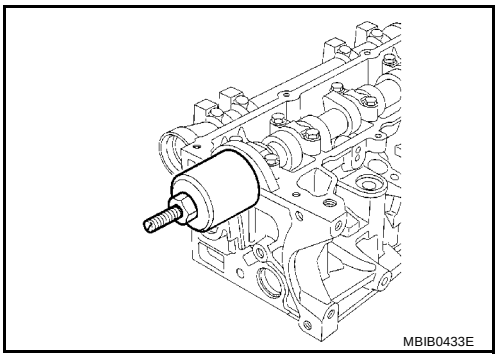

MBIB0431E

6. Install the cover (E) and the collar nut (F) of Tool KV113B0230 (Mot. 1632).

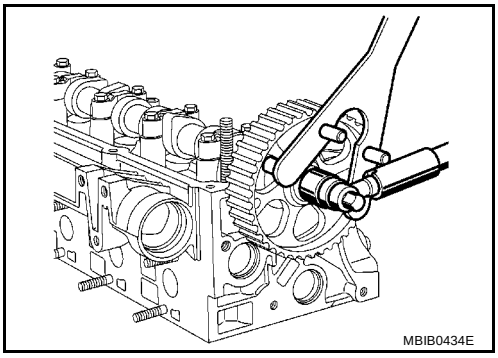


MBIB0432E

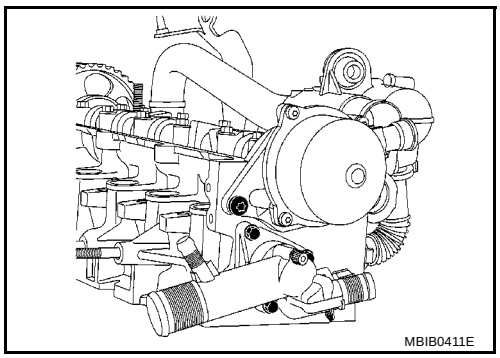
7. Screw the collar nut until the cover touches the cylinder head.


MBIB0433E

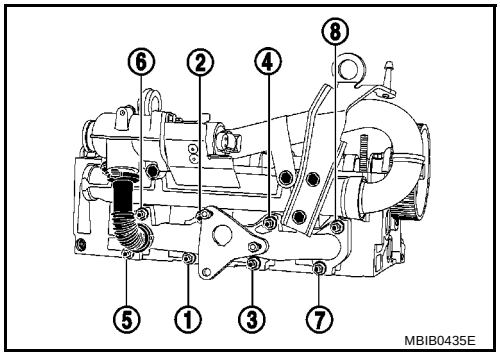
8. Remove the nut, the cover, the protector and the shouldered rod.
9. Install the camshaft pulley. Tighten the new nut to a torque of 30 N·m (3.1 kg-m, 22 ft-lb) plus an angle tightening of 84°.


MBIB0434E

10. Install the vacuum pump with a new gasket. Tighten the bolts to a torque of 21 N·m (2.1 kg-m, 15 ft-lb).
11. Install water outlet unit with a new gasket. Tighten the bolts to a torque of 26 N·m (2.7 kg-m, 19 ft-lb).

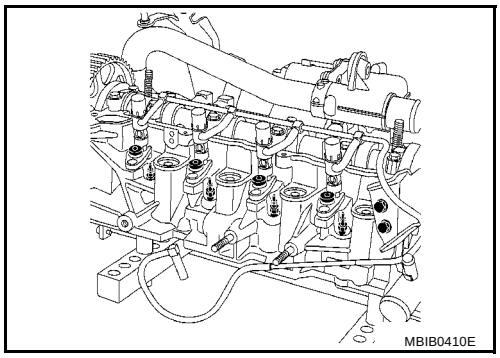

MBIB0411E

12. Install the exhaust manifold with new gasket. Tighten the bolts to a torque of 26 N·m (2.7 kg-m, 19 ft-lb) in the numerical order as shown.
13. Install the EGR unit with new clips. Tighten the mounting bolts of the valve to a torque of 21 N·m (2.1 kg-m, 15 ft-lb), then tighten the clips of the pipe using Tool KV113B0190 (Mot. 1567).
14. Install the air inlet pipe with a new seal.
15. Install the front engine slinger.



MBIB0435E

16. Clean the injector sockets and the injector bodies, as well as their brackets using a lint-free cloth (use the wipes recommended for this purpose) dipped in clean solvent.
    Dry off using a different new wipe.
    Replace the compression washer with a new washer.
17. Install the injectors (using the marks made during removal). Tighten the mounting flanges to a torque of 28 N·m (2.9 kg-m, 21 ft-lb).
18. Install the glow plugs. Tighten them to a torque of 15 N·m (1.5 kg-m, 11 ft-lb).
19. Install the rear engine slinger.


MBIB0410E

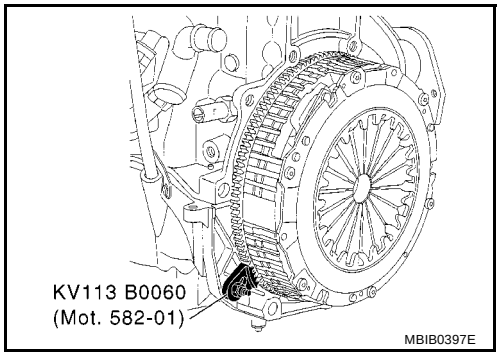
20. Install fuel injection pump and related parts. Refer to EC-K9K-25, “High pressure pump”, “DIESEL EQUIPMENT” in EC section.

Disassembly of The Bottom Engine

EBS01C74

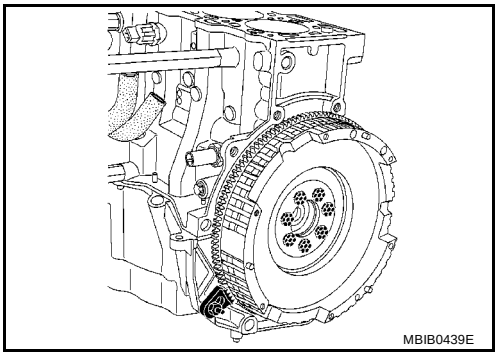
REMOVAL

1. Install the Tool KV113B0060 (Mot. 582-01).

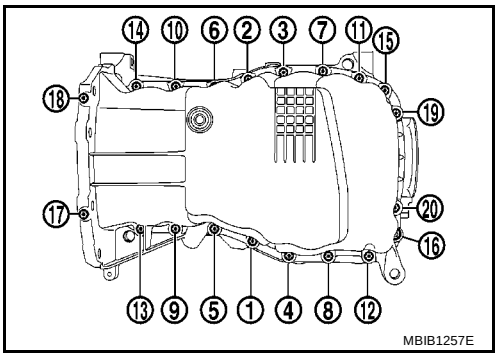


MBIB0397E

2. Remove the clutch housing.
3. Remove the flywheel.

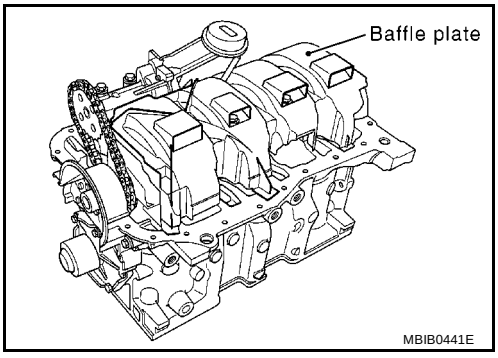

MBIB0439E

4. Remove the oil pan bolt in reverse order as shown.



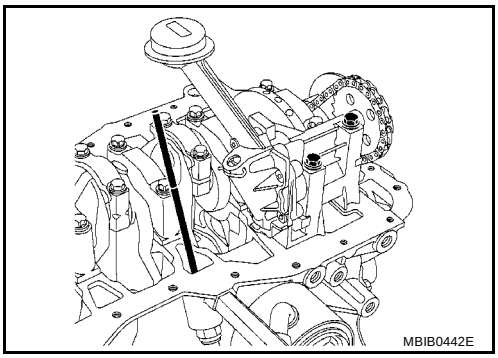
MBIB1257E

5. Remove the baffle plate.

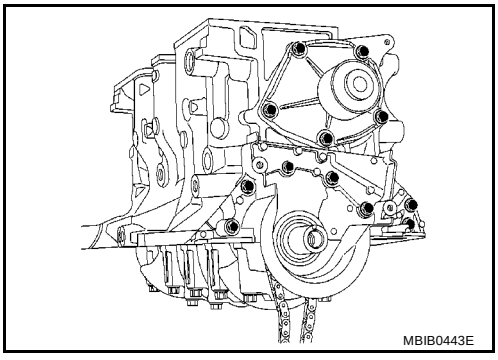


MBIB0441E

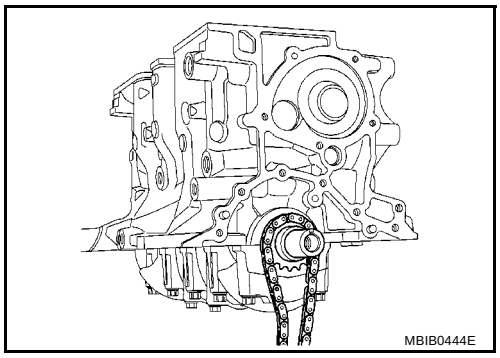
6. Remove the oil level sensor.
7. Remove the oil pump.


MBIB0442E

8. Remove the rear oil seal retainer.
9. Remove the water pump.


MBIB0443E

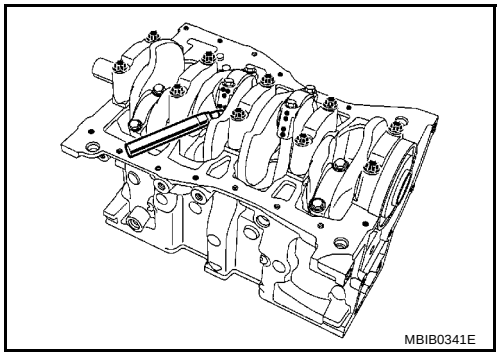
10. Remove the oil pump chain.
11. Remove the oil pump drive sprocket.


MBIB0444E

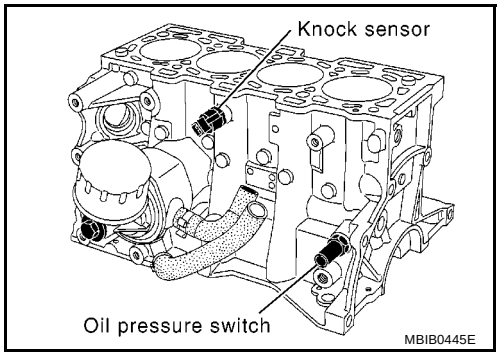
WARNING:
Do not use a sharp point to mark the bearing caps in relation to their connecting rods to avoid starting a crack in the rod. Use a permanent marker pen.

12. Remove the big end cap bolts and the connecting rod/piston assemblies.

    NOTE:
    It is essential to mark the position of the main bearing cap, as the category may be different for each bearing.
13. Remove the main bearing caps.
14. Remove the crankshaft.

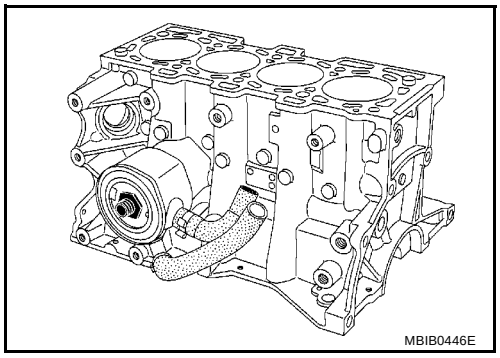

MBIB0341E

15. Remove the oil pressure switch, the knock sensor and oil filter bracket connecting bolt.



MBIB0445E

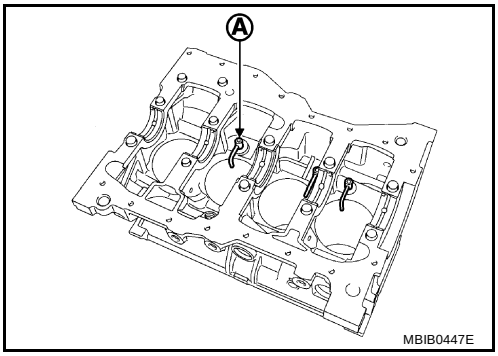
16. Remove the oil cooler connecting bolt.


MBIB0446E

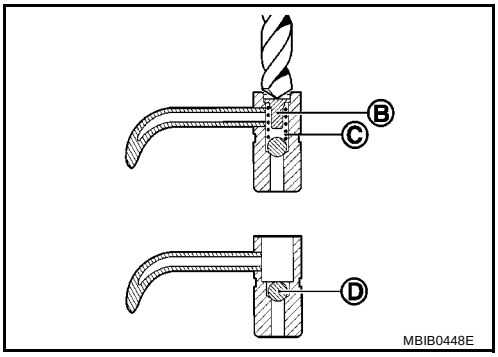
REPLACEMENT OF THE OIL JETS

Removal

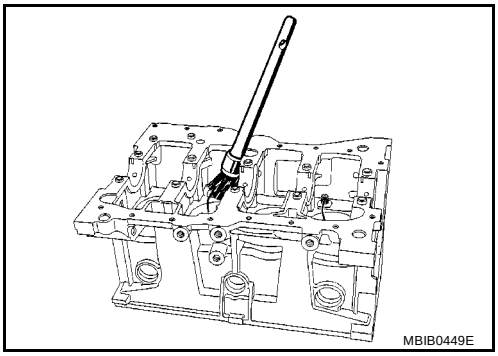
1. To remove the oil jets (A), they must be drilled with a 7 mm (0.28 in) diameter drill. This is necessary in order to remove the spring stop (B) and the spring (C).



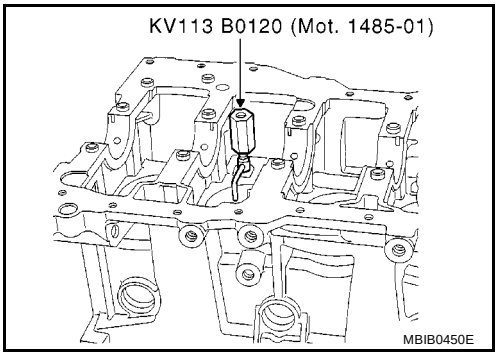
NOTE:
Do not remove the ball (D) to prevent from entering the cooling circuit.



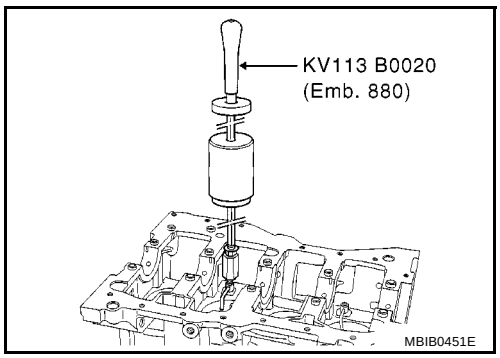
2. Remove the using a suitable brush.



3. Screw Tool KV113B0120 (Mot. 1485-01) in the drilled out jets using a 6 mm (0.24 in) Allen key which must slide into the tool.



4. Screw Tool KV113B0020 (Emb. 880) onto KV113B0120 (Mot. 1485-01) and remove the oil jet.



Assembly

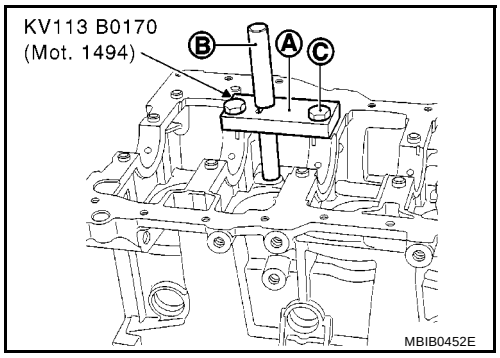
EBS01C75

INSTALLATION OF OIL JETS

- The oil jets must be installed using Tool KV113B0170 (Mot. 1494).

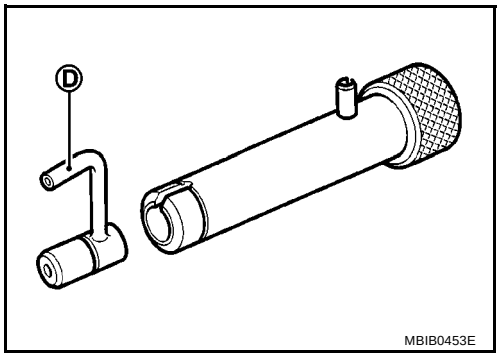
Installation of The Oil Jets For No. 1 and No. 3 Cylinders

1. Install plate (A) of Tool KV113B0170 (Mot. 1494) onto the cylinder block (as shown in the figure) without tightening the two bolts (C).
2. Position the guide rod (B) in the plate (A) and the end of the guide rod in the hole of the oil jet to center the plate (A).
3. Tighten the two bolts (C).
4. Remove the guide rod.

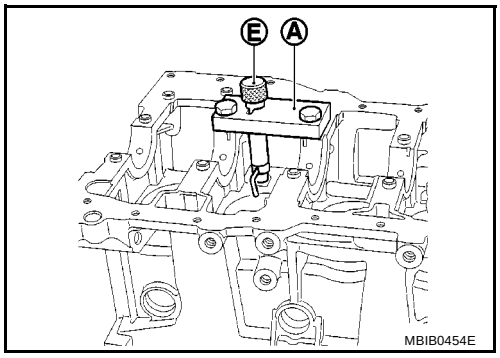


5. Install the push rod instead of the guide rod, then insert the oil jet into the push rod.

   NOTE:
   Check that the oil jet is correctly oriented with the end of the jet (D) directed towards the center of the cylinder.

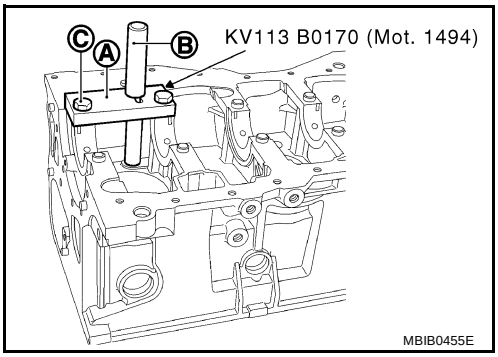


6. With a hammer, tap the push rod until the shoulder (E) of the push rod comes into contact with the plate (A).



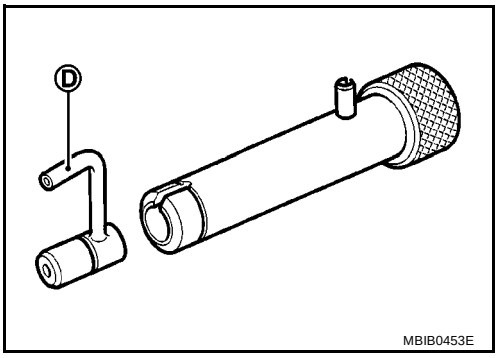
Installation of The Oil Jets For No. 1 and No. 4 Cylinders

1. Fit plate (A) of Tool KV113B0170 (Mot. 1494) onto the cylinder block (as shown in the figure) without tightening the two bolts (C).
2. Position the guide rod (B) in the plate (A) and the end of the guide rod in the hole of the oil jet to center the plate (A).
3. Tighten the two bolts (C).
4. Remove the guide rod.

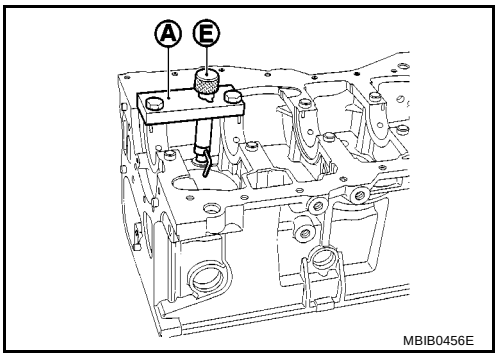


5. Position the push rod instead of the guide rod, then insert the oil jet into the push rod.

   NOTE:
   Check that the oil jet is correctly oriented with the end of the jet (D) directed towards the center of the cylinder.



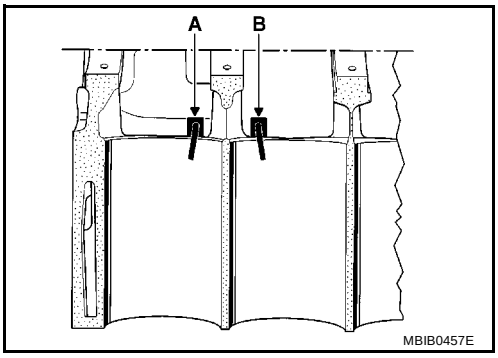
6. With a hammer, tap the push rod until the shoulder (E) of the push rod comes into contact with the plate (A).



Orientation Of The Oil Jets (See Diagram Below)

A	Orientation of the oil jets of No. 2 and No. 4 cylinders
B	Orientation of the oil jets of No. 1 and No. 3 cylinders

1. Clean the cylinder block and crankshaft by passing a wire through the lubrication channels.



METHOD FOR INSTALLING THE OIL COOLER AND OIL FILTER

1. Install oil cooler. Refer to LU-28, "OIL COOLER" .
2. Install oil filter. Refer to LU-26, "OIL FILTER" .

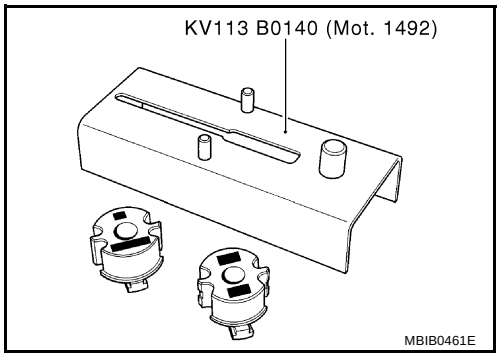
Removing The Piston Pins

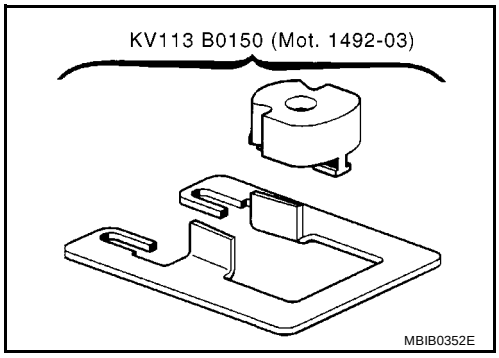
EBS01C76

NOTE:
It is imperative to mark the connecting rod to match it to its piston, because the piston height classes in the same engine may be different (see Technical Specifications section).
To remove the piston pin, remove the snap ring using a screwdriver, then release the pin.

CONNECTING ROD BEARING

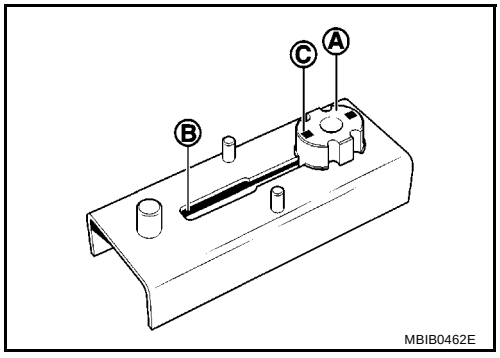
1. The connecting rod bearing are installed using Tool KV113B0140 (Mot. 1492) and Tool KV113B0150 (Mot. 1492-03).



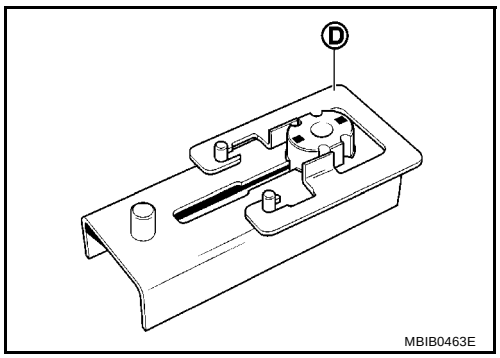


ON THE CONNECTING ROD BODY

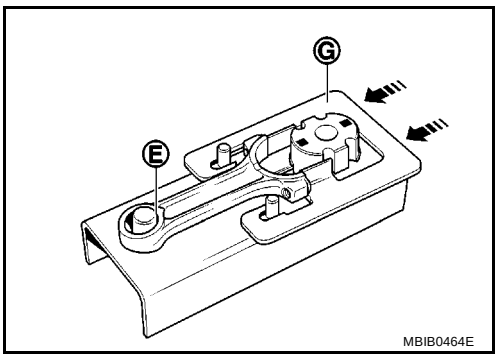
1. Slide the connecting rod bearing support (A) of Tool KV113B0150 [Mot. 1492-03 (positioning the engraved mark (B) as shown in the figure)] into the groove (C) of the base of Tool KV113B0140 (Mot. 1492).



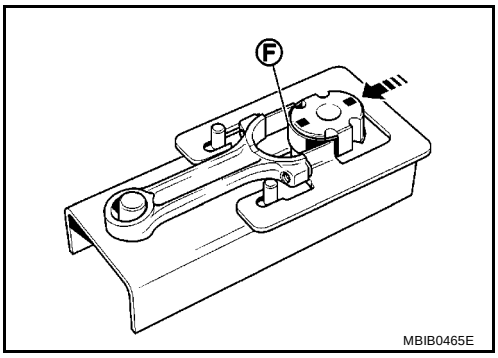
2. Install the guide (D) of Tool KV113B0150 (Mot. 1492-03) onto the base (as shown in the figure).



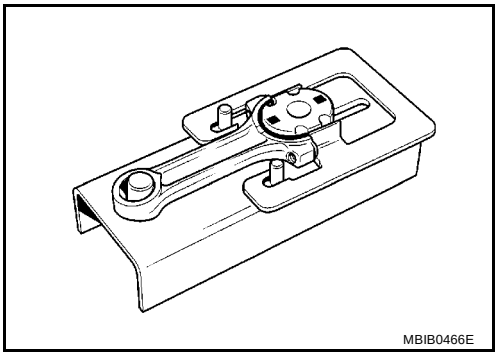
3. Lay the body of the connecting rod on the base of the tool (as shown in the diagram). Check that the lower part (E) of the small end is touching the centering pin and push the guide (G) in the direction of the arrow.



4. Lay the connecting rod bearing [with a width of 20.625 mm (0.8120 in)] (F) on the connecting rod bearing support, then push it in the direction of the arrow (as shown in the figure).

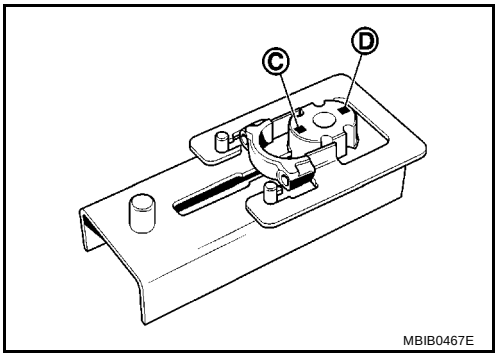


5. Bring the connecting rod support up against the base of the connecting rod body.
6. Remove the connecting rod body support and repeat the operation for the remaining connecting rod bodies.

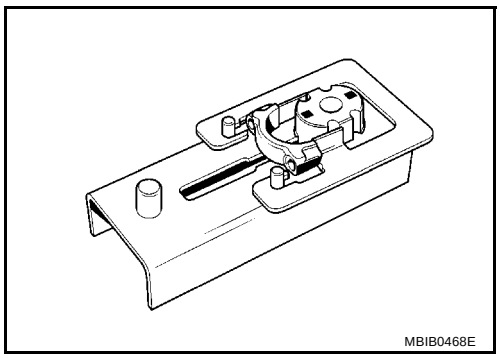


ON THE CONNECTING ROD CAP

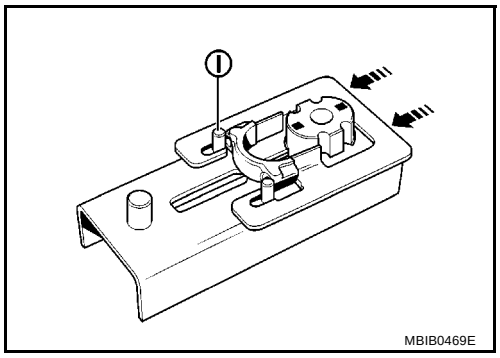
1. Position the connecting rod bearing support either on the engraved mark (C) if the width of the connecting rod bearing is equal to 20.625 mm (0.8120 in).
2. Position the connecting rod bearing support either on the engraved mark (D) if the width of the connecting rod bearing is equal to 17.625 mm (0.6939 in).



3. Install the connecting rod cap as shown in the figure.

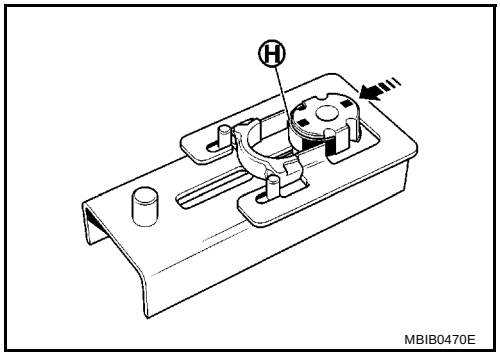

MBIB0468E

4. Push the guide (in the direction of the arrow) until the connecting rod cap is in contact with the pins (I) on the base of the tool.



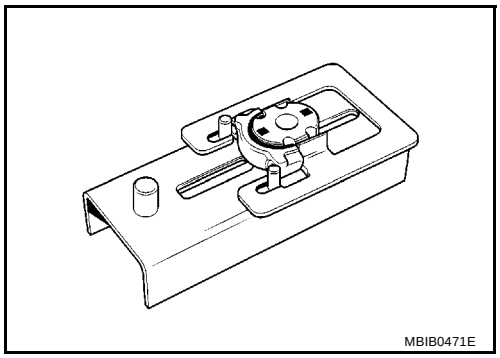
MBIB0469E

5. Install the connecting rod bearing (H) on the bearing support, then push it in the direction of the arrow (as shown in the figure).



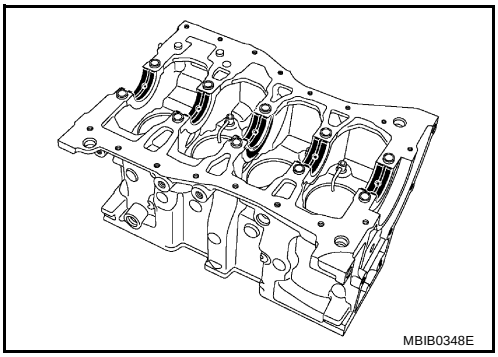
MBIB0470E

6. Bring the connecting rod bearing support up against the base of the connecting rod cap.
7. Remove the connecting rod bearing support and repeat the operation for the remaining connecting rod caps.

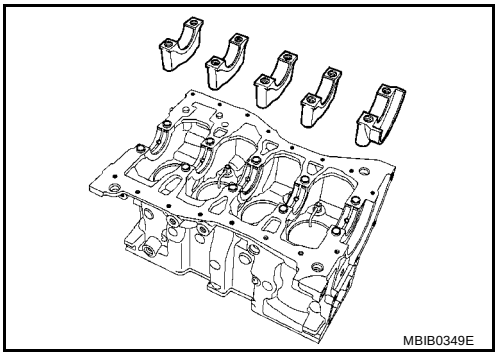

MBIB0471E

INSTALLATION OF MAIN BEARING

1. Position the grooved main bearing on the cylinder block.

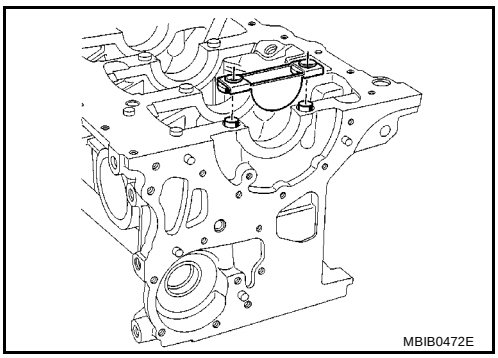

MBIB0348E

2. Install the smooth bearing cap on the bearings.

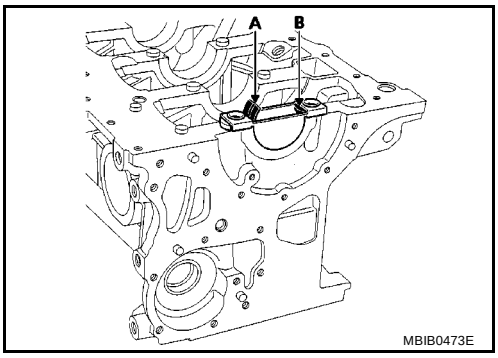

MBIB0349E

ON THE CYLINDER BLOCK

1. Position tool KV113B0160 (Mot. 1493-01) on the cylinder block.


MBIB0472E

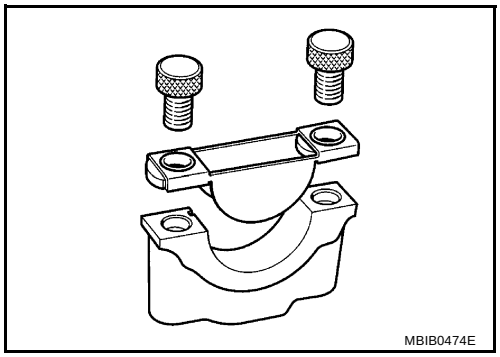
2. Install the bearing cap in Tool KV113B0160 (Mot. 1493-01), then press at (A) until the bearing cap is touching at (B) with KV113B0160 (Mot. 1493-01).



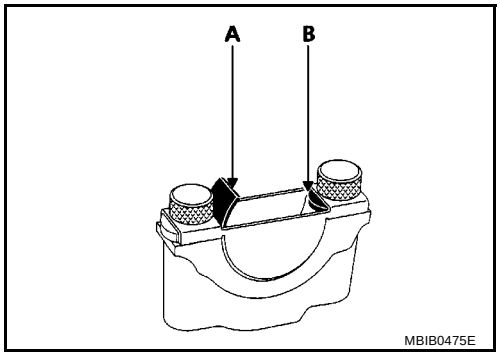
MBIB0473E

ON THE BEARING CAPS

1. Position Tool KV113B0160 (Mot. 1493-01) on the bearing cap.

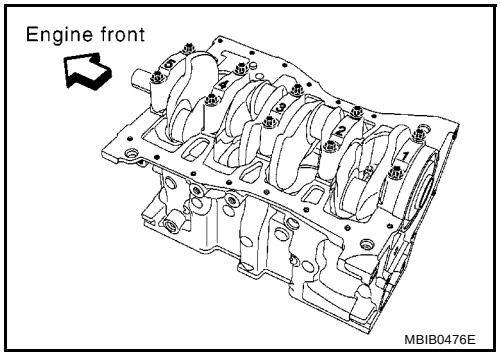

MBIB0474E

2. Install the main bearing in Tool KV113B0160 (Mot. 1493-01), then press at (A) until the main bearing is touching at (B) with Tool KV113B0160 (Mot. 1493-01).



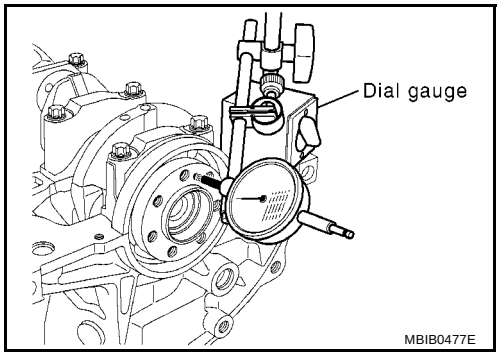
MBIB0475E

3. Oil the main bearing.
4. Install the crankshaft.
5. Install the lateral shims on bearing No. 3, putting the grooves on the crankshaft side.
6. Install the main bearing caps on bearing cap No. 1 (these are numbered from 1 - 5 and these numbers should be positioned opposite the water pump). Then tighten the bolts to a torque of 27 N·m (2.8 kg-m, 20 ft-lb) plus an angle tightening of 47°±5°.



MBIB0476E

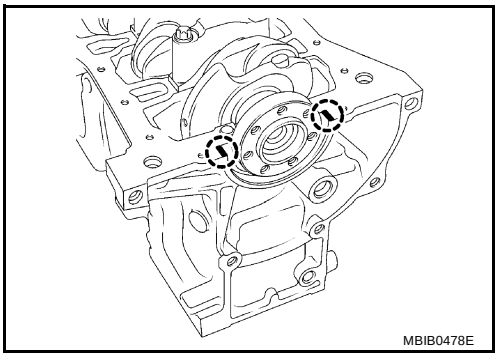
7. Check the lateral clearance of the crankshaft which should be without wear on lateral shims: 0.045 - 0.252 mm (0.0018 - 0.0099 in)
8. Check the lateral clearance of the crankshaft which should be with wear on the lateral shims: 0.045 - 0.852 mm (0.0018 - 0.0335 in)



MBIB0477E

INSTALLATION OF NO. 1 BEARING

1. **Degrease the gasket faces (of the cylinder block and bearing No. 1). They should be clean, dry and free from grease (in particular, remove finger marks).**
2. Lay two beads of liquid sealant with a width of 1 mm (0.04 in) on bearing No. 1 of the cylinder block.
   Tighten the bolts of bearing cap No. 1 to a torque of 27 N·m (2.8 kg-m, 20 ft-lb) plus an angle tightening of 47°±5°.



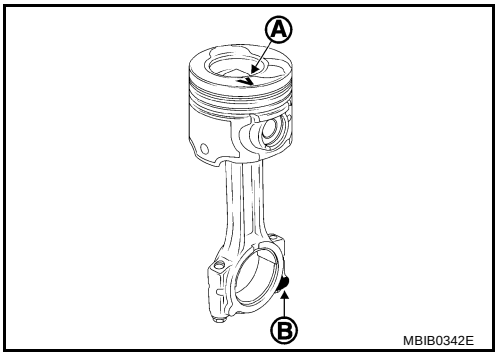
CONNECTING RODS / PISTON ASSEMBLY

- The pistons have a mark engraved on their heads indicating the engine rear side.

1. Oil the piston pin.
2. Check that the piston pins rotate correctly in the new piston and in the matching connecting rod.

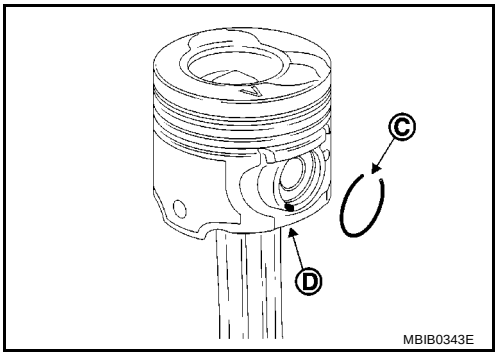
Direction Of Installation Of The Connecting Rod In Relation To The Piston

- Point the mark (A) engraved on the top of the piston upwards and the flat (B) of the big end downwards as shown in the figure.



DIRECTION FOR INSTALLATION THE SNAP RINGS ON THE PISTON

- Position the opening (C) of the snap rings opposite the removal and fitting channel (D).

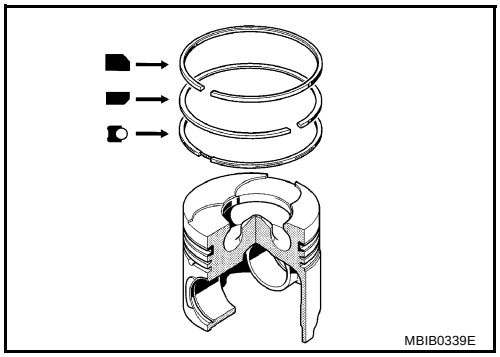


INSTALLATION OF THE SNAP RINGS

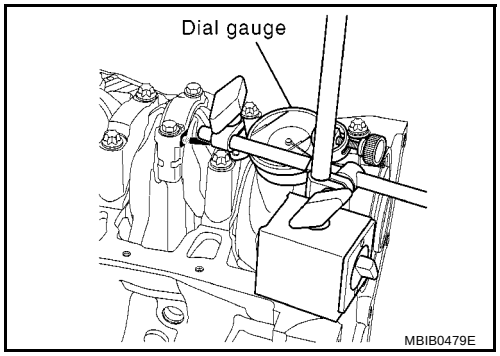
1. Rings set to their original adjustment must be free within their channels.
2. Ensure the snap rings are fitted the correct way, with the word TOP pointing upwards.

Orientation Of The Piston Rings In The Piston

1. Ensure the break in each piston ring is correctly oriented as shown in the figure.



2. Apply new engine oil to the pistons.
3. Install the connecting rod/piston assemblies into the cylinder block using the ring, being careful to fit them the right way round (mark towards the flywheel).
4. Install the connecting rods onto the oiled crankshaft pins of the crankshaft.
5. Install the connecting rod caps, ensuring they are correctly matched.
6. Tighten the big end cap bolts to a torque of 20 N·m (2.0 kg-m, 15 ft-lb), plus an angle tightening of 45°±6°.
7. Inspect that the big ends have the correct lateral clearance of 0.205 to 0.467 mm (0.0081 to 0.0184 in).

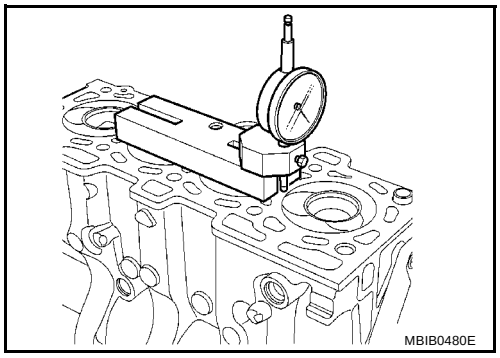


CHECKING PISTON PROTRUSION

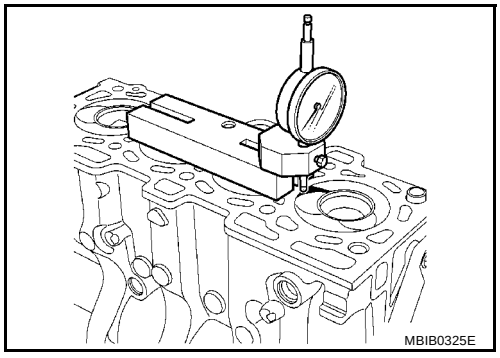
1. Clean the piston head.
2. Turn the crankshaft one turn in its operating direction to bring piston No. 1 close to TDC.
3. Install Tool KV113B0050 (Mot. 252-01) on the piston.
4. Install Tool KV113B0040 (Mot. 251-01) equipped with a gauge on support plate KV113B0050 (Mot. 252-01), and find TDC.

   NOTE:
   All measurements must be carried out along the longitudinal axis of the engine, in order to eliminate any errors due to tilting of the piston.

   WARNING:
   The gauge follower must not be in the valve clearance.

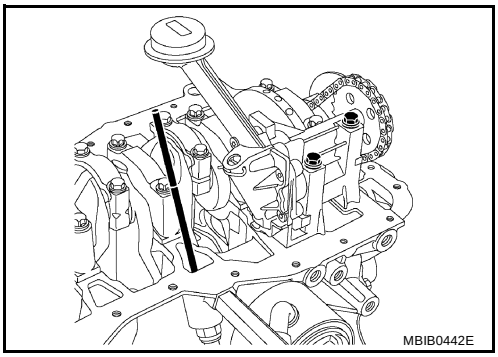


5. Inspect the piston protrusion which must be 0.099 to 0.285 mm (0.0039 to 0.0112 in).



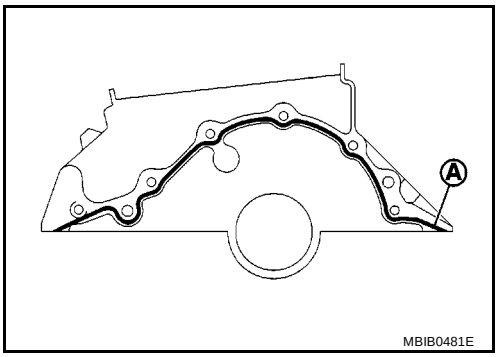
INSTALLATION OF REAR OIL SEAL RETAINER AND OIL PUMP

1. Tighten the knock sensor to a torque of 20 N·m (2.0 kg-m, 15 ft-lb).
2. Tighten the oil pressure switch to a torque of 22 N·m (2.2 kg-m, 16 ft-lb).
3. Install the oil pump sprocket and chain to a torque of 25 N·m (2.6 kg-m, 18 ft-lb).


MBIB0442E

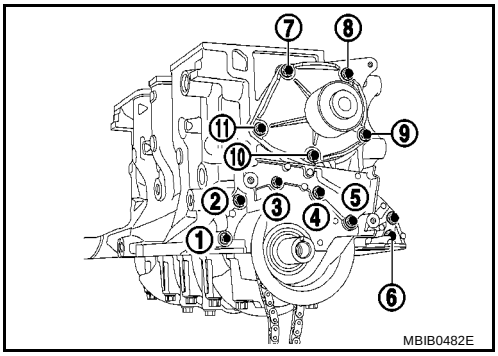
NOTE:
The gasket faces (cylinder block, rear oil seal retainer and water pump) must be clean, dry and free from grease (in particular, remove finger marks).
The rear oil seal retainer should be applied with liquid gasket. The bead (A) must be 1.5 to 2 mm (0.059 to 0.079 in) wide and be applied in accordance with the figure.

- Use Genuine Liquid Gasket or equivalent.



MBIB0481E

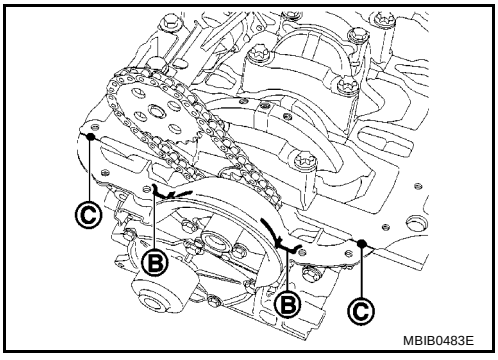
4. Install the rear oil seal retainer.
   - Tighten bolts 1 and 6 to a torque of 8 N·m (0.8 kg-m, 71 in-lb).
   - Tighten bolts 2, 3, 4 and 5 to a torque of 12 N·m (1.2 kg-m, 9 ft-lb).
   - Tighten bolts 1 and 6 to a torque of 12 N·m (1.2 kg-m, 9 ft-lb).
5. Put a new gasket to water pump face and install the water pump. Put a drop of locking sealant on the bolts, then tighten them to a torque of 11 N·m (1.1 kg-m, 8 ft-lb) in the numerical order.
   - Use Genuine thread locking sealant or equivalent.



MBIB0482E

NOTE:
The gasket faces (cylinder block and rear oil seal retainer) must be clean, dry and free from grease (in particular, remove finger marks).

6. Apply four beads (B) of liquid gasket, with a diameter of 5 mm (0.20 in).
7. Apply two drops (C) of liquid gasket, with a diameter of 7 mm (0.28 in) at the intersection of the rear oil seal retainer and the cylinder block.
   - Use Genuine Liquid Gasket or equivalent.



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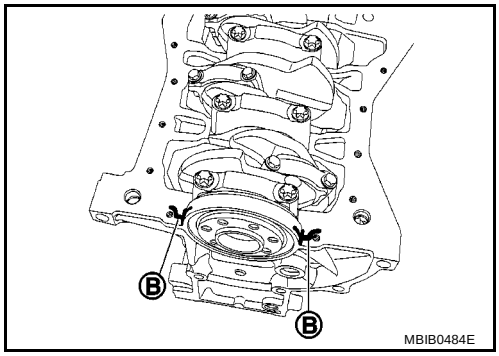
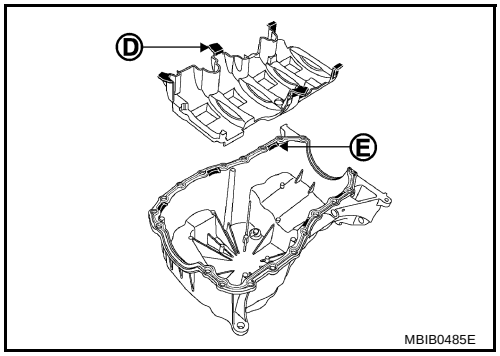
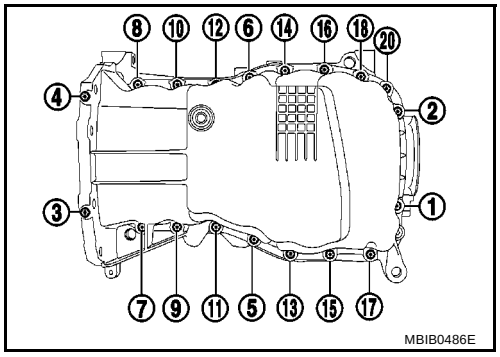


8. When installing the oil pan, ensure that the tabs (D) of the baffle plate are correctly positioned in the slots (E).
9. When installing the oil pan, ensure that the cylinder block and the oil pan are correctly aligned on the flywheel side, to prevent the clutch housing from being damaged when installing the transaxle.
10. Install the baffle plate.

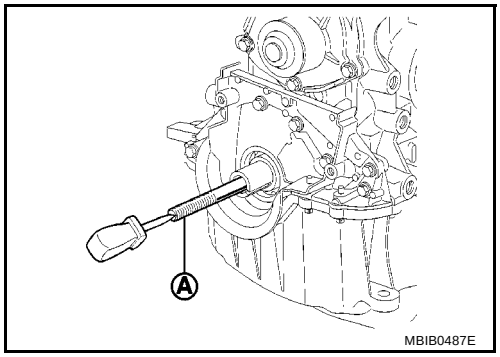


11. Install the oil pan and tighten the bolts as follows:
    - Tighten the bolts in the numerical order shown in the figure to a torque of 8 N·m (0.8 kg-m, 71 in-lb).
    - Tighten the mounting bolts of oil pan on the clutch housing without locking.
    - Tighten the bolts in the numerical order shown in the figure to a torque of 15 N·m (1.5 kg-m, 11 ft-lb).
    - Tighten the mounting bolts of oil pan on the clutch housing to a torque of 44 N·m (4.5 kg-m, 32 ft-lb).

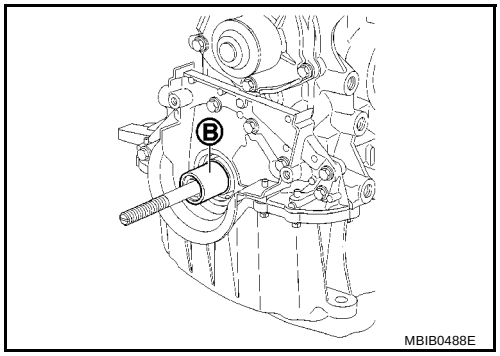


INSTALLATION OF THE CRANKSHAFT SEAL GASKETS

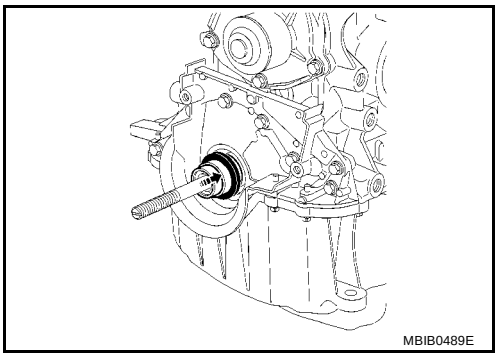
1. Crankshaft elastomer seal, timing side.
2. Screw the threaded rod (A) of Tool KV113B0220 (Mot. 1586) into the crankshaft.



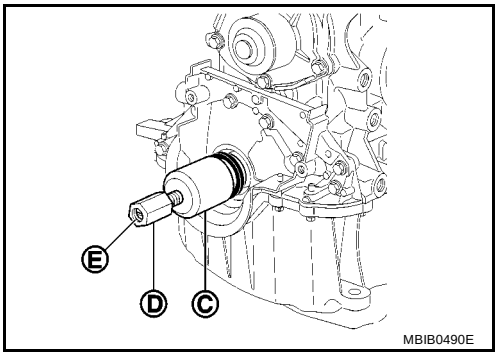
3. Position the spacer (B) of Tool KV113B0220 (Mot. 1586) on the crankshaft.



4. Install the protector complete with the seal onto the spacer, taking care not to touch the seal.


MBIB0489E

5. Install the cover (A) and the nut (B) (putting the threaded part (C) of the nut on the side away from the engine) of Tool KV113B0220 (Mot. 1586).



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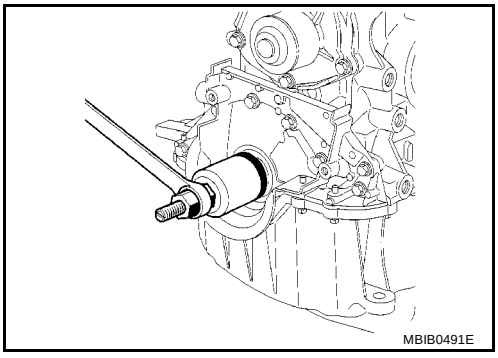
6. Tighten the nut until the cover touches the spacer.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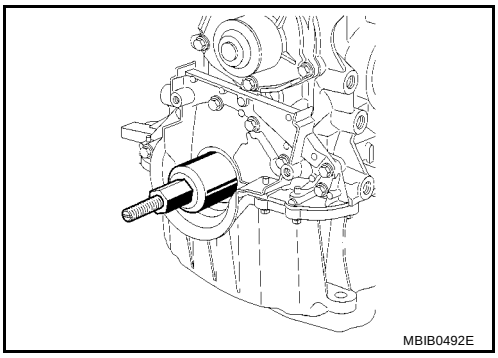
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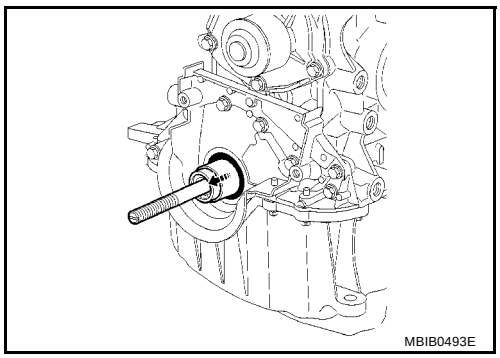
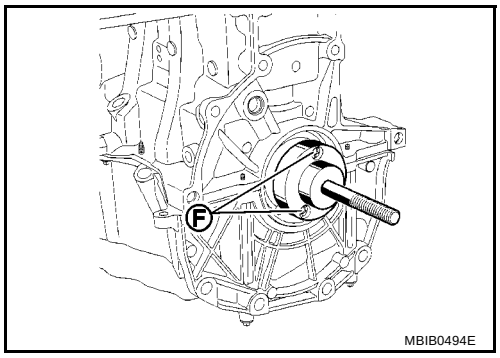
7. Remove the nut, the cover, the protector and the threaded rod.

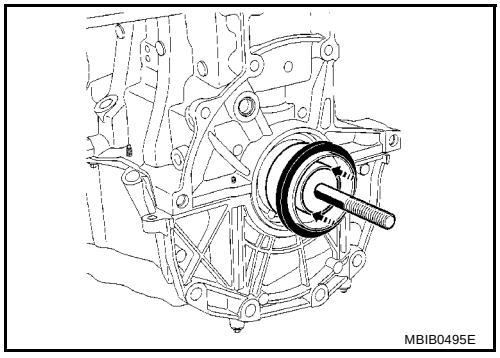

MBIB0493E

8. Crankshaft elastomer seal, flywheel side.
9. Install Tool KV113B0210 (Mot. 1585) on the crankshaft, securing it with bolts (F).

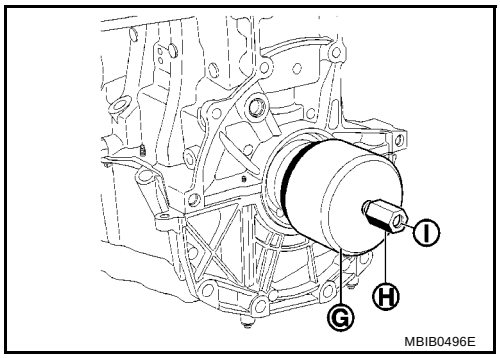


MBIB0494E

10. Put the protector complete with the seal on Tool KV113B0210 (Mot. 1585), being careful not to touch the seal.


MBIB0495E

11. Install the cover (G) and nut (H) (putting the threaded part (I) of the nut on the side away from the engine) of Tool KV113B0210 (Mot. 1585).



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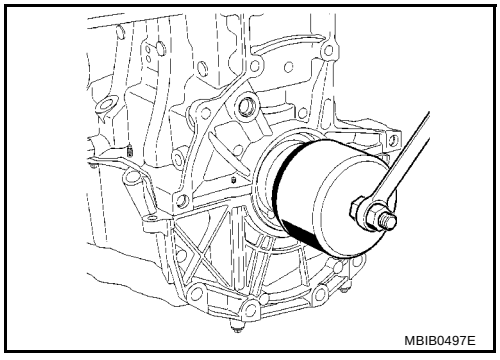
12. Tighten the nut until the cover touches the cylinder block.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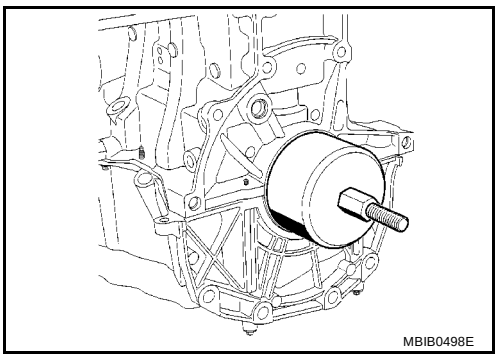
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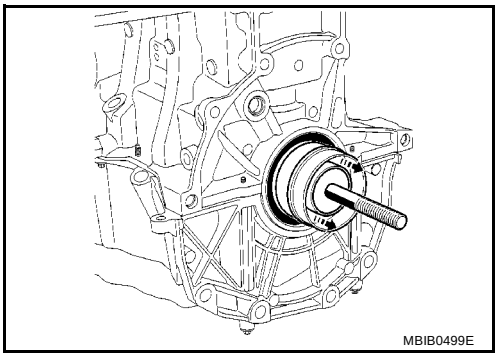
13. Remove the nut, the cover, the protector and the threaded rod.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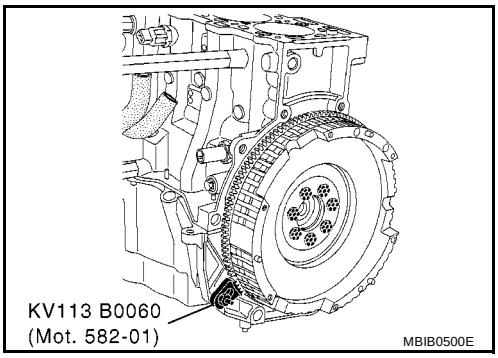
14. Install Tool KV113B0060 (Mot. 582-01) and tighten the new bolts to a torque of 50 to 55 N·m (5.1 to 5.6 kg-m, 37 to 40 ft-lb).



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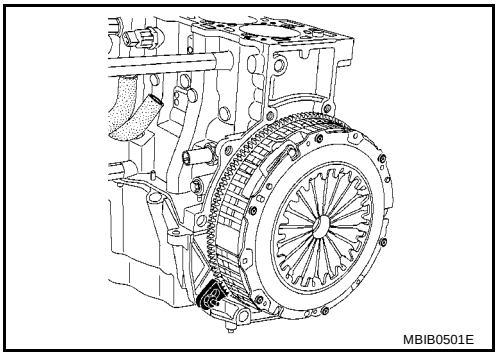
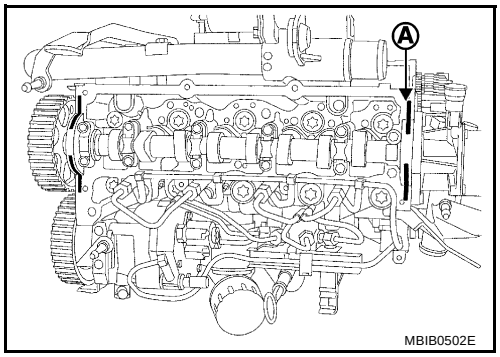
15. Install the clutch housing, tightening the bolts to a torque of 8 N·m (0.8 kg-m, 71 in-lb).
16. Remove Tool KV113B0060 (Mot. 582-01).


MBIB0501E

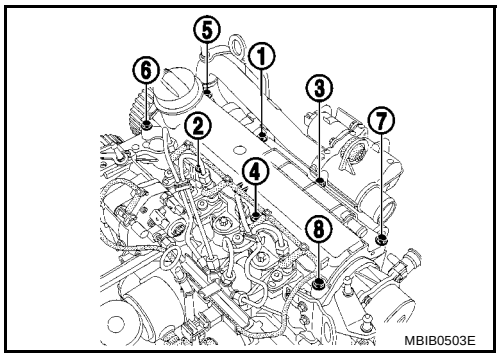
INSTALLATION OF THE CYLINDER HEAD

1. Position the pistons at mid-stroke.
2. Install the cylinder head gasket using the centering dowels of the cylinder block.
3. Tighten the cylinder head, Refer to EM-296, "ASSEMBLY OF THE CYLINDER HEAD" .

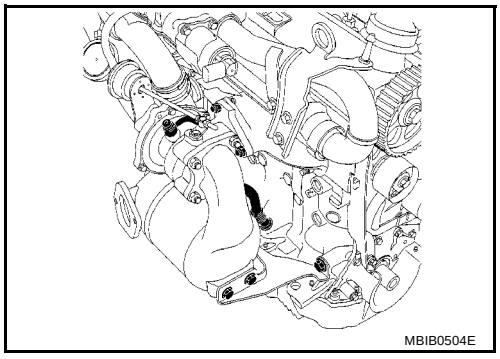
   NOTE:
   The gasket faces (cylinder head and rocker cover) must be clean, dry and free from grease (in particular, remove finger marks).
4. Lay four beads (A) of liquid gasket, with a diameter of 2 mm (0.08 in).
   - Use Genuine Liquid Gasket or equivalent.



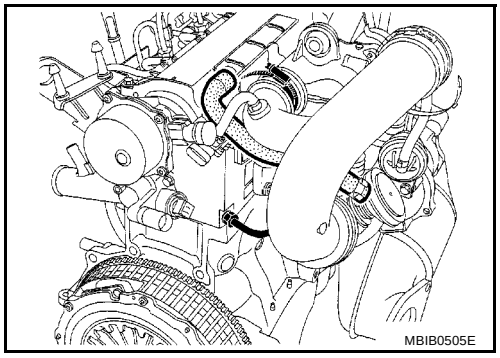
5. Install the rocker cover, tightening the bolts to a torque of 10 N·m (1.0 kg-m, 7 ft-lb) in the numerical order as shown.



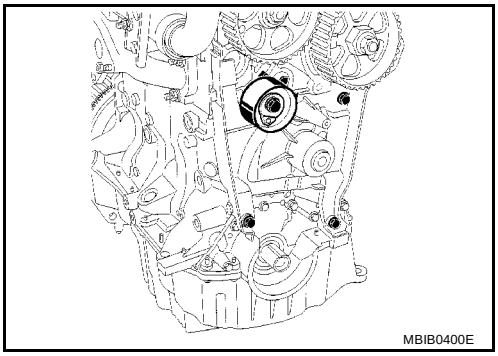
6. Put new seals on the pipe ends and install the turbocharger oil return pipe.
7. Install the turbocharger, tightening the nuts and the torx bolt to a torque of 26 N·m (2.7 kg-m, 19 ft-lb).
8. Install the catalytic converter bracket.
9. Install the turbocharger oil supply pipe.



10. Tighten the bolts of the turbocharger oil return pipe to a torque of 9 N·m (0.9 kg-m, 80 in-lb).
11. Tighten the nut and the bolt of the turbocharger oil supply pipe to a torque of 23 N·m (2.3 kg-m, 17 ft-lb).
12. Install the oil vapor rebreathing pipe.
13. Install the new turbocharger air ducts.



14. Install the inner timing cover.
15. Install the timing tensioner.

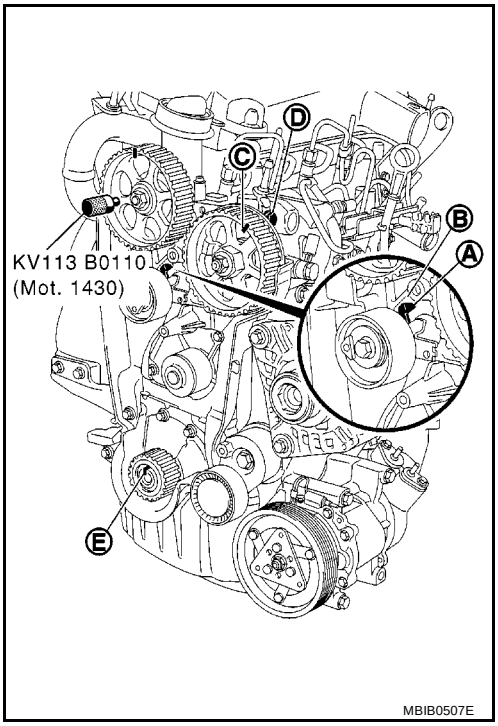


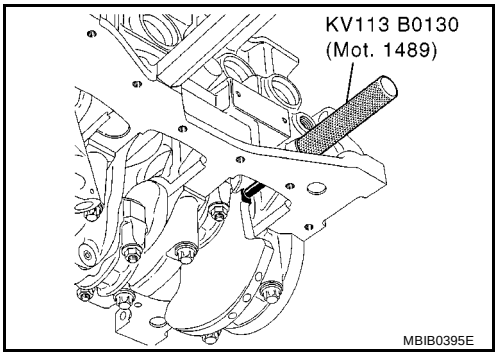
TIMING ADJUSTMENT

CAUTION:

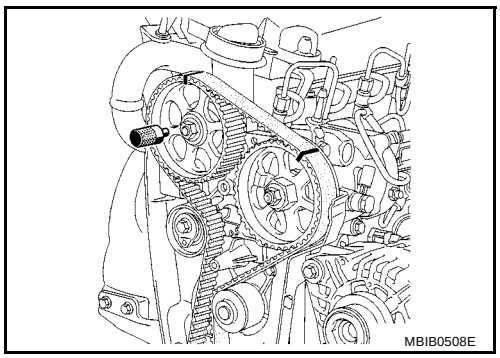
It is essential to degrease the end of the crankshaft, the bore of the crankshaft sprocket and the bearing faces of the accessories pulley to prevent any slip between the timing and the crankshaft which would risk destroying the engine.
Ensure that the peg (A) of the tension wheel is correctly positioned in the groove (B).

1. Insert Tool KV113B0110 (Mot. 1430) in the camshaft and cylinder head pulley holes.
2. Check that the mark on the high pressure pump pulley (C) is opposite the bolt head (D).
3. Check that the crankshaft is touching Tool KV113B0130 (Mot. 1489) (the crankshaft groove (E) must be facing upwards).

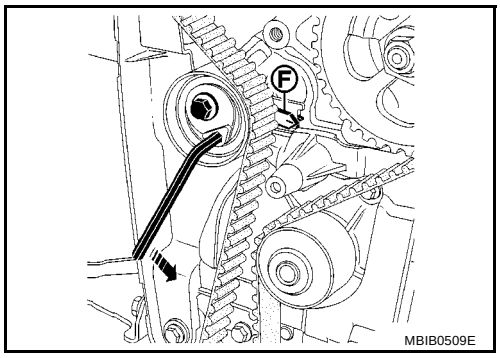




4. Install the timing belt, aligning the marks on the belt with those on the camshaft and fuel injection pump sprockets (19 teeth spaces on the belt between the marks on the camshaft and pump sprockets).


MBIB0508E

5. Using a 6 mm (0.24 in) Allen key, move the movable index (F) of the tension wheel into the position shown below, by turning the key counterclockwise.



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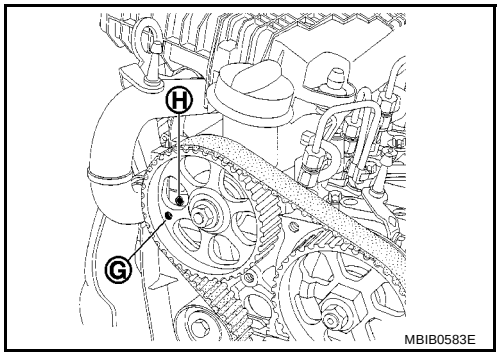
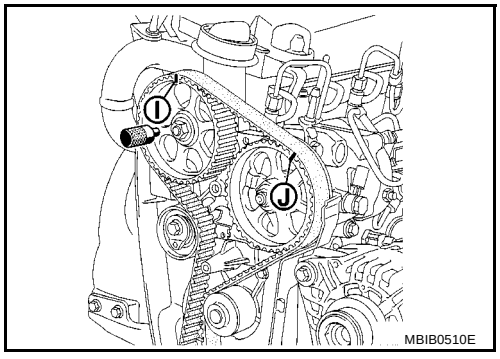
6. Tighten the tension wheel bolts to a torque of 25 N·m (2.6 kg-m, 18 ft-lb).
7. Install the crankshaft pulley, tightening the M12 bolt to a torque of 60 N·m (6.1 kg-m, 44 ft-lb), then angle tighten to 100°±10°, or M14 bolt to a torque of 120 N·m (12 kg-m, 89 ft-lb), then angle tighten to 95°±15°.
8. Remove Tool KV113B0130 (Mot. 1489) and Tool KV113B0110 (Mot. 1430).
9. Turn the crankshaft two full turns in a clockwise direction (timing side). Just before the hole (G) of the camshaft pulley is opposite the cylinder head hole (H), Tool KV113B0130 (Mot. 1489) into the cylinder block.



MBIB0583E

10. Then move the crankshaft slowly and without jolting it until it is resting on the pin.
11. Check that Tool KV113B0110 (Mot. 1430) is correctly inserted in the holes of the camshaft and cylinder head pulleys and that there are 19 teeth spaces between the marks on the camshaft (I) and the fuel pump (J) sprockets.
12. Remove Tool KV113B0130 (Mot. 1489) and Tool KV113B0110 (Mot. 1430).



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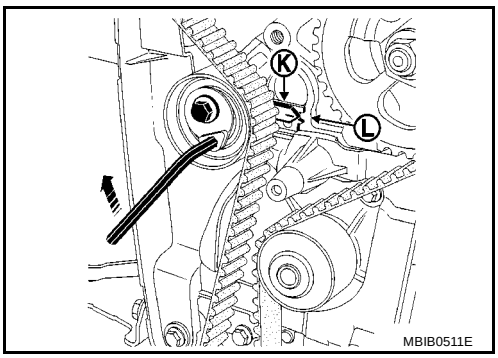
13. Undo the tension wheel bolt by a maximum of one turn while holding it using a 6 mm (0.24 in) Allen key, then gradually bring the movable index (K) (by turning the key clockwise) to the center of the timing window (L) and tighten the nut to a torque of 25 N·m (2.6 kg-m, 18 ft-lb).
14. Install the cap of the TDC pin, apply liquid gasket to the thread and tighten to a torque of 20 N·m (2.0 kg-m, 15 ft-lb).



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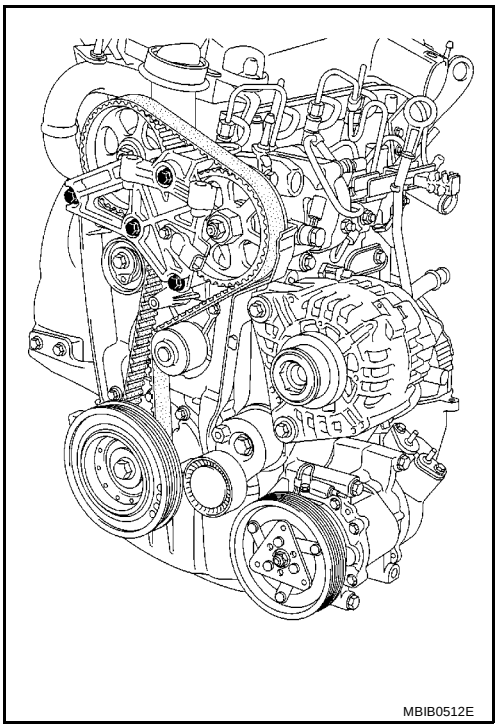
15. Install the cylinder head suspended bracket. Tighten the bolts to a torque of 21 N·m (2.1 kg-m, 15 ft-lb).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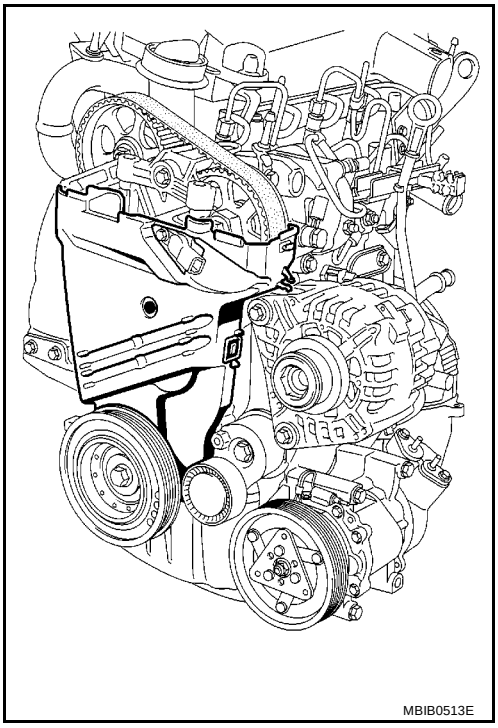
16. Install the lower timing cover by positioning the tab (M) into the hole (N) on the inner timing cover.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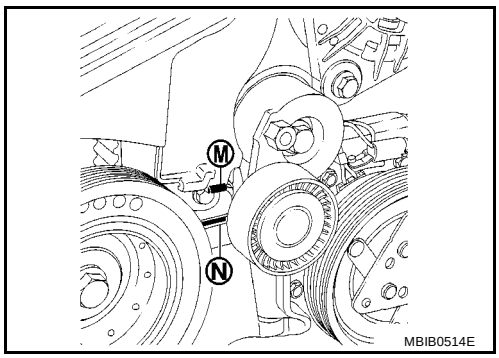
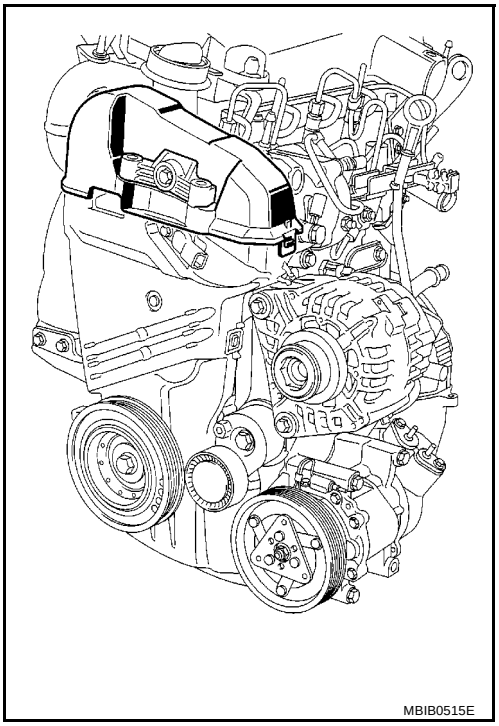
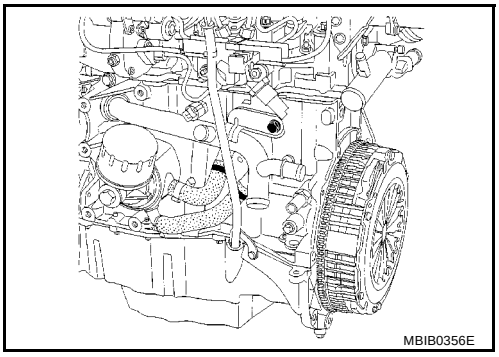


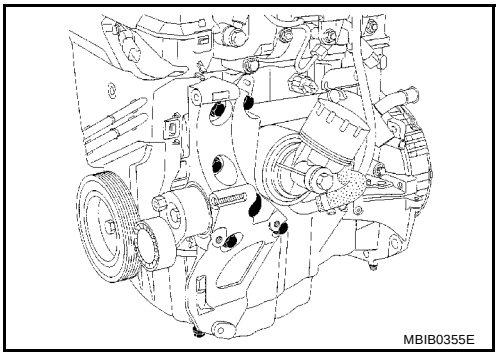
17. Install the upper timing cover.
18. Remove the engine from the Tool KV113B0070 (Mot. 792-03).



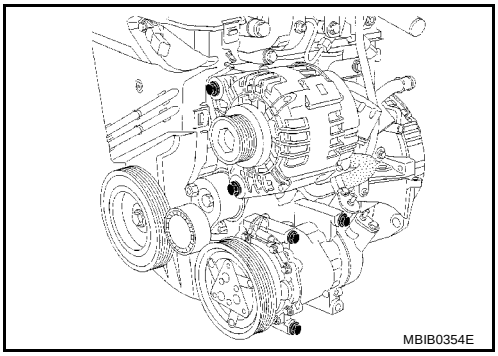
19. Install the water pipe. Tighten the bolt to a torque of 22 N·m (2.2 kg-m, 16 ft-lb).
20. Install the two water hoses.



21. Install the alternator bracket. Tighten the bolts to a torque of 44 N·m (4.5 kg-m, 32 ft-lb).



22. Install the alternator. Tighten the bolts to a torque of 21 N·m (2.1 kg-m, 15 ft-lb).
23. Install the A/C compressor. Tighten the bolts to a torque of 21 N·m (2.1 kg-m, 15 ft-lb).
24. Install the power steering pump or the washer which replaces the pulley (if the engine has one). Tighten the bolts to a torque of 21 N·m (2.1 kg-m, 15 ft-lb).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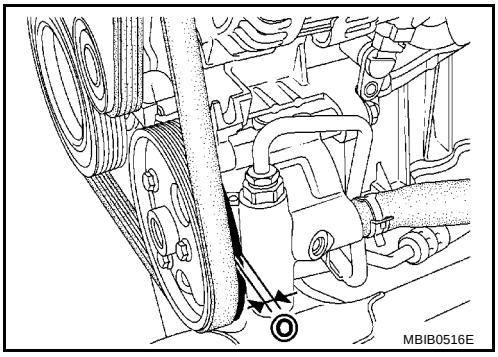
25. Install the drive belt.

NOTE:
The accessories belt has five teeth as opposed to the pulleys which have six. It is therefore essential to ensure that tooth "O" remains free when installing the belt.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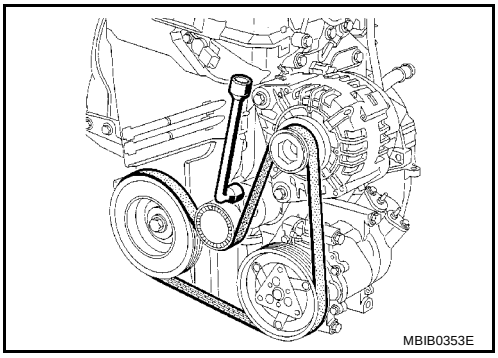
Models With A/C Compressor

NOTE:
The engine must be turned through two revolutions in order to position the belt correctly.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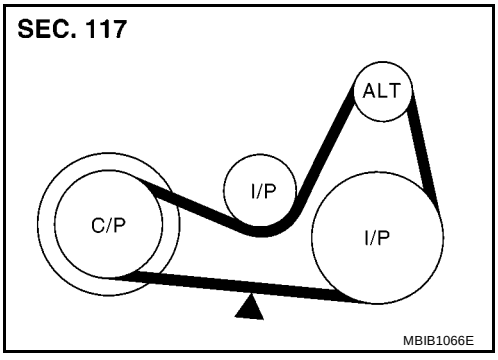
Models Without A/C Compressor

1. The belt is tensioned using tool belt tension gauge (commercial service tool) (with the two mounting bolts of the tensioner undone).
2. The tension value is 233±5 Hz.

NOTE:
The engine must be turned through two revolutions in order to position the belt correctly.



MBIB1066E

BASIC INSPECTION

PFP:00013

Cylinder Head

EBS01C77

CYLINDER HEAD TIGHTENING PROCEDURE

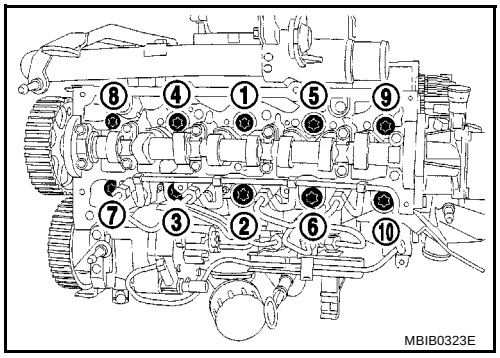
NOTE:
Use a syringe to remove any oil which may have entered the cylinder head mounting bolt holes to achieve correct tightening of the bolts.

1. All bolts must always be changed after removal. Do not oil the new bolts.
2. Tighten all the bolts in the numerical order as shown.

   : 25 N·m (2.6 kg-m, 18 ft-lb)

3. Check that all the bolts are correctly tightened to 25 N·m (2.6 kg-m, 18 ft-lb) then angle tightening of 245 to 265 degrees.

Do not retighten the cylinder head bolts after performing this procedure.



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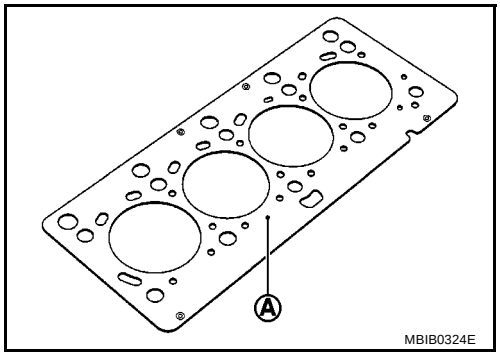
THICKNESS OF THE CYLINDER HEAD GASKET

- The thickness of the cylinder head gasket is measured at (A):

  Thickness : 0.75 - 0.81 mm (0.0295 - 0.0319 in)



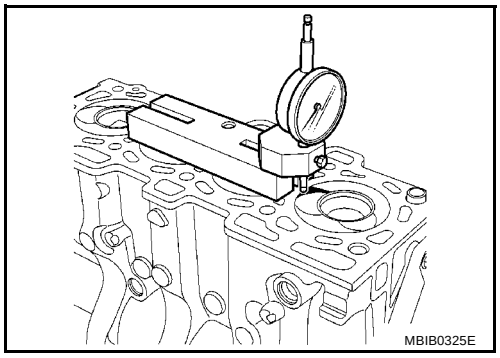
MBIB0324E

INSPECTION OF THE PISTON PROTRUSION

1. Clean the piston heads in order to eliminate any traces of deposits.
2. Turn the crankshaft one turn in its operating direction to bring piston No. 1 close to TDC.
3. Install Tool KV113B0040 (Mot. 251-01) equipped with a gauge on its base plate KV113B0050 (Mot. 252-01), and find TDC of the piston.

NOTE:
All measurements must be carried out along the longitudinal axis of the engine, in order to eliminate any errors due to tilting of the piston.

WARNING:
The gauge follower must not be in the valve clearance.
Measure the piston protrusion.
The protrusion must be: 0.099 - 0.285 mm (0.0039 - 0.0112 in).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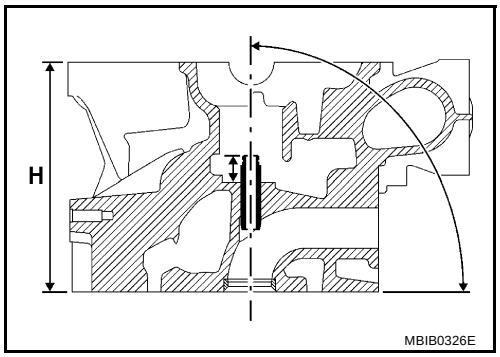
Height of the cylinder head:

H = 127 mm (5.00 in)

Gasket face bow:

Cylinder head : 0.05 mm (0.0020 in)

Cylinder block : 0.03 mm (0.0012 in)



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NO REGRINDING IS AUTHORIZED
Test the cylinder head to detect possible cracks using the cylinder head test container (comprising a tray and a kit suited to the cylinder head, plug, sealing plate and blanking plate).

VALVE

Valve Dimensions

Stem diameter:
- Intake: 5.969 - 5.985 mm (0.2350 - 0.2356 in)
- Exhaust: 5.955 - 5.971 mm (0.2344 - 0.2351 in)

Face angle:
- Intake and exhaust: 90°

Head diameter:
- Intake: 33.38 - 33.62 mm (1.3142 - 1.3236 in)
- Exhaust: 28.88 - 29.12 mm (1.1370 - 1.1465 in)

Valve length:
- Intake: 100.73 - 101.17 mm (3.9657 - 3.9831 in)
- Exhaust: 100.53 - 100.97 mm (3.9579 - 3.9752 in)

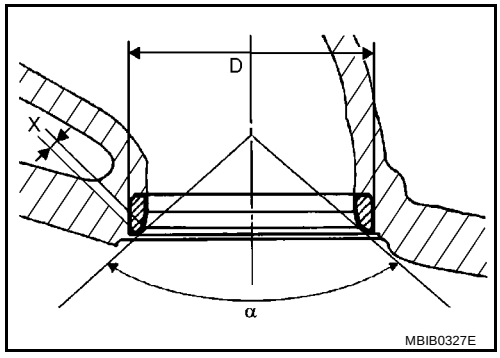
Max. valve lift:
- Intake: 8.015 mm (0.3156 in)
- Exhaust: 8.595 mm (0.3384 in)

Protrusion of valves in relation to the cylinder head gasket face:
- Intake and exhaust: –0.7 to 0.7 mm (–0.028 to 0.028 in)

VALVE SEAT

Seat angle (α):
- Intake and exhaust: 89°30′

Contacting width (X):
- Intake and exhaust: 1.8 mm (0.071 in)



Seat outer diameter (D):
- Intake: 34.444 - 34.460 mm (1.3561 - 1.3567 in)
- Exhaust: 30.034 - 30.050 mm (1.1824 - 1.1831 in)

Diameter of the housing in the cylinder head:
- Intake: 34.444 - 34.474 mm (1.3561 - 1.3572 in)
- Exhaust: 29.955 - 29.985 mm (1.1793 - 1.1805 in)

VALVE GUIDE

Length:
- Intake and exhaust: 40.35 - 40.65 mm (1.5886 - 1.6004 in)

Guide outer diameter:
- Standard: 11.044 - 11.062 mm (0.4348 - 0.4355 in)

Guide inner diameter:

Intake and exhaust
- Not machined: 5.50 - 5.62 mm (0.2165 - 0.2213 in)
- Machined*: 6.000 - 6.018 mm (0.2362 - 0.2369 in)

*** This dimension is measured with the guide fitted in the cylinder head.**

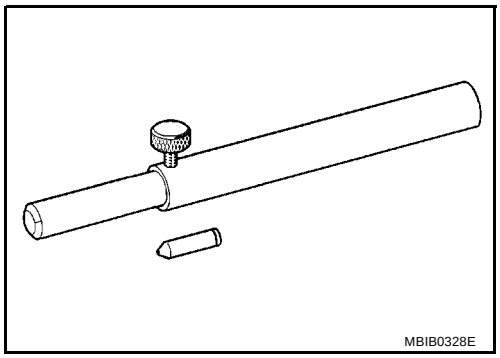
Diameter of the housing in the cylinder head:

Standard : 10.9925 - 11.0075 mm (0.4328 - 0.4334 in)

The intake and exhaust guides have valve stem seals which must be changed each time the valves are removed.

It is imperative to fit the valve stem seals using Tool KV113B0180 (Mot. 1511-01) or suitable tool.

NOTE:
Do not lubricate the valve stem seals before fitting them.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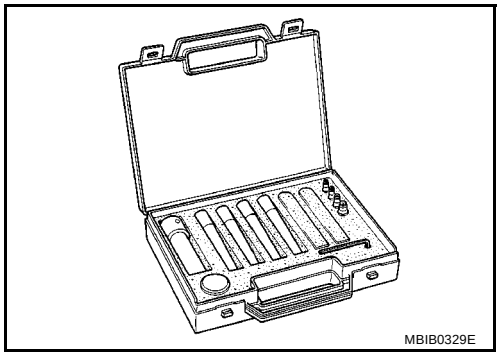
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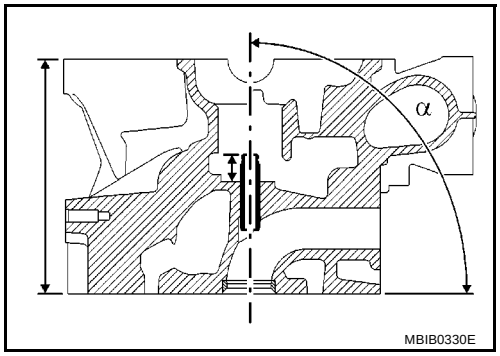
Angle of the intake and exhaust guides (in degrees)

Intake and exhaust : α = 90



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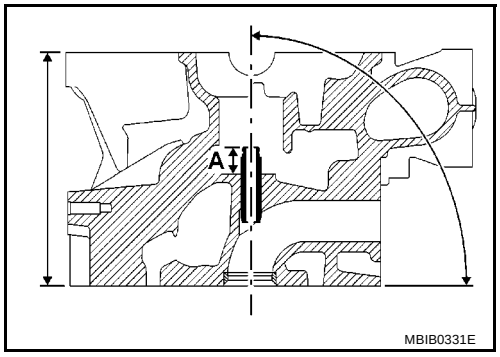
Position of the intake and exhaust valve guides

Intake : A = 14 mm (0.55 in)

Exhaust : A = 14.2 mm (0.559 in)



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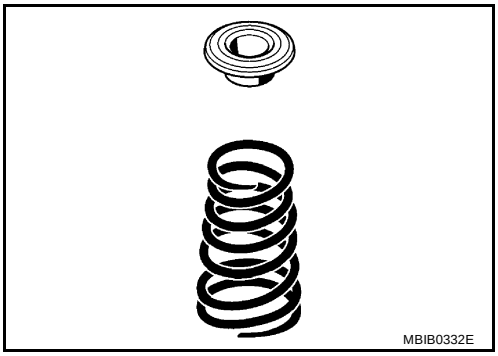
VALVE SPRING

The valve springs are tapered (ensure the correct direction of fitting).



Free height:	**: 43.31 mm (1.7051 in)**
Length under a load of	
230 N (23.5 kg, 51.7 lb)	**: 33.80 mm (1.3307 in)**
500 N (51.0 kg, 112.4 lb)	**: 24.80 mm (0.9764 in)**
Joined spires:	**: 23.40 mm (0.9213 in)**
Wire diameter:	**: 3.45 mm (0.1358 in)**
Inner diameter:	
Bottom	**: 18.78 - 18.82 mm (0.7394 - 0.7409 in)**
Top	**: 13.90 - 14.30 mm (0.5472 - 0.5630 in)**
Outer diameter:	
Bottom	**: 25.50 - 25.90 mm (1.0039 - 1.0197 in)**
Top	**: 20.8 - 21.2 mm (0.819 - 0.835 in)**

WARNING:
This engine does not have any valve spring lower washers.

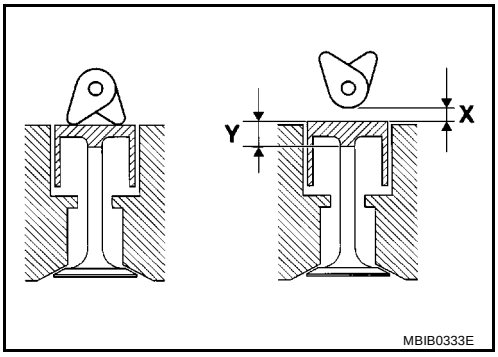
PISTON

Piston outer diameter	**: 34.965 - 34.985 mm (1.3766 - 1.3774 in)**
Diameter of the housing in the cylinder head	**: 35.00 - 35.04 mm (1.3780 - 1.3795 in)**

INSPECTION OF VALVE CLEARANCE

1. Place the valves of the cylinder concerned at the “end of exhaust - beginning of intake” position and inspect the clearance (X).

   NOTE:
   Dimension (Y) corresponds to the tappet thickness sizes (there are 25 sizes at the service parts).



1	4
3	2
4	1
2	3

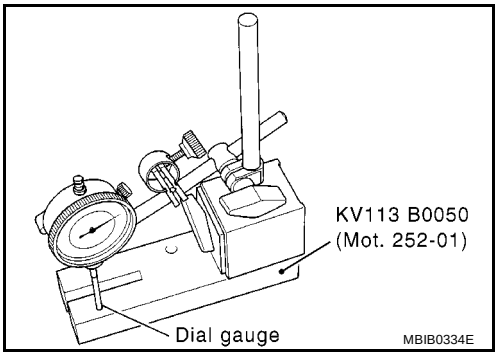
2. Compare the values recorded with the values specified, then replace the tappets which are not within tolerance.

   Clearance, when the engine is cold:

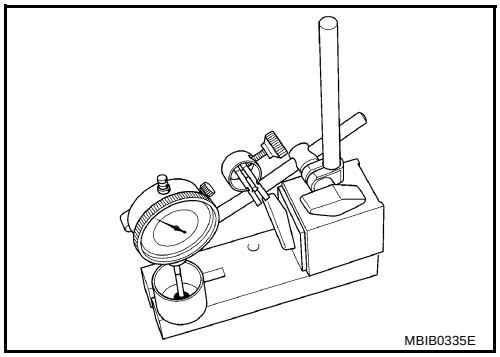
   Intake : 0.125 - 0.25 mm (0.0049 - 0.0098 in)

   Exhaust : 0.325 - 0.45 mm (0.0128 - 0.0177 in)

3. The camshaft must be removed to replace the tappets.
   Determining dimension “Y”.
4. Set up the following assembly using Tool KV113B0050 (Mot. 252-01) and dial gauge, then calibrate the gauge.



5. Raise the gauge extension (without modifying the position of the magnetic support/gauge assembly), then slide in the tappet to be measured.
Note dimension (Y) and repeat the operation for the tappets where the valve clearance is not within tolerance.
Refer to the Replacement Parts Catalogue for the vehicle concerned to select the various thicknesses of the tappet(s). The service parts supplies 25 sizes of single-piece tappets.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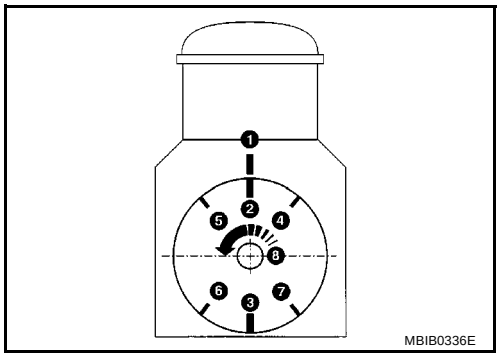
CAMSHAFT

End play : 0.08 - 0.178 mm (0.0031 - 0.0070 in)
Number of bearings : 6
Diameter of the camshaft bearings
On the camshaft:
Bearings 1, 2, 3, 4, 5 : 24.979 - 24.999 mm (0.9834 - 0.9842 in)
Bearing 6 : 27.979 - 27.999 mm (1.1015 - 1.1023 in)
On the cylinder head:
Bearings 1, 2, 3, 4, 5 : 25.04 - 25.06 mm (0.9858 - 0.9866 in)
Bearing 6 : 28.04 - 28.06 mm (1.1039 - 1.1047 in)
Timing diagram
Intake opening retard * : –9
Intake closing retard : 20
Exhaust opening advance : 27
Exhaust closing advance ** : –7

*** As the intake opening retard is negative, the valve is opened after TDC.**
**** As the exhaust closing advance is negative, the valve is closed before TDC.**

1	Cylinder block TDC fixed mark
2	Flywheel TDC moving mark
3	Flywheel BDC moving mark
4	Intake Opening Retard
5	Exhaust Closing Advance
6	Intake Closing Retard
7	Exhaust Opening Advance
8	Direction of engine rotation (flywheel end).



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Piston

EBS01C78

- Install the piston pin in the connecting rod and in the piston.
- The piston pin is retained by circlips.

PISTON MARKING

1	Direction of fitting of the piston mark towards the flywheel
2	Height between the piston pin and the top of the piston (see table below).
3	Used by the supplier only
4	Used by the supplier only
5	Used by the supplier only
6	Piston axis of symmetry
7	Piston pin hole axis
8	Offset between the hole axis (7) and the piston's axis of symmetry (6) is 0.3 mm (0.012 in)

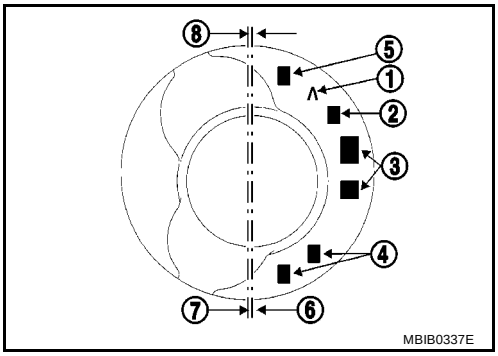

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TABLE OF PISTON PIN HEIGHT

Unit: mm (in)

* Mark on piston	Piston pin height
K	41.667 (1.6404)
L	41.709 (1.6421)
M	41.751 (1.6437)
N	41.793 (1.6454)
P	41.835 (1.6470)

The tolerance on the piston pin heights is ±0.02 mm (±0.0008).
*** The different piston pin heights are exclusively reserved for the engine assembly plant.**
The service parts will only supply piston classes (height) L, M, N.

NOTE:

- **If the engine is installed with a K class piston, an L class piston must be installed as a replacement.**
- **If the engine is installed with a P class piston, an N class piston must be installed as a replacement.**

MEASURING THE PISTON DIAMETER

The piston diameter must be measured at height A = 56 mm (2.20 in).

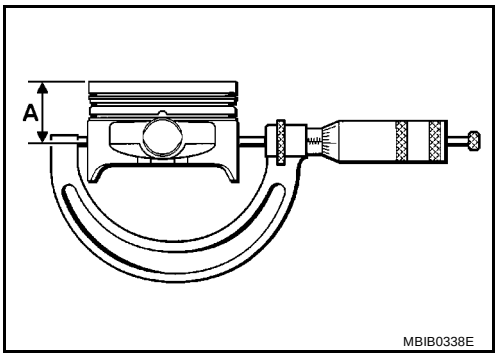
Piston diameter : 75.933 - 75.947 mm (2.9895 - 2.9900 in)

Piston pin:

Length : 59.7 - 60.3 mm (2.350 - 2.374 in)

Outer diameter : 24.8 - 25.2 mm (0.976 - 0.992 in)

Inner diameter : 13.55 - 13.95 mm (0.5335 - 0.5492 in)



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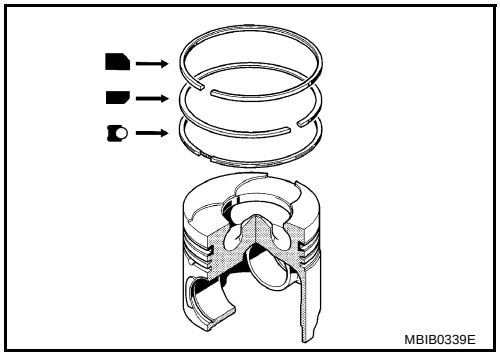
PISTON RING

Thickness:

Top ring	**: 1.97 - 1.99 mm (0.0776 - 0.0783 in)**
2nd ring	**: 1.97 - 1.99 mm (0.0776 - 0.0783 in)**
Oil ring	**: 2.47 - 2.49 mm (0.0972 - 0.0980 in)**

The piston rings are supplied ready adjusted.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PISTON RING END GAP

Top ring	**: 0.20 - 0.35 mm (0.0079 - 0.0138 in)**
2nd ring	**: 0.70 - 0.90 mm (0.0276 - 0.0354 in)**
Oil ring	**: 0.25 - 0.50 mm (0.0098 - 0.0197 in)**

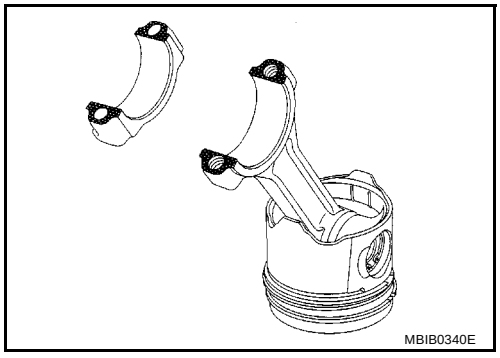
Connecting Rod

EBS01C79

The connecting rod is of the detachable cap type.

WARNING:

- **The bolts must be coated with engine oil under the heads and on the threads when the connecting rods are installed in the engine.**
- **The big end caps are positioned on the connecting rod by irregularities on the parting line.**
- **The occurrence of impacts or a foreign body between the body - cap mating surfaces will lead to rapid rupture of the connecting rod.**


MBIB0340E

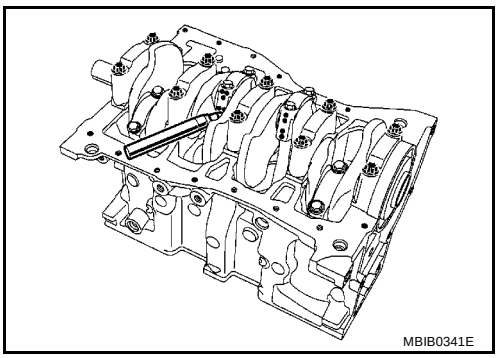
Lateral big end play	**: 0.205 - 0.467 mm (0.0081 - 0.0184 in)**
Diametrical big end play	**: 0.035 - 0.045 mm (0.0014 - 0.0018 in)**
Center distance between the big end and small end	**: 133.75 mm (5.2657 in)**
Diameter of the big end	**: 47.610 - 47.628 mm (1.8744 - 1.8751 in)**
Diameter of the small end	
(without ring)	**: 27.24 - 27.26 mm (1.0724 - 1.0732 in)**
(with ring)	**: 25.013 - 25.025 mm (0.9848 - 0.9852 in)**

NOTE:
The connecting rod small end rings cannot be replaced.

The maximum weight difference for the connecting rod, piston and piston pin assemblies for the same engine must be 0.245 N (25 g, 0.88 oz).

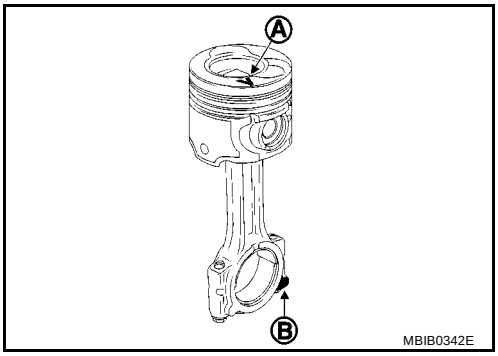
WARNING:

- **To avoid initiating a crack in the connecting rod, do not use a sharp point to mark the big end caps in relation to their connecting rod.**
- **Use a permanent marker pen.**


MBIB0341E

DIRECTION OF INSTALLATION OF THE CONNECTING ROD IN RELATION TO THE PISTON

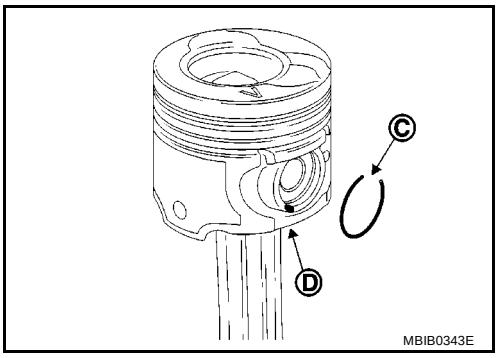
- Point the mark (A) engraved on the top of the piston upwards and the machined flat (B) of the big end downwards as shown in the figure.



MBIB0342E

DIRECTION FOR INSTALLATION THE SNAP RINGS ON THE PISTON

- Position the opening (C) of the snap rings opposite of the removal and installation channel (D).



MBIB0343E

Crankshaft

EBS01C7A

Number of main journals	**: 5**
Crankshaft side clearance:	
Without wear on side shims	**: 0.045 - 0.252 mm (0.0018 - 0.0099 in)**
With wear on side shims	**: 0.045 - 0.852 mm (0.0018 - 0.0335 in)**
Crankshaft diametrical clearance:	
Journals	**: 0.027 - 0.054 mm (0.0011 - 0.0021 in)**
Crankshaft pins	**: 0.035 - 0.045 mm (0.0014 - 0.0018 in)**
Journal diameter:	**: 47.99 - 48.01 mm (1.8894 - 1.8902 in)**
Crankshaft pin diameter:	**: 43.96 - 43.98 mm (1.7307 - 1.7315 in)**

- The lateral shims are located on bearing No. 3.
- No rectifications are allowed.

WORKING OUT THE CLASS OF MAIN BEARING (ORIGINAL FITMENT)

Marking (A) On The Crankshaft

Detail of the marking (A):

Number of journals

1*	2	3	4	5	Classes of journal diameters A = D1 B = D2 C = D3
B	B	C	C	B	

* Flywheel end.

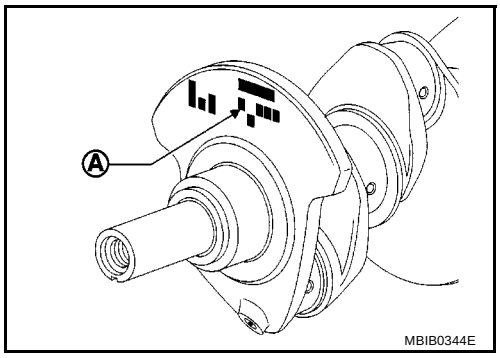


Table Of Journal Diameter Classes

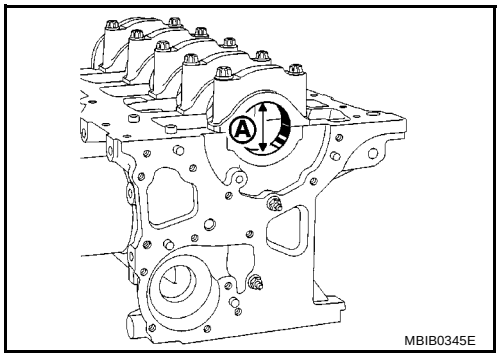
Unit: mm (in)

Journal class mark on the crankshaft	Journal diameter
A = D1	47.990 - 47.996 (1.8894 - 1.8896)
B = D2	47.997 - 48.003 (1.8896 - 1.8899)
C = D3	48.004 - 48.010 (1.8899 - 1.8902)

Cylinder Block

EBS01C7B

The diameters of the bearings (A) of the cylinder block are marked by a hole on the block (B) located above the oil filter.



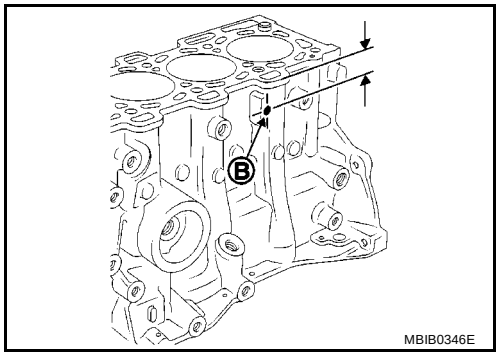


TABLE OF CYLINDER BLOCK MAIN BEARING HOUSING INNER DIAMETERS

Hole position (B)	Class reference	Cylinder block main bearing housing inner diameter
X = 33 mm (1.30 in)	1 or blue	51.936 - 51.942 mm (2.0447 - 2.0450 in)
Y = 43 mm (1.69 in)	2 or red	51.942 - 51.949 mm (2.0450 - 2.0452 in)

NOTE:

The marking zone includes:

- X - Y gives the diameter class of bearings A or B.

MATCHING THE MAIN BEARING

	Journal diameter class		
	D1	D2	D3
1*	C1 1.949 - 1.955 mm (0.0767 - 0.0770 in) yellow	C2 1.946 - 1.952 mm (0.0766 - 0.0769 in) blue	C3 1.943 - 1.949 mm (0.0765 - 0.0767 in) black
2*	C4 1.953 - 1.959 mm (0.0769 - 0.0771 in) red	C1 1.949 - 1.955 mm (0.0767 - 0.0770 in) yellow	C2 1.946 - 1.952 mm (0.0766 - 0.0769 in) blue
	Bearing thickness and class		

* Cylinder block main bearing diameter class.

NOTE:
The service parts will only supply class C2 (blue).

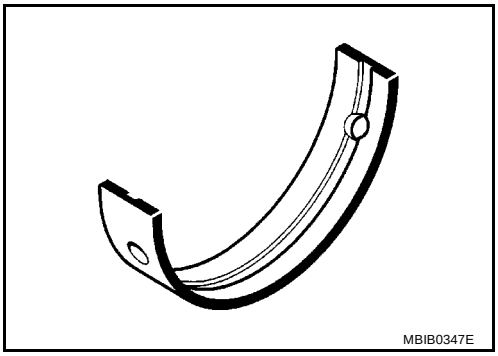
Main Bearing and Cap

EBS01C7C

MAIN BEARING

- **The engine is installed with main bearing without a locator notch.**

1. The main bearings are installed on the cylinder block and on the bearings using Tool KV113B0160 (Mot. 1493-01).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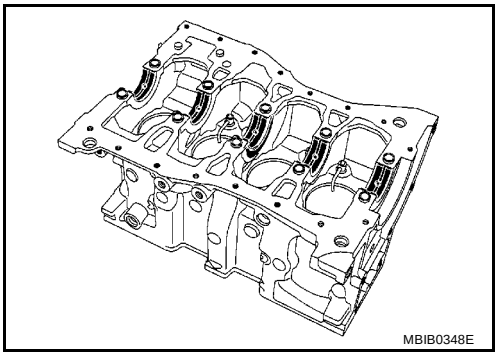
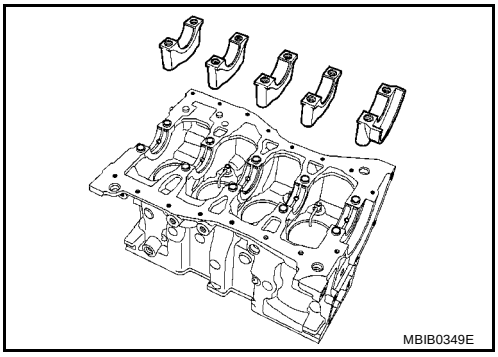
2. For direction of installation on the cylinder block, install grooved main bearing on all the bearings.


MBIB0348E

3. For direction of installation on the bearing caps, install non-grooved main bearing.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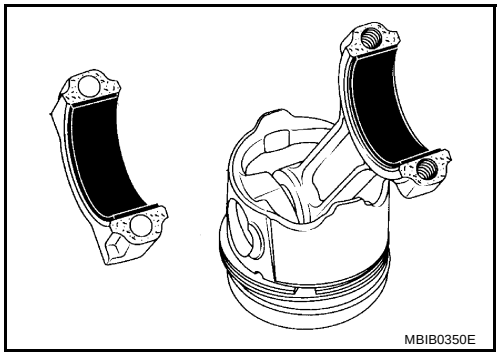
CONNECTING ROD BEARING

- **The engine is installed with connecting rod bearing without a locator notch.**

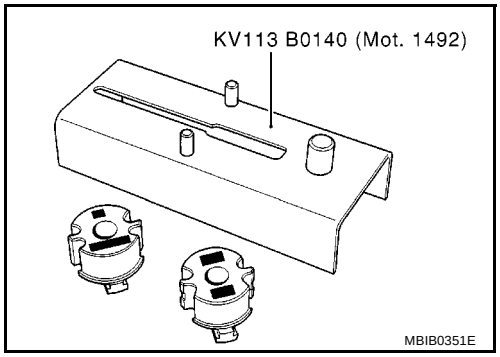
  NOTE:
  The upper and lower connecting rod bearing are not the same width.

  Connecting rod bearing width:

  Upper bearing : 20.625 mm (0.8120 in)
  Lower bearing : 17.625 mm (0.6939 in)


MBIB0350E

- The connecting rod bearing are installed using Tool KV113B0140 (Mot. 1492) and Tool KV113B0150 (Mot. 1492-03).



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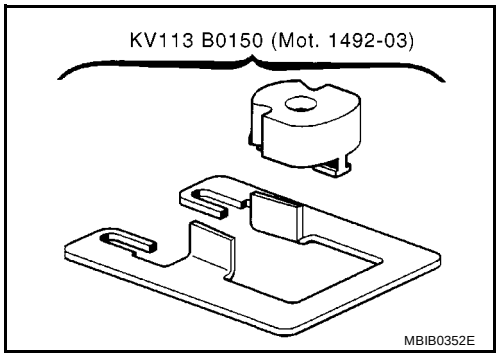


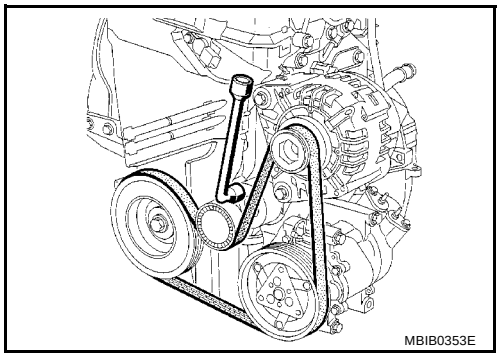
MBIB0352E

Preparing the engine to be on the stand

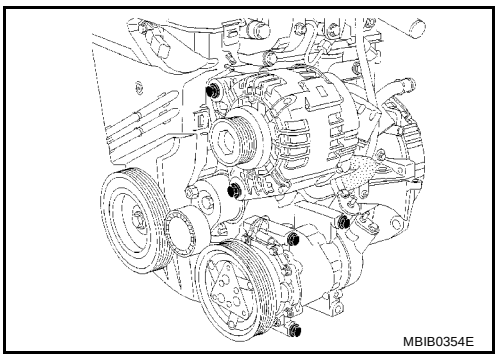
EBS01C7D

Before the engine is mounted on the Tool KV113B0070 (Mot. 792-03), the engine's electrical harness must be removed and the engine oil drained.

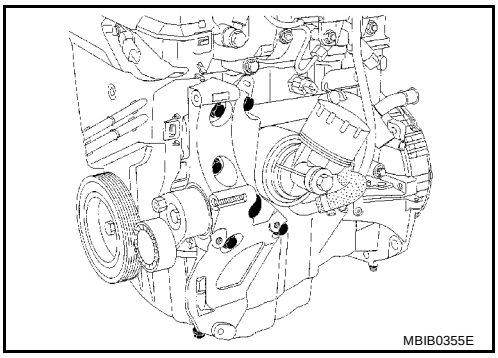
1. Remove the drive belt.


MBIB0353E

2. Remove the alternator.


MBIB0354E

3. Remove the air conditioning compressor or idler pulley.
4. Remove the multifunction support.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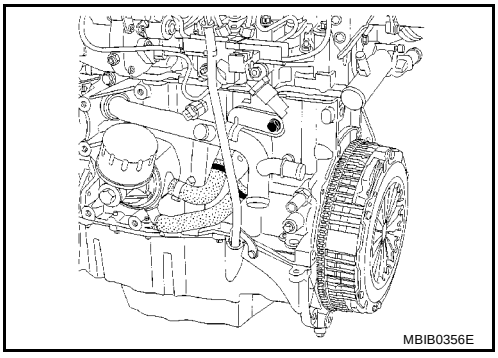
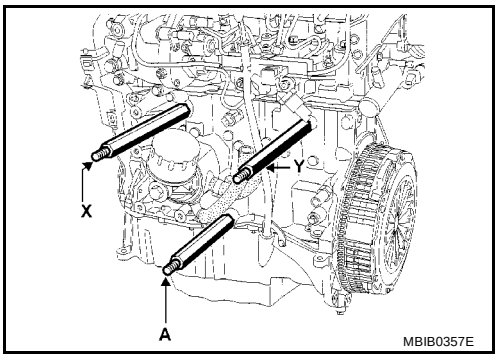
5. Remove the coolant inlet pipe on the water pump.


MBIB0356E

6. Place the rods (**A**), (**X**), (**Y**) or Tool KV113B0100 (Mot. 1378) on the cylinder block so that they fit into the holes (**20, 32, 33**) on the plate of Tool KV113B0070 (Mot. 792-03).



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Parts To Be Replaced After Removal

EBS01C7E

- All gaskets
- Flywheel bolts
- Crankshaft bearing bolts
- Camshaft pulley bolt
- Crankshaft pulley bolts
- Big end cap bolts
- Injector holder copper washers
- Fuel injection tubes

- Pipe plugs
- Belts
- Timing belt tension wheel
- Oil jets
- Turbocharger plastic pipes

Installation of Thread Inserts

EBS01C7F

Threaded holes on all engine component parts can be repaired by using thread inserts.