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SECTION **EM**

ENGINE MECHANICAL

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PRECAUTIONS

PRECAUTIONS

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Precautions for Draining Engine Coolant

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Drain engine coolant when engine is cooled.

Precautions for Disconnecting Fuel Piping

EBS01E5I

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

Precautions for Removal and Disassembly

EBS01E5J

- When instructed to use SST, 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

EBS01E5K

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

Precautions for Assembly and Installation

EBS01E5L

- 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 liquid gasket, packing, oil seal or O-ring.
- Dowel pins are used for several parts alignment. When replacing and reassembling parts with dowel pins, make sure that dowel pins are installed in the original position.
- Thoroughly wash, clean, and air-blow each part. Carefully check engine oil or engine coolant passages for any restriction and blockage.
- Avoid damaging sliding or mating surfaces. Completely remove foreign materials such as cloth lint or dust. Before assembly, oil sliding surfaces well.
- Release air within route when refilling after draining engine coolant.
- After repairing, start engine and increase engine speed to check engine coolant, fuel, engine oil, and exhaust systems for leakage.

Parts Requiring Angle Tightening

EBS01E5M

- Use an angle wrench [SST: KV10112100] for the final tightening of the following engine parts:
 - Cylinder head bolts
 - Main bearing cap bolts
 - Connecting rod cap nuts
 - Crankshaft pulley bolt (No angle wrench is required as the bolt flange is provided with notches for 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

Precautions For Liquid Gasket REMOVAL OF LIQUID GASKET

EBS01E5N

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

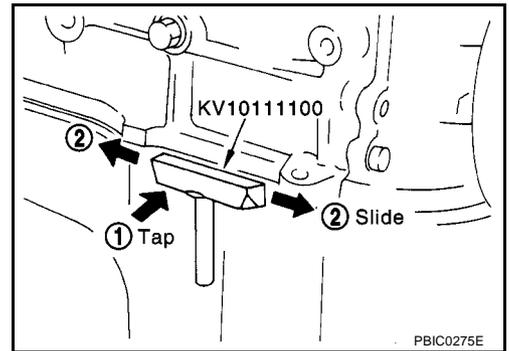
CAUTION:

Be careful not to damage the mating surfaces.

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

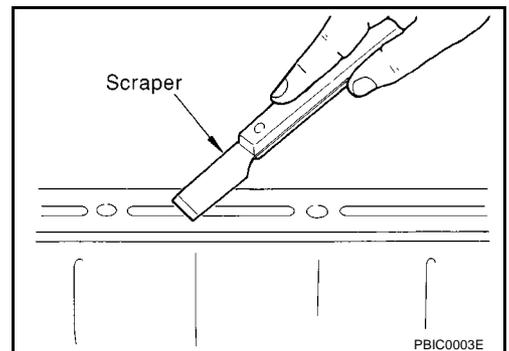
CAUTION:

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

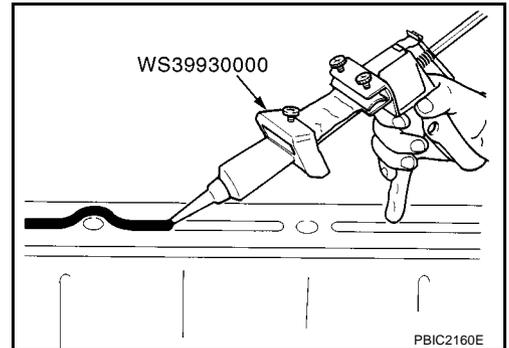


LIQUID GASKET APPLICATION PROCEDURE

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.



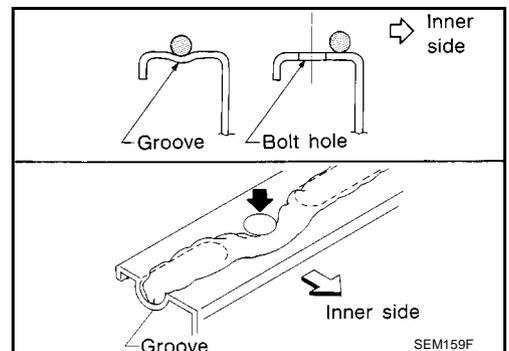
3. Attach the liquid gasket tube to the tube presser [SST].
Use Genuine Liquid Gasket or equivalent.
4. Apply the liquid gasket without breaks to the specified location with the specified dimensions.
 - If there is a groove for the liquid gasket application, apply the liquid gasket to the groove.



- As for the bolt holes, normally apply the liquid gasket inside the holes. If specified, it should be applied outside the holes. Make sure to read the text of this manual.
- Within five minutes of liquid gasket application, install the mating component.
- If the liquid gasket protrudes, wipe it off immediately.
- Do not retighten mounting bolts or nuts after the installation.
- After 30 minutes or more have passed from the installation, fill the engine oil and engine coolant.

CAUTION:

If there are instructions in this manual, observe them.



PREPARATION

PREPARATION

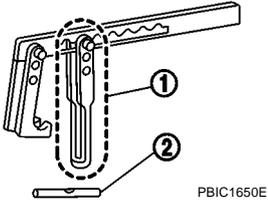
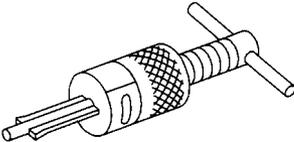
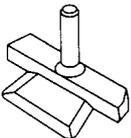
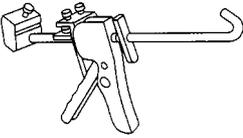
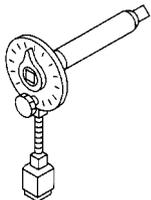
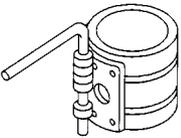
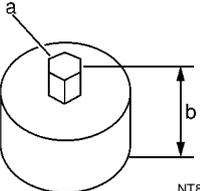
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Special Service Tools

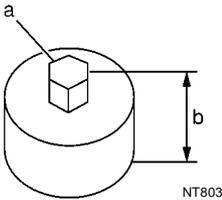
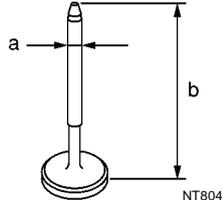
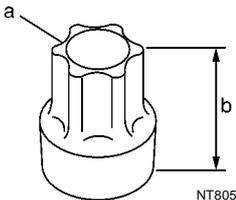
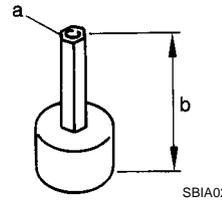
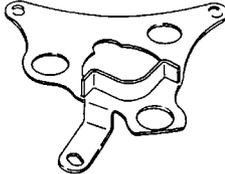
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Tool number Tool name	Description
KV10115600 Valve oil seal drift	Installing valve oil seal Use side A. Side A a: 20 (0.79) dia. b: 13 (0.51) dia. c: 10.3 (0.406) dia. d: 8 (0.31) dia. e: 10.7 (0.421) f: 5 (0.20) Unit: mm (in)
KV10107902 Valve oil seal puller 1. KV10116100 Valve oil seal puller adapter	Removing valve oil seal
KV11103000 Pulley puller	Removing crankshaft pulley
ED19600610 Compression gauge adapter	Checking compression pressure
KV101056S0 Ring gear stopper 1. KV10105630 Adapter 2. KV10105610 Plate	Preventing crankshaft from rotating a: 3 (0.12) b: 6.4 (0.252) c: 2.8 (0.110) d: 6.6 (0.260) e: 107 (4.21) f: 14 (0.55) g: 20 (0.79) h: 14 (0.55) dia. Unit: mm (in)
KV101151S0 Lifter stopper set 1. KV10115110 Camshaft pliers 2. KV10115120 Lifter stopper	Changing adjusting shim

PREPARATION

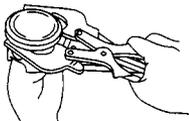
Tool number Tool name	Description	A
KV10116200 Valve spring compressor 1. KV10115900 Attachment 2. KV10109220 Adapter	 Disassembling and assembling valve mechanism Part (1) is a component of KV10116200, but Part (2) is not so.	EM
ST16610001 Pilot bushing puller	 Removing crankshaft pilot bush	C D E
KV10111100 Seal cutter	 Removing oil pan upper, oil pan lower and rear chain case, etc.	F G
WS39930000 Tube presser	 Pressing the tube of liquid gasket	H I J
KV10112100 Angle wrench	 Tightening bolts for bearing cap, cylinder head, etc.	K L
EM03470000 Piston ring compressor	 Installing piston assembly into cylinder bore	M
KV11106010 Hexagon wrench	 Removing and installing chain tensioner a: 5 mm (0.20 in) (Face to face) b: 20 mm (0.79 in)	

PREPARATION

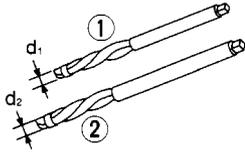
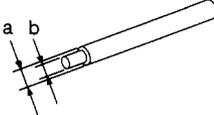
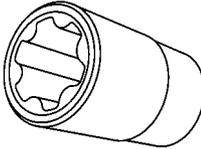
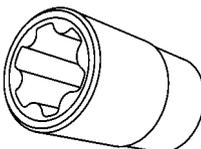
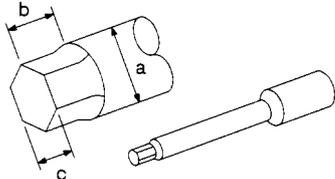
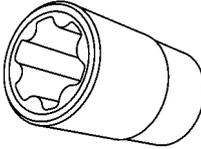
Tool number Tool name		Description
KV11106020 Hexagon wrench	 <p style="text-align: right; margin-right: 20px;">NT803</p>	Removing and installing slack guide a: 6 mm (0.24 in) (Face to face) b: 20 mm (0.79 in)
KV11106030 Positioning stopper pin	 <p style="text-align: right; margin-right: 20px;">NT804</p>	Fixing fuel pump sprocket a: 6 mm (0.24 in) dia. b: 80 mm (3.15 in)
KV11106040 TORX wrench	 <p style="text-align: right; margin-right: 20px;">NT805</p>	Removing and installing fuel pump sprocket nut a: T70 b: 26 mm (1.02 in)
KV11106050 Hexagonal wrench	 <p style="text-align: right; margin-right: 20px;">SBIA0224E</p>	Removing and installing fuel pump sprocket a: 6 mm (0.24 in) (Face to face) b: 42 mm (1.65 in)
KV11106060 Sprocket holder	 <p style="text-align: right; margin-right: 20px;">SBIA0225E</p>	Holding fuel pump sprocket

Commercial Service Tools

EBS01E6P

Tool name		Description
Valve seat cutter set	 <p style="text-align: right; margin-right: 20px;">NT048</p>	Finishing valve seat dimensions
Piston ring expander	 <p style="text-align: right; margin-right: 20px;">NT030</p>	Removing and installing piston ring

PREPARATION

Tool name	Description
Valve guide reamer  NT016	Reaming valve guide with (1) or hole for oversize valve guide with (2) Intake and Exhaust: d1 = 6.0 mm (0.236 in) dia. d2 = 10.2 mm (0.402 in) dia.
Valve guide drift  NT015	Removing and installing valve guide Intake and Exhaust: a = 9.5 mm (0.374 in) dia. b = 5.5 mm (0.217 in) dia.
TORX socket  NT807	Loosening and tightening fuel pump mounting bolt Size: E10
TORX socket  PBIC1113E	Loosening and tightening flywheel mounting bolt Size: T55
TORX socket  NT807	Loosening and tightening drive plate mounting bolt Size: E20
Cylinder head bolt wrench  NT583	Loosening and tightening cylinder head bolt, and used with angle wrench [SST: KV10112100] a: 13 (0.51) dia. b: 12 (0.47) c: 10 (0.39) Unit: mm (in)
TORX socket  NT807	Loosening and tightening main bearing cap bolt Size: E14

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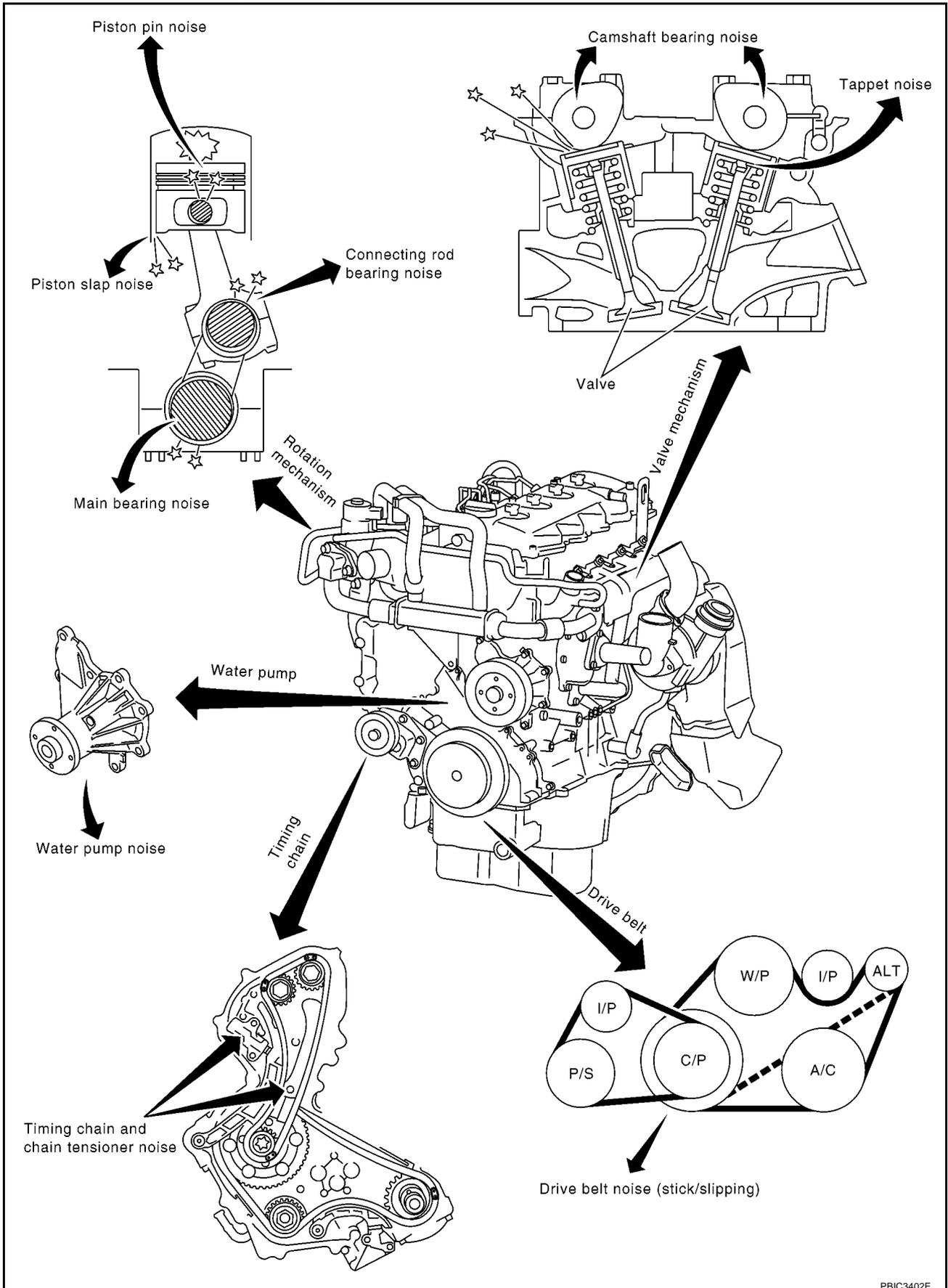
NOISE, VIBRATION AND HARSHNESS (NVH) TROUBLESHOOTING

NOISE, VIBRATION AND HARSHNESS (NVH) TROUBLESHOOTING

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NVH Troubleshooting — Engine Noise

EBS01E50



PBIC3402E

NOISE, VIBRATION AND HARSHNESS (NVH) TROUBLESHOOTING

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

EBS01E5R

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-66
	Rattle	C	A	—	A	B	C	Camshaft bearing noise	Camshaft oil clearance Camshaft runout	EM-61 EM-61
Crankshaft pulley Cylinder block (Side of engine) Oil pan	Slap or knock	—	A	—	B	B	—	Piston pin noise	Piston to piston pin clearance Connecting rod bushing oil clearance	EM-125 EM-127
	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-129 EM-126 EM-126 EM-127
	Knock	A	B	C	B	B	B	Connecting rod bearing noise	Connecting rod bushing oil clearance Connecting rod bearing oil clearance (Big end)	EM-127 EM-131
	Knock	A	B	—	A	B	C	Main bearing noise	Main bearing oil clearance Crankshaft runout	EM-132 EM-131
Front of engine Timing chain case	Tapping or ticking	A	A	—	B	B	B	Timing chain and chain tensioner noise	Timing chain cracks and wear Timing chain tensioner operation	EM-75 EM-84 EM-79
Front of engine	Squeaking or fizzing	A	B	—	B	—	C	Drive belts (Sticking or slipping)	Drive belts deflection	EM-12
	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-21 "WATER PUMP"

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

DRIVE BELTS

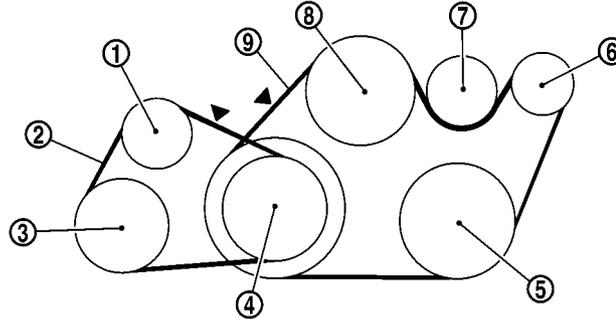
DRIVE BELTS

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Checking Drive Belts

EBS01EJ4

SEC. 117



PBIC4038E

- | | | |
|----------------------|--|--|
| 1. Idler pulley | 2. Power steering oil pump belt | 3. Power steering oil pump |
| 4. Crankshaft pulley | 5. A/C compressor (Models with A/C)
Dummy pulley (Models without A/C) | 6. Alternator |
| 7. Idler pulley | 8. Water pump pulley | 9. A/C compressor, alternator and
water pump belt |

- Before inspecting engine, make sure engine has cooled down; wait approximately 30 minutes after engine has been stopped.
- Visually inspect all belts for wear, damage or cracks on contacting surfaces and edge areas.
- Measure deflection at the marked point (▲).

CAUTION:

- **When checking belt deflection 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.**
- **Tighten idler pulley lock nut by hand and measure deflection without looseness.**

Belt Deflection:

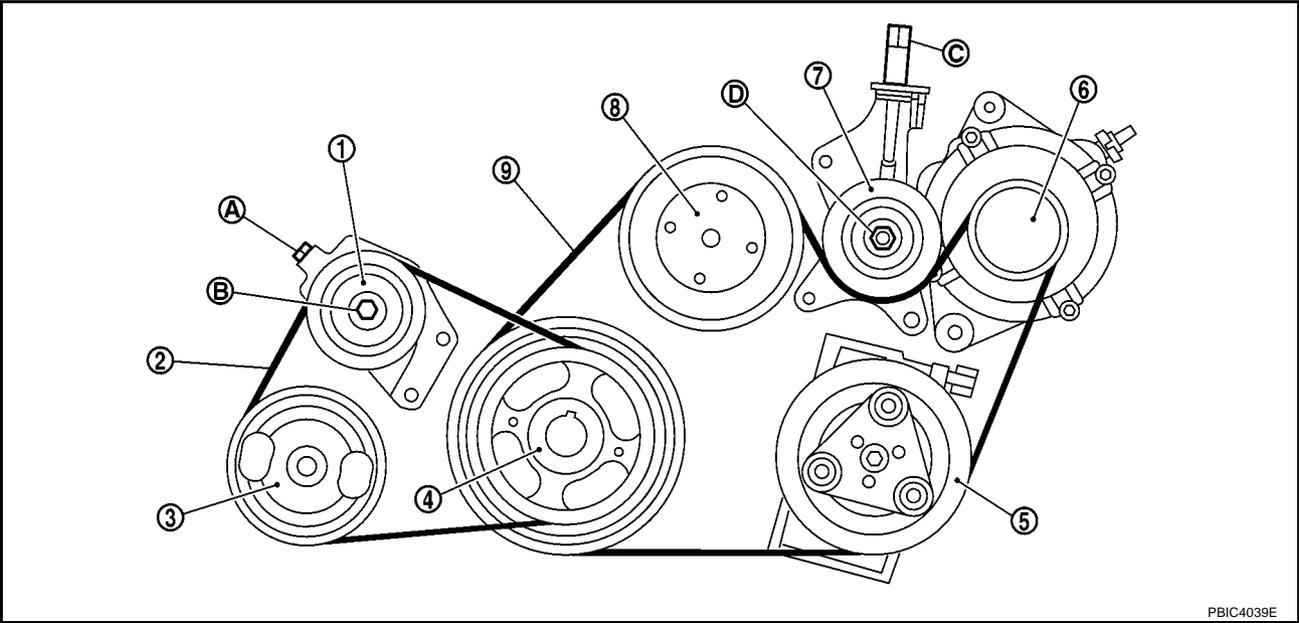
Applied belt	Belt deflection with 98 N (10 kg, 22 lb) force applied* mm (in)		
	New	Adjusted	Limit for re-adjusting
A/C compressor, alternator and water pump belt	2.9 - 3.4 (0.114 - 0.134)	3.9 - 4.4 (0.154 - 0.173)	8.5 (0.335)
Power steering oil pump belt	4.6 - 5.4 (0.181 - 0.213)	7.1 - 7.7 (0.280 - 0.303)	11.3 (0.445)

*: When engine is cold.

DRIVE BELTS

Deflection Adjustment

EBS01EJ5



- | | | |
|--------------------------|--|--|
| 1. Idler pulley | 2. Power steering oil pump belt | 3. Power steering oil pump |
| 4. Crankshaft pulley | 5. Dummy pulley (Models without A/C)
A/C compressor (Models with A/C) | 6. Alternator |
| 7. Idler pulley | 8. Water pump pulley | 9. A/C compressor, alternator and
water pump belt |
| A. Adjusting bolt | B. Idler pulley lock nut | C. Adjusting nut |
| D. Idler pulley lock nut | | |

- Adjust belts with the parts shown below.

Applied belt	Belt adjustment method
Power steering oil pump belt	Adjusting bolt on idler pulley (A)
Alternator and water pump belt or A/C compressor, alternator and water pump belt	Adjusting nut on idler pulley (C)

CAUTION:

- When a new belt is installed as a replacement, adjust it to the specified value under “New” value because of insufficient adaptability with pulley grooves.
- If the belt deflection of the current belt is out of the “Limit for re-adjusting”, adjust to the “Adjusted” value.
- When checking belt deflection immediately after installation, first adjust it to the specified value. Then, after turning crankshaft two turns or more, re-adjust it to the specified value to avoid variation in deflection between pulleys.
- Make sure the belts are fully fitted into the pulley grooves during installation.
- Handle with care to avoid smearing the belts with engine oil or engine coolant.
- Do not twist or bend the belts with strong force.

POWER STEERING OIL PUMP BELT

1. Remove engine undercover front. Refer to [EI-15, "FRONT BUMPER"](#) .
2. Loosen idler pulley lock nut (B).
3. Turn adjusting bolt (A) to adjust. Refer to [EM-13, "Deflection Adjustment"](#) .
4. Tighten idler pulley lock nut (B).

Nut B:

: 28.0 N·m (2.9 kg-m, 21 ft-lb)

DRIVE BELTS

A/C COMPRESSOR, ALTERNATOR AND WATER PUMP BELT

1. Loosen idler pulley lock nut (D).
2. Turn adjusting nut (C) to adjust. Refer to [EM-13, "Deflection Adjustment"](#) .
3. Tighten lock nut (D).

Nut D:

: 45.0 N·m (4.6 kg-m, 33 ft-lb)

Removal and Installation

EBS01EJ6

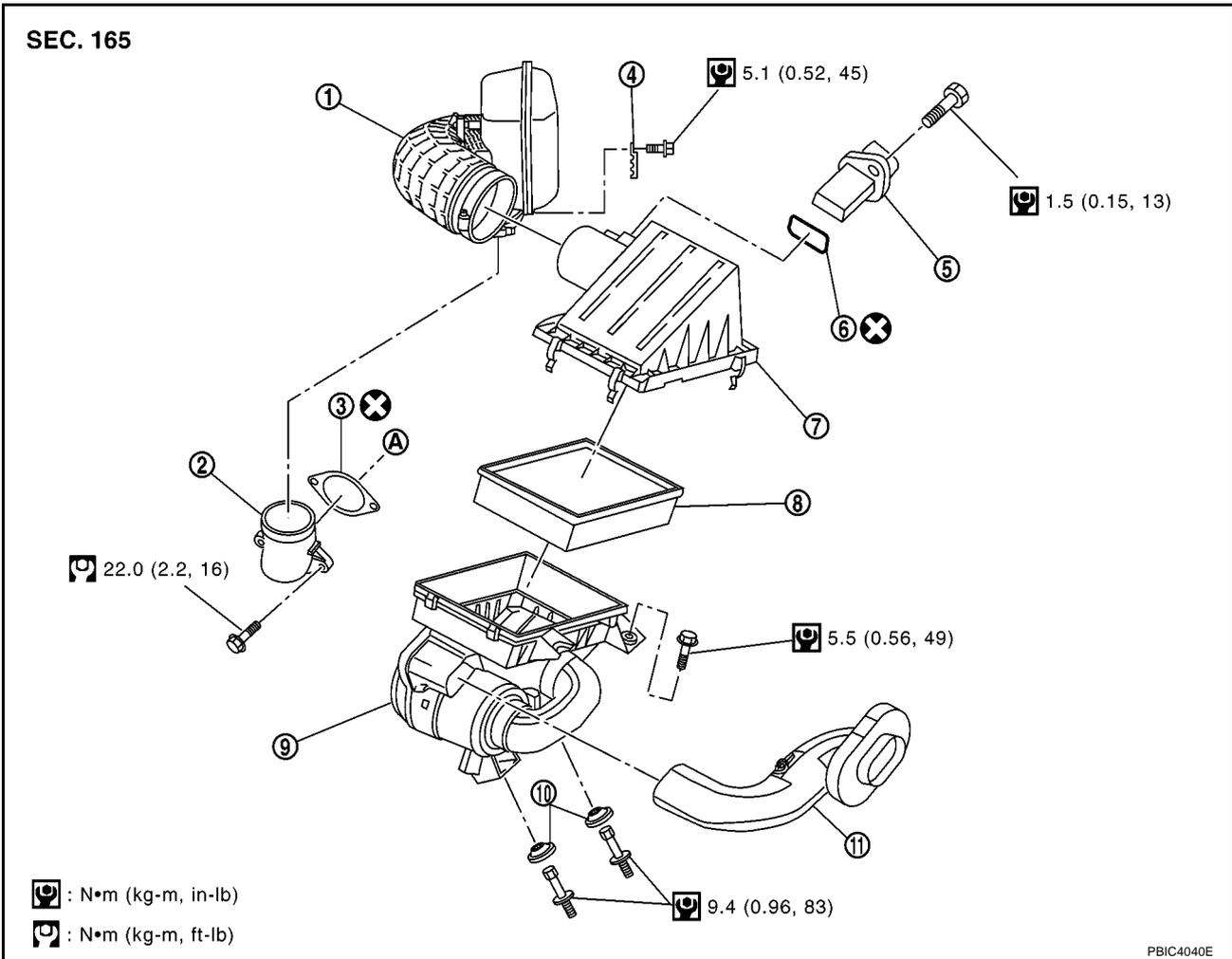
REMOVAL

1. Loosen each belt. Refer to [EM-13, "Deflection Adjustment"](#) .
2. Remove power steering oil pump belt. Refer to [EM-13, "POWER STEERING OIL PUMP BELT"](#) .
3. Remove A/C compressor, alternator and water pump belt. Refer to [EM-14, "A/C COMPRESSOR, ALTERNATOR AND WATER PUMP BELT"](#) .

INSTALLATION

1. Install each belt on pulley in the reverse order of removal.
2. Adjust belt deflection. Refer to [EM-13, "Deflection Adjustment"](#) .
3. Tighten nuts provided for adjustment to the specified torque.
4. Make sure again that each belt deflection is as specified.

Components



- | | | |
|-----------------------------|-------------------------|-----------------------------|
| 1. Air duct | 2. Air inlet pipe | 3. Gasket |
| 4. Bracket | 5. Mass air flow sensor | 6. O-ring |
| 7. Air cleaner case (upper) | 8. Air cleaner filter | 9. Air cleaner case (lower) |
| 10. Mounting rubber | 11. Air duct side | |
- A. To turbocharger

- Refer to [GI-10, "Components"](#) for symbol marks in the figure.

Removal and Installation

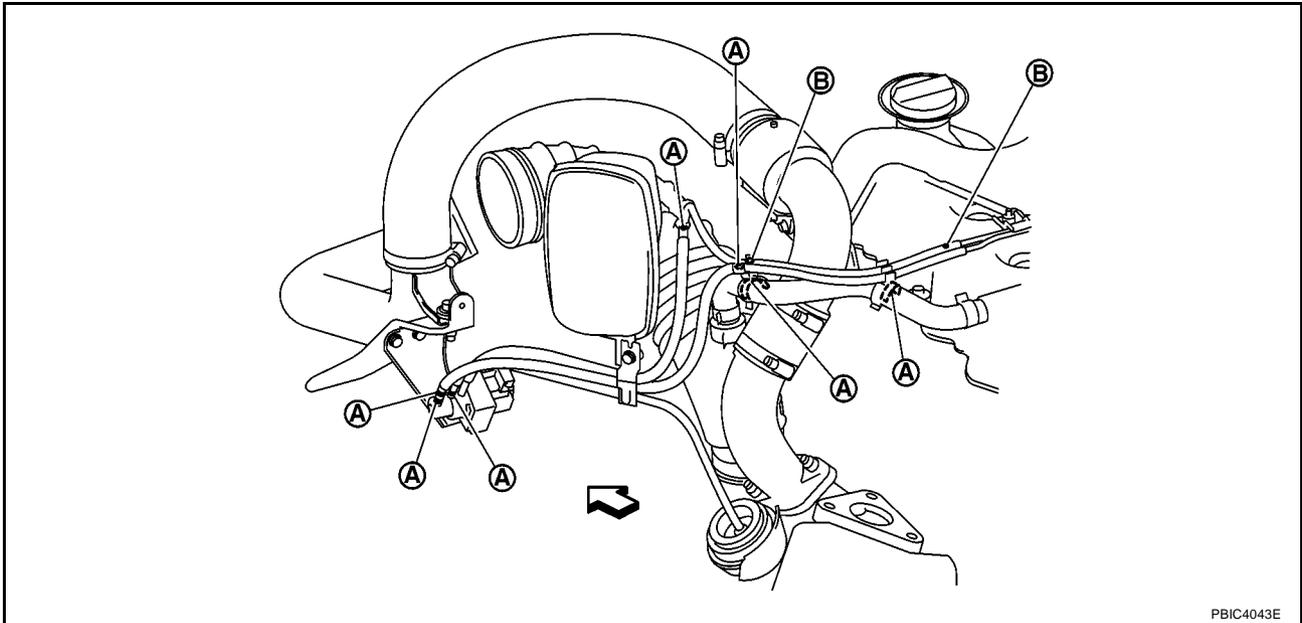
REMOVAL

1. Remove mass air flow sensor harness clamp from air cleaner case (upper).
2. Disconnect harness connector from mass air flow sensor.
3. Remove air cleaner case (upper) and air cleaner filter.
 - Add marks as necessary for easier installation.
4. Remove mass air flow sensor from air cleaner case (upper).

CAUTION:

- Do not shock it.
 - Do not disassemble it.
 - Do not touch its sensor.
5. Remove air duct with ventilation hose and vacuum hoses disconnected.
 - Add marks as necessary for easier installation.

AIR CLEANER AND AIR DUCT



PBIC4043E

A. White mark

B. Yellow mark

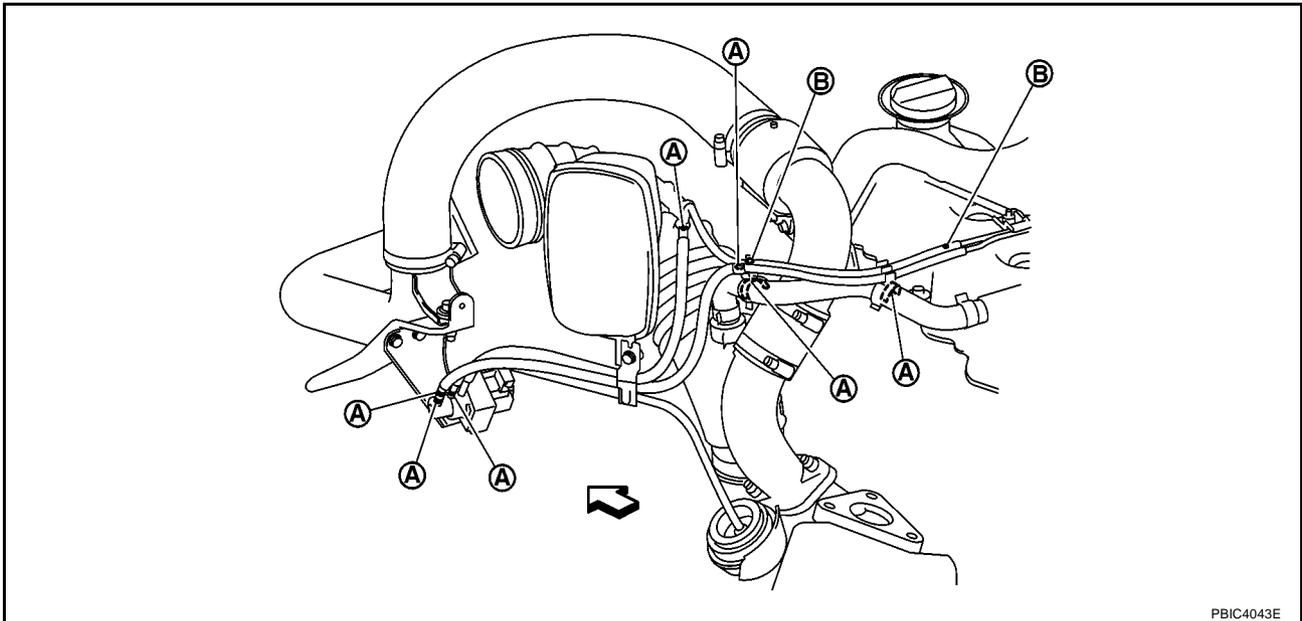
← Vehicle front

6. Remove air cleaner case (lower) and air duct side.

INSTALLATION

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

- Align marks. Attach each joint. Screw clamps firmly.
- Install ventilation hose and vacuum hoses as shown in the figure.



PBIC4043E

A. White mark

B. Yellow mark

← Vehicle front

- Install vacuum hose by referring to paint marks avoiding twisting.
- When an insert stopper is not provided with the pipe, insert the hose up to dimension A. When the pipe is shorter than dimension A, insert hose fully until it reaches the end.

Dimension A :15 - 20 mm (0.591 - 0.787 in)

- When an insert stopper is provided on the pipe side, insert the hose until it reaches the stopper.

AIR CLEANER AND AIR DUCT

CHANGING AIR CLEANER FILTER

Removal

1. Remove mass air flow sensor harness clamp from air cleaner case (upper).
2. Disconnect harness connector from mass air flow sensor.
3. Unfasten clips and lift up air cleaner case (upper).
4. Remove air cleaner filter.

Installation

Installation is the reverse order of removal.

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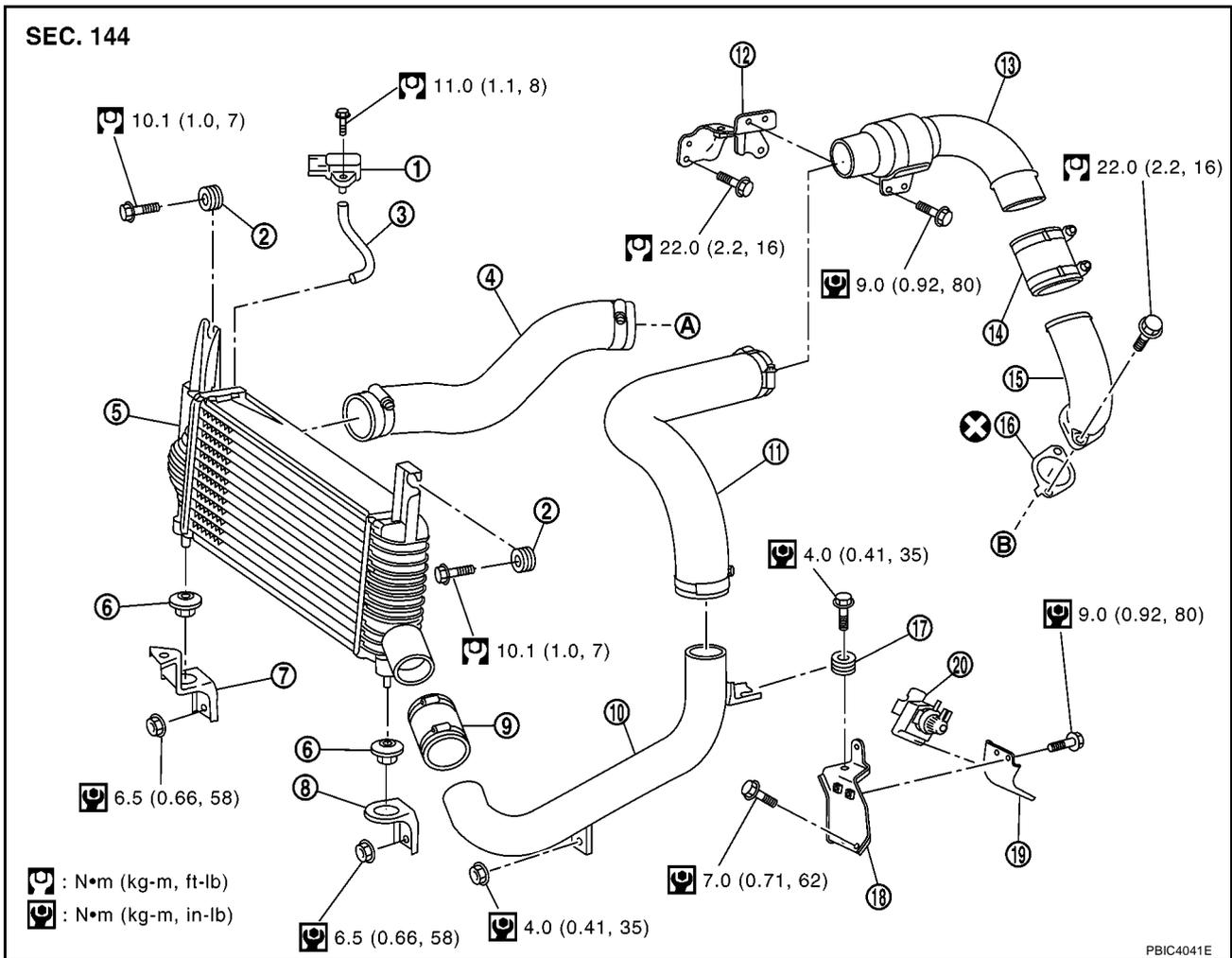
CHARGE AIR COOLER

PFP:14461

EBS01EJD

CHARGE AIR COOLER

Components



- | | | |
|------------------------------|---|--------------------|
| 1. Turbocharger boost sensor | 2. Grommet | 3. Vacuum hose |
| 4. Air inlet hose | 5. Charge air cooler | 6. Mounting rubber |
| 7. Bracket | 8. Bracket | 9. Air inlet hose |
| 10. Air inlet tube | 11. Air inlet hose | 12. Bracket |
| 13. Air inlet tube | 14. Air inlet hose | 15. Air inlet pipe |
| 16. Gasket | 17. Grommet | 18. Bracket |
| 19. Bracket | 20. Turbocharger boost control solenoid valve | |
| A. To throttle chamber | B. To turbocharger | |

Removal and Installation

REMOVAL

EBS01E5T

- Remove front grille. Refer to [EI-19, "FRONT GRILLE"](#).
- Disconnect harness connector from turbocharger boost sensor.
- Remove turbocharger boost control solenoid valve.
- Remove air inlet tube and air inlet hose.
 - Add marks as necessary for easier installation.
- Remove charge air cooler.
- Remove turbocharger boost sensor if necessary.

CAUTION:

When removing charge air cooler, close opening on turbocharger and on intake manifold with shop cloth or other suitable material.

CHARGE AIR COOLER

INSPECTION AFTER REMOVAL

Check air passages of charge air cooler core and fins for clogging, leaks or deformation. Clean or replace charge air cooler if necessary.

- **Be careful not to deform core fins.**
- **For cleaning procedure of charge air cooler core, refer to [CO-13, "Checking Radiator"](#).**

INSTALLATION

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

- Pay attention to identification mark color and direction when installing air inlet hose.
- Align marks. Attach each joint. Screw clamps firmly.

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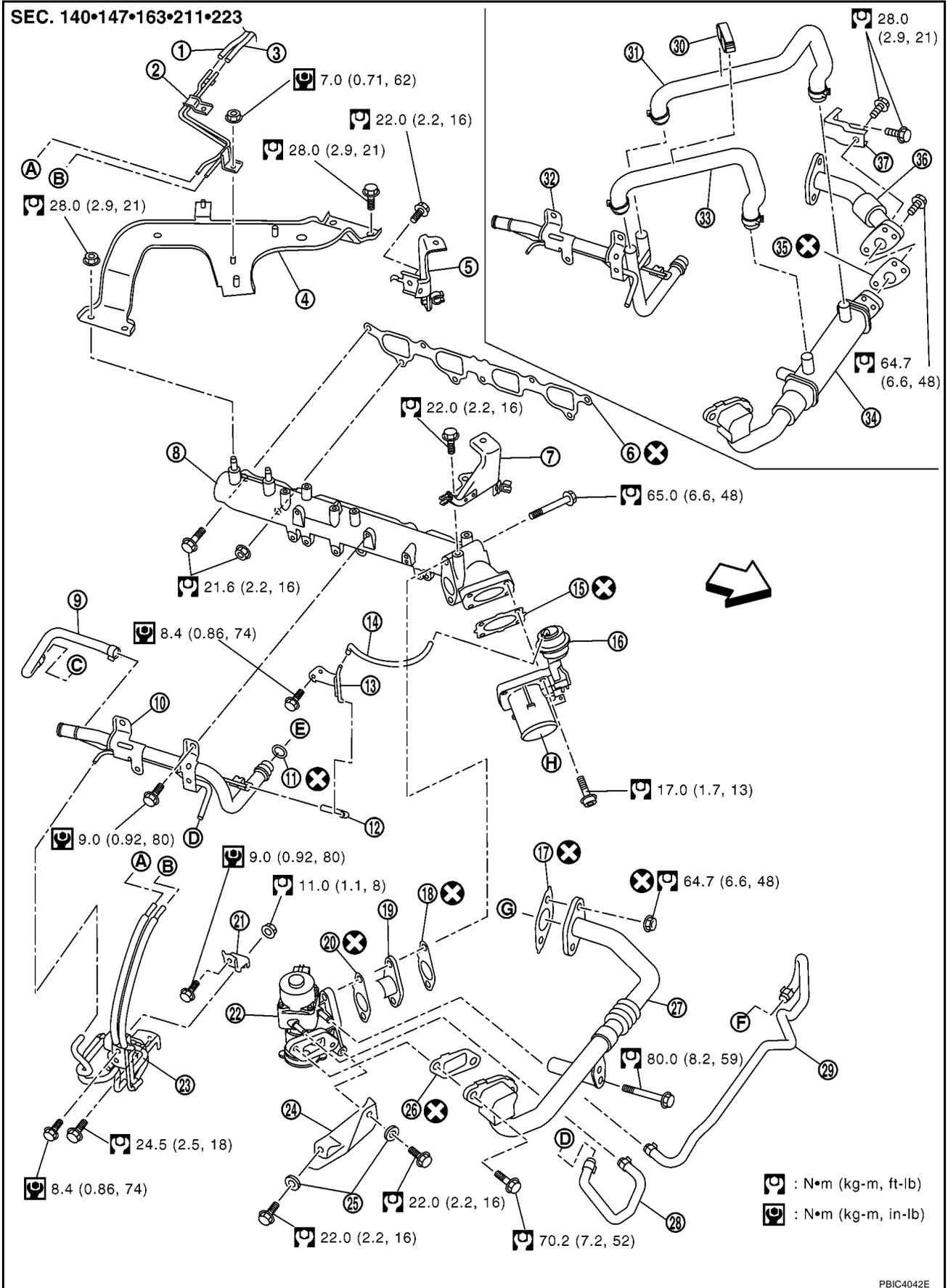
INTAKE MANIFOLD

PFP:14003

INTAKE MANIFOLD

Components

EBS01EJE



PBIC4042E

INTAKE MANIFOLD

- | | | |
|-----------------------------------|-----------------------------------|-----------------------------|
| 1. Vacuum hose | 2. Vacuum gallery | 3. Vacuum hose |
| 4. Bracket | 5. Bracket | 6. Gasket |
| 7. Bracket | 8. Intake manifold | 9. Water hose |
| 10. Heater feed pipe (M/T models) | 11. O-ring | 12. Vacuum hose |
| 13. Vacuum gallery | 14. Vacuum hose | 15. Gasket |
| 16. Throttle chamber | 17. Gasket | 18. Gasket |
| 19. EGR passage | 20. Gasket | 21. Bracket |
| 22. EGR volume control valve | 23. Vacuum gallery | 24. Bracket |
| 25. Washer | 26. Gasket | 27. EGR tube (M/T models) |
| 28. Water hose | 29. Water hose | 30. Clip (A/T models) |
| 31. Water hose (A/T models) | 32. Heater feed pipe (A/T models) | 33. Water hose (A/T models) |
| 34. EGR cooler (A/T models) | 35. Gasket (A/T models) | 36. EGR tube (A/T models) |
| 37. Bracket (A/T models) | | |
| C. To heater return pipe | E. To cylinder head | F. To water outlet |
| G. To exhaust manifold | H. To air inlet hose | |
- ↶ Vehicle front

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- Refer to [GI-10, "Components"](#) for symbol marks except in the above.

Removal and Installation

REMOVAL

EBS01EJF

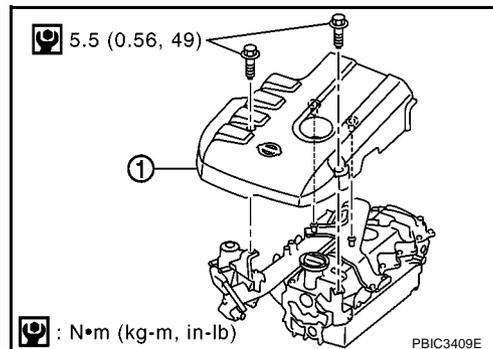
WARNING:

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

- Drain engine coolant. Refer to [CO-7, "Changing Engine Coolant"](#).
- Remove engine cover (1).

CAUTION:

Be careful not to damage engine cover surface.



- Disconnect air inlet hose from throttle chamber. Refer to [EM-18, "CHARGE AIR COOLER"](#).
- Remove fuel filter. Refer to [FL-4, "FUEL FILTER"](#).
- Remove oil level gauge guide. Refer to [EM-36, "OIL PAN AND OIL STRAINER"](#).
- Remove fuel hoses and fuel gallery. Refer to [EM-44, "INJECTION TUBE AND FUEL INJECTOR"](#).
 - To prevent fuel from flowing out, plug the opening of the hose with plug after disconnection.

CAUTION:

Be careful not to spill fuel in the engine component.

- Add marks as necessary for easier installation.
- Remove vacuum galleries and vacuum hoses.
 - Add marks as necessary for easier installation.
 - Disconnect EGR volume control valve water hoses and wiring harness.
 - Disconnect heater feed hose, water hoses, and remove heater feed pipe.
 - Remove EGR cooler (A/T models) or EGR tube (M/T models).
 - Remove injection tube center. Refer to [EM-44, "Removal and Installation"](#).

CAUTION:

Be careful not to spill fuel in the engine component.

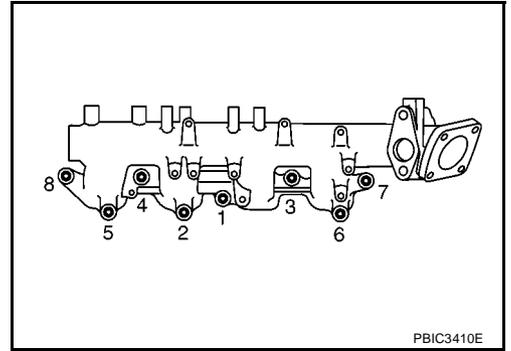
- Remove water pipe.

INTAKE MANIFOLD

13. Loosen bolts and nuts in the reverse order of that shown in the figure, and remove intake manifold.

CAUTION:

Cover engine openings to avoid entry of foreign materials.



14. Remove EGR volume control valve and throttle chamber from intake manifold.

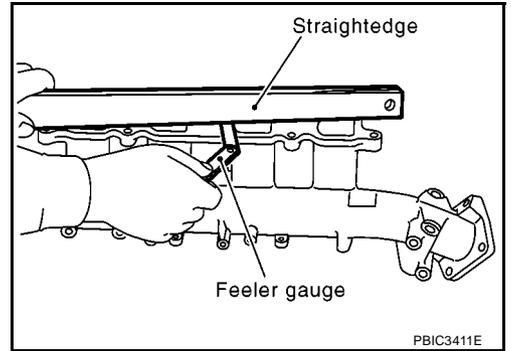
INSPECTION AFTER REMOVAL

Surface Distortion

- Check distortion on the mounting surface with a straightedge and feeler gauge.

Limit : 0.1 mm (0.004 in)

- If it exceeds the limit, replace intake manifold.

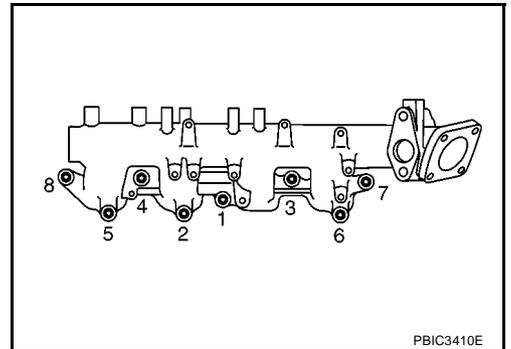


INSTALLATION

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

- Install intake manifold.
 - Tighten fixing bolts and nuts in numerical order as shown in the figure.
 - If stud bolts were removed, tighten them to the specified torque.

: **10.8 N·m (1.1 kg·m, 8 ft·lb)**



- Install EGR tube (M/T models).
 - Tighten fixing bolts and nuts in numerical order as shown in the figure.

INTAKE MANIFOLD

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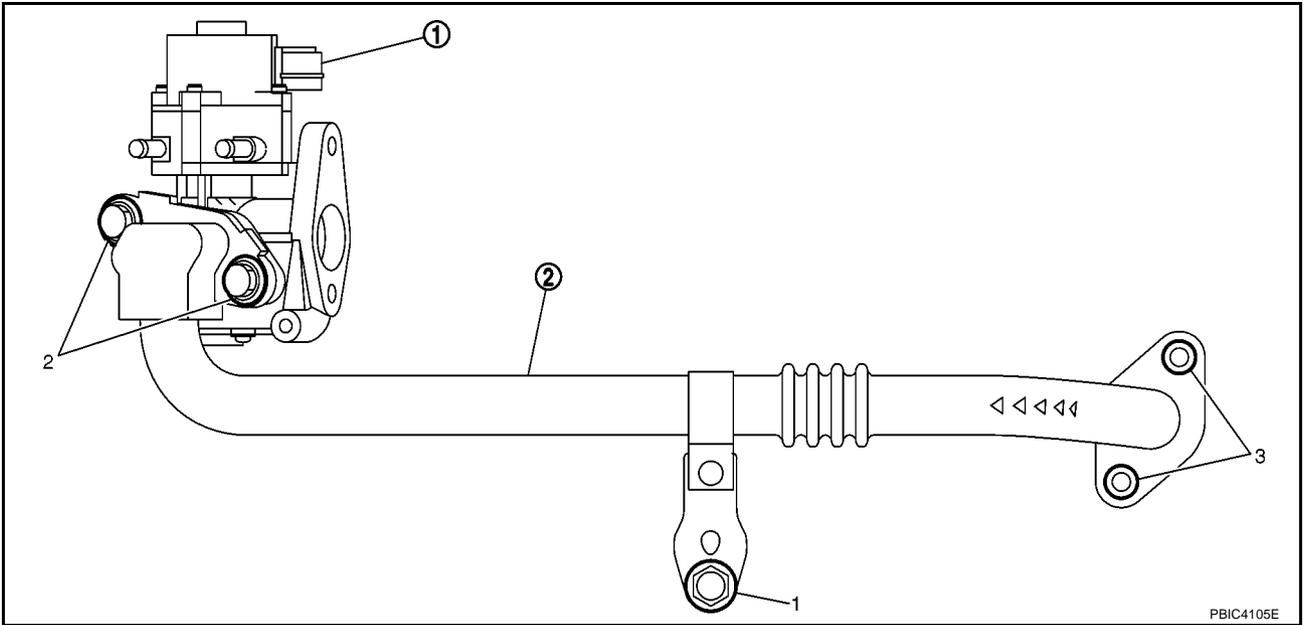
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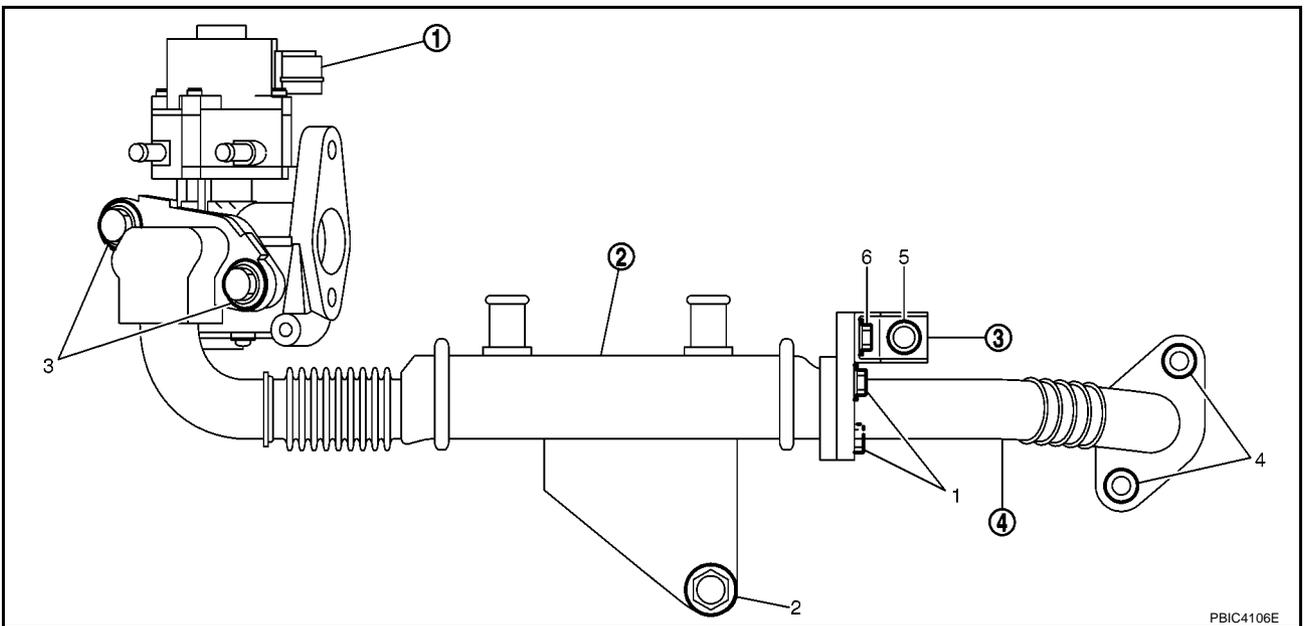
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- 1. EGR volume control valve
- 2. EGR tube

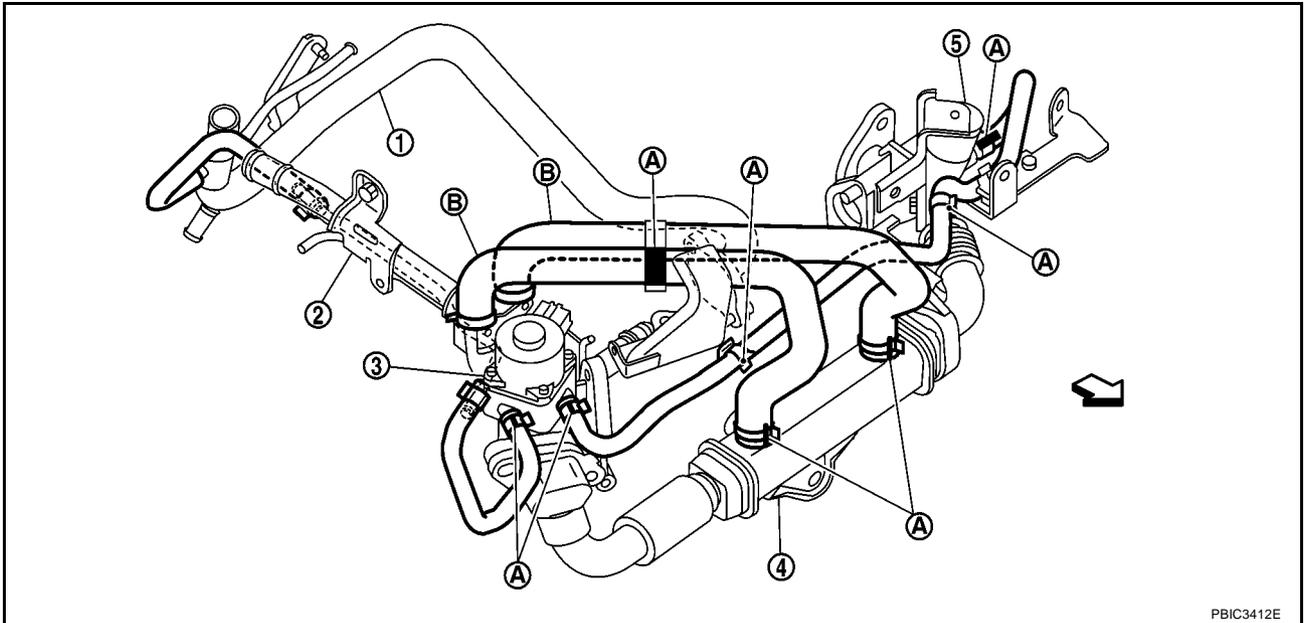
- Install EGR cooler (A/T models).
- Tighten fixing bolts and nuts in numerical order as shown in the figure.



- 1. EGR volume control valve
- 2. EGR cooler
- 3. Bracket
- 4. EGR tube

- Install water hoses and heater feed hose.

INTAKE MANIFOLD



PBIC3412E

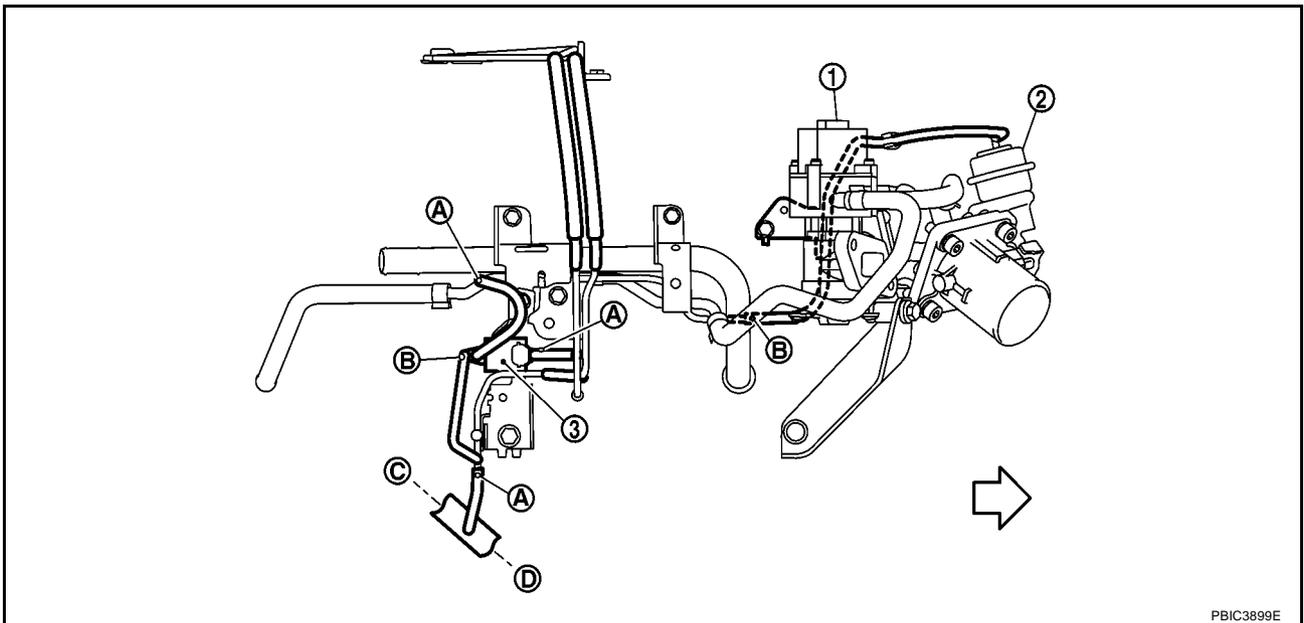
- | | | |
|---|---------------------|-----------------------------|
| 1. Heater return pipe | 2. Heater feed pipe | 3. EGR volume control valve |
| 4. EGR cooler (A/T models)
EGR tube (M/T models) | 5. Water outlet | |
| A. Paint mark | B. A/T models only | |

← Vehicle front

- Install water hose by referring to paint marks avoiding twisting.
- When an insert stopper is not provided with the pipe, insert the hose up to dimension A. When the pipe is shorter than dimension A, insert hose fully until it reaches the end.

Dimension A : 27 - 32 mm (1.063 - 1.260 in)

- When an insert stopper is provided on the pipe side, insert the hose until it reaches the stopper.
- Install vacuum hoses.



PBIC3899E

- | | | |
|-----------------------------|---------------------|--|
| 1. EGR volume control valve | 2. Throttle chamber | 3. Intake shutter control solenoid valve |
| A. Yellow paint | B. White paint | C. To brake booster |
| D. To vacuum pump | ← Vehicle front | |

- Install vacuum hose by referring to paint marks avoiding twisting.

INTAKE MANIFOLD

- When an insert stopper is not provided with the pipe, insert the hose up to dimension A. When the pipe is shorter than dimension A, insert hose fully until it reaches the end.

Dimension A : 15 – 20 mm (0.591 – 0.787 in)

- When an insert stopper is provided on the pipe side, insert the hose until it reaches the stopper.
- Before starting engine, bleed air from fuel piping. Refer to [FL-5, "Air Bleeding"](#) .

INSPECTION AFTER INSTALLATION

Start engine and increase engine speed to check for fuel leak.

CAUTION:

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

NOTE:

Use mirrors for checking at points out of clear sight.

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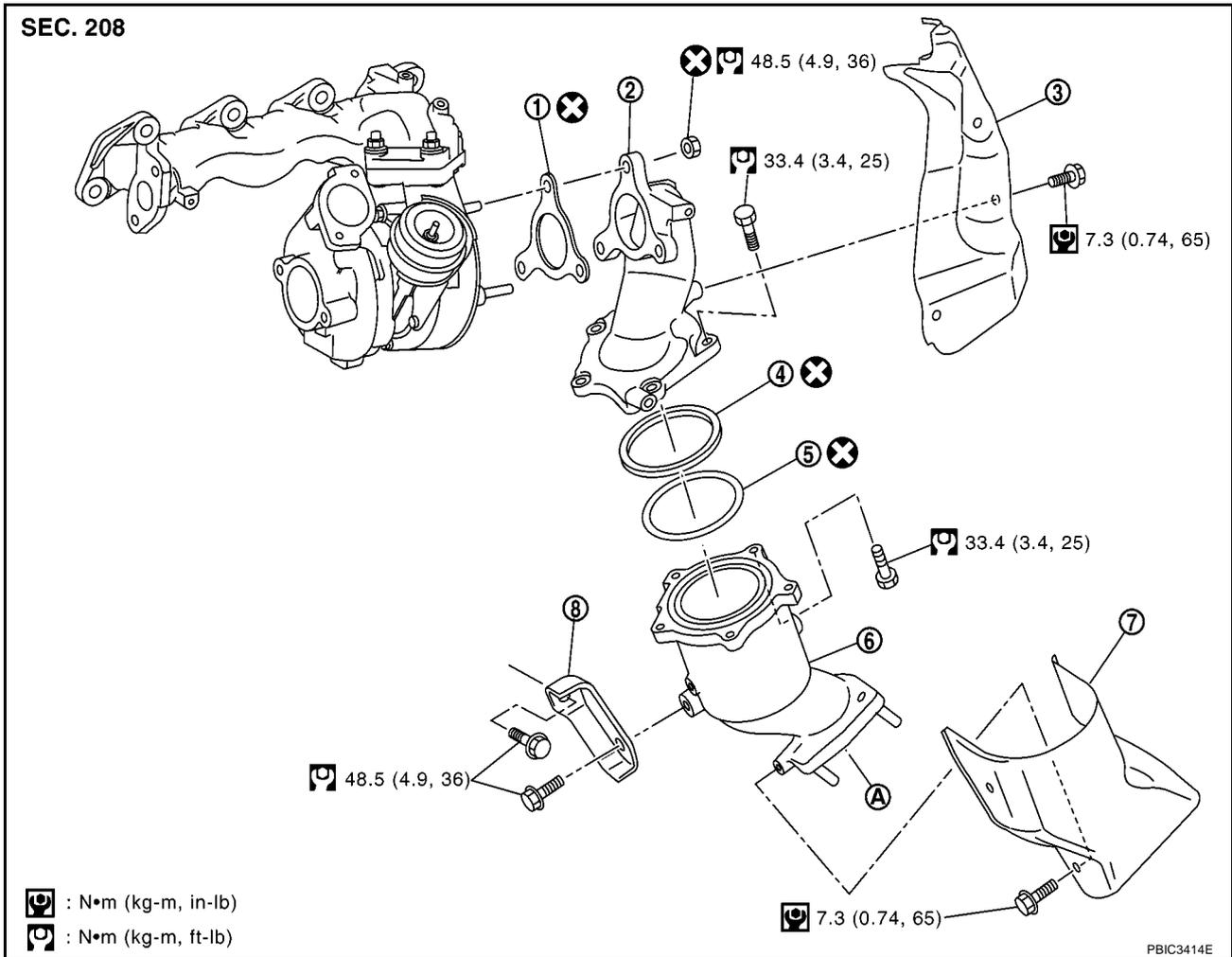
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CATALYST

PFP:20905

CATALYST Components

EBS01EJG



- | | | |
|-------------------|-------------------|-------------------------|
| 1. Gasket | 2. Exhaust outlet | 3. Exhaust outlet cover |
| 4. Gasket | 5. Gasket cap | 6. Catalyst |
| 7. Catalyst cover | 8. Bracket | |
- A. To exhaust front tube

- Refer to [GI-10, "Components"](#) for symbol marks in the figure.

Removal and Installation REMOVAL

EBS01E5V

1. Remove engine undercover.
2. Remove catalyst cover and exhaust outlet cover.
3. Remove exhaust front tube. Refer to [EX-2, "EXHAUST SYSTEM"](#).
4. Remove air inlet hose and air inlet tube. Refer to [EM-18, "CHARGE AIR COOLER"](#).
5. Remove exhaust manifold cover. Refer to [EM-34, "EXHAUST MANIFOLD"](#).
6. Remove catalyst and exhaust outlet.
7. Remove catalyst from exhaust outlet, as necessary.

CATALYST

INSTALLATION

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

- If stud bolts of turbocharger were removed, tighten them to the specified torque.

 : **25.5 N·m (2.6 kg-m, 19 ft-lb)**

- If stud bolts of catalyst were removed, tighten them to the specified torque.

 : **45.0 N·m (4.6 kg-m, 33 ft-lb)**

- Pushing bracket against the cylinder block and the catalyst, temporarily tighten the mounting bolt. And then tighten it to the specified torque.

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TURBO CHARGER

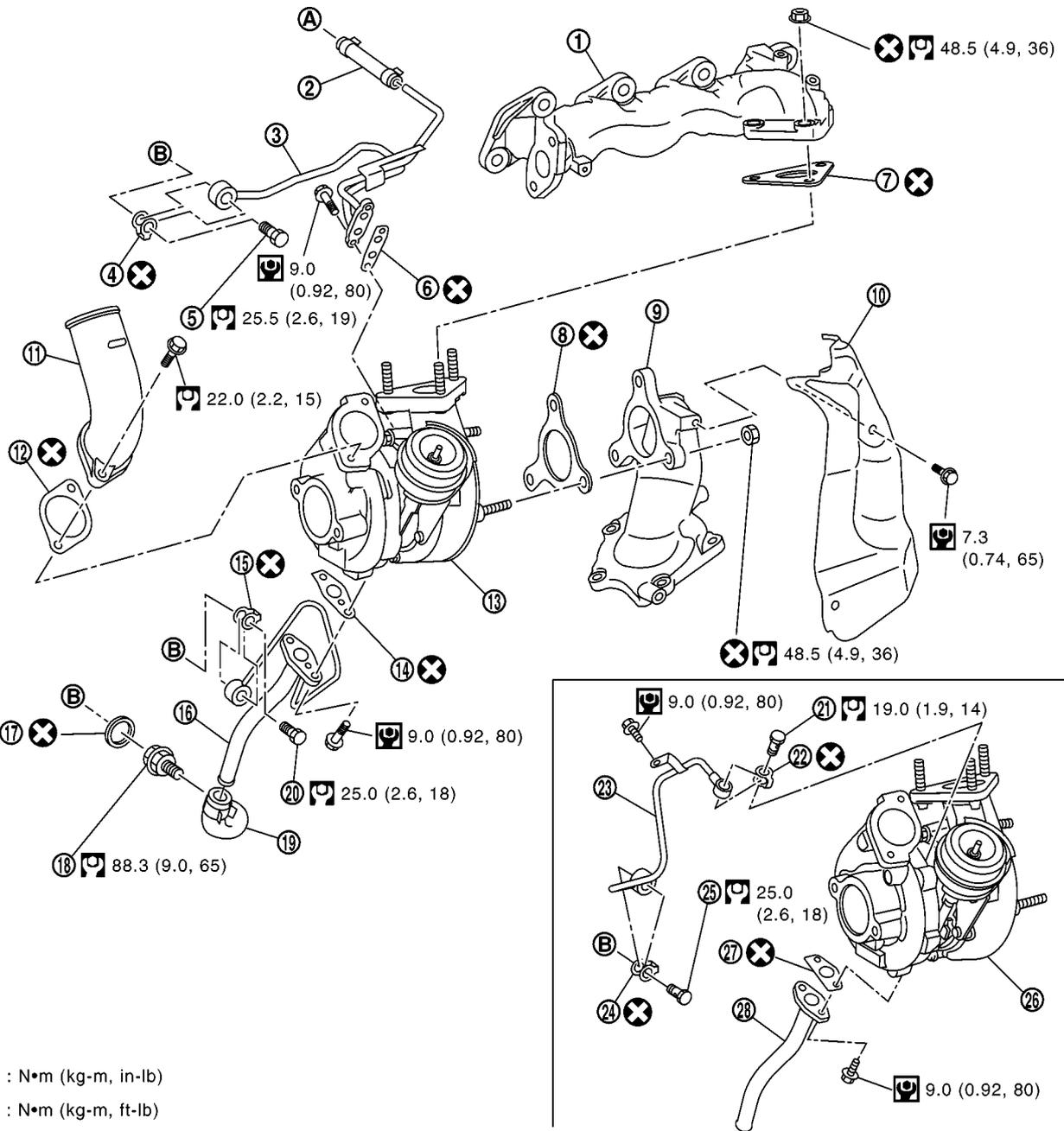
PFP:14411

EBS01EJH

TURBO CHARGER

Components

SEC. 144



PBIC4095E

- | | | |
|--|--------------------------------|--------------------------------|
| 1. Exhaust manifold | 2. Water hose (4WD models) | 3. Water tube (4WD models) |
| 4. Copper washer (4WD models) | 5. Eye-bolt (4WD models) | 6. Gasket (4WD models) |
| 7. Gasket | 8. Gasket | 9. Exhaust outlet |
| 10. Exhaust outlet cover | 11. Air inlet pipe | 12. Gasket |
| 13. Turbocharger (4WD models) | 14. Gasket (4WD models) | 15. Copper washer (4WD models) |
| 16. Oil feed tube and oil return tube (4WD models) | 17. Washer | 18. Connector |
| 19. Oil return hose | 20. Eye-bolt (4WD models) | 21. Eye-bolt (2WD models) |
| 22. Cooper washer (2WD models) | 23. Oil feed tube (2WD models) | 24. Cooper washer (2WD models) |
| 25. Eye-bolt (2WD models) | 26. Turbocharger (2WD models) | 27. Gasket (2WD models) |

TURBO CHARGER

28. Oil return tube (2WD models)

A. To heater return pipe

B. To cylinder block

A

- Refer to [GI-10, "Components"](#) for symbol marks in the figure.

Removal and Installation

EBS01E5X

EM

REMOVAL

- After applying penetrative lubricant to the mounting nuts, check for the penetration of the lubricant, and then loosen the nuts to remove.
1. Drain engine coolant (4WD models). Refer to [CO-7, "Changing Engine Coolant"](#) .
 2. Remove air inlet hose and air inlet pipe. Refer to [EM-18, "CHARGE AIR COOLER"](#) .
 3. Remove air duct and air inlet pipes. Refer to [EM-15, "AIR CLEANER AND AIR DUCT"](#) .
 4. Remove exhaust manifold cover. Refer to [EM-34, "EXHAUST MANIFOLD"](#) .
 5. Remove exhaust outlet and catalyst. Refer to [EM-26, "CATALYST"](#) .
 6. Remove eye bolt and water hose from water tube (4WD models).
 7. Loosen and remove eye-bolts from oil feed tube.
 8. Disconnect oil return hose from oil return tube.
 9. Remove turbocharger with water tube (4WD models) and oil feed tube and oil return tube.

CAUTION:

Be careful not to deform water tube and oil feed tube and oil return tube.

10. Remove water tube (4WD models) and oil feed tube and oil return tube from turbocharger.

CAUTION:

- Do not disassemble or adjust the turbocharger.
- Be careful not to contact with the vehicle.
- Do not hold turbocharger boost control actuator and actuator rod.

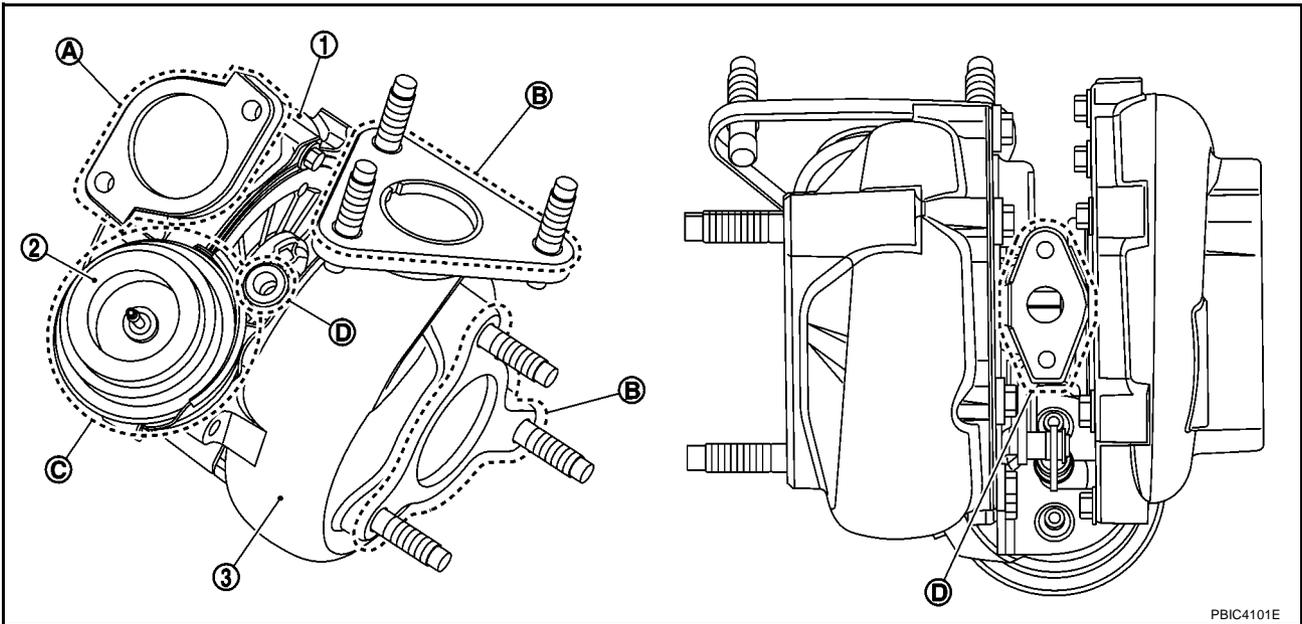
Water Tube and Oil Tube

- Clean inside of water tube (4WD models), oil feed tube and oil return tube, and check tubes for clogging.
- Replace water tube (4WD models), oil feed tube and/or oil return tube if clogging still exists after cleaning.

TURBO CHARGER

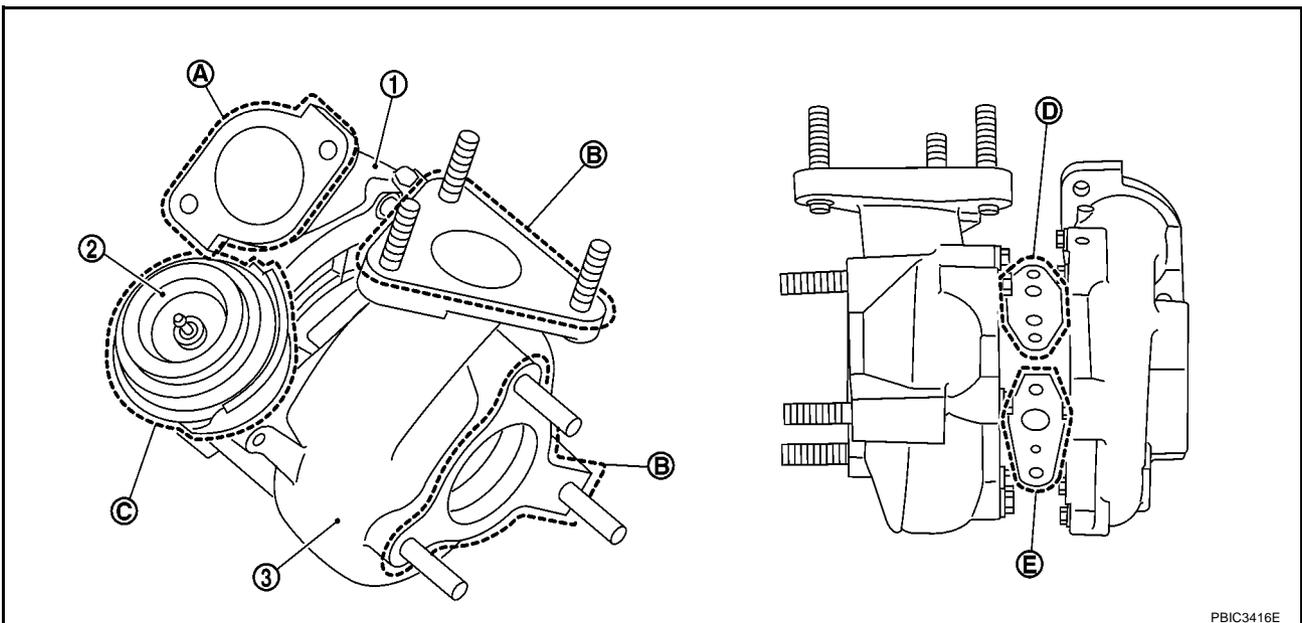
INSPECTION AFTER REMOVAL

2WD Models



- | | | |
|--|--|--|
| 1. Compressor housing | 2. Turbocharger boost control actuator | 3. Turbine housing |
| A. Check for charge air pressure leaks | B. Check for exhaust gas leaks | C. Check for negative air pressure leaks |
| D. Check for engine oil leaks | | |

4WD Models



- | | | |
|--|--|--|
| 1. Compressor housing | 2. Turbocharger boost control actuator | 3. Turbine housing |
| A. Check for charge air pressure leaks | B. Check for exhaust gas leaks | C. Check for negative air pressure leaks |
| D. Check for engine coolant leaks | E. Check for engine oil leaks | |

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 malfunction:

- Suction side : Between turbocharger and charge air cooler
- Exhaust side : Between turbocharger and catalyst

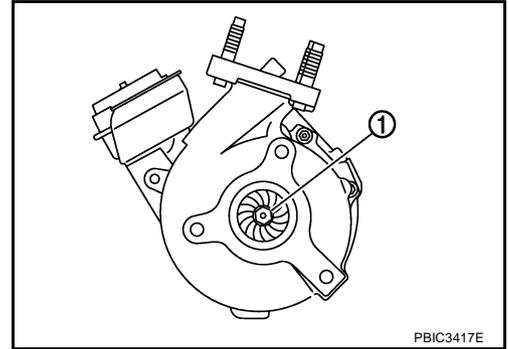
TURBO CHARGER

Rotor Shaft Clearance

- Make sure that the rotor shaft (1) rotates smoothly without any resistance when it is rotated by your fingertips.
- Make sure that the rotor shaft (1) is not loose when it is moved vertically or horizontally.
- Measure looseness with a dial gauge inserting its measuring rod through oil drain hole of turbocharger.

Standard : 0.086 - 0.117 mm (0.0034 - 0.0046 in)

- Replace turbocharger if out of standard.

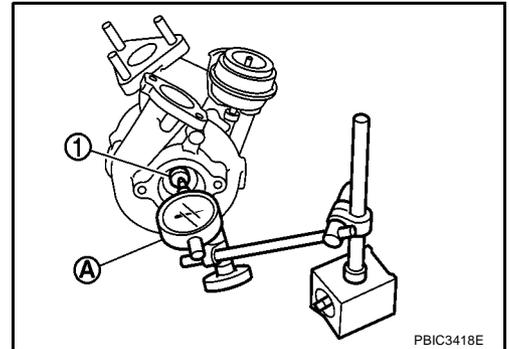


Rotor Shaft End Play

- Place a dial gauge (A) at the rotor shaft (1) end in the axial direction to measure the end play.

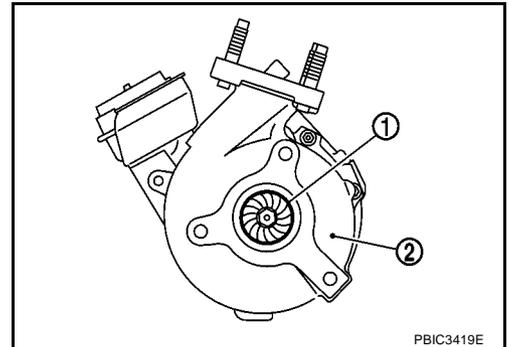
Standard : 0.036 - 0.090 mm (0.0014 - 0.0035 in)

- Replace turbocharger if out of standard.



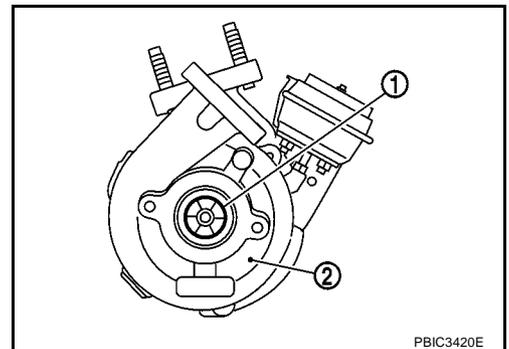
Turbine Wheel

- Make sure that there is no engine oil adhesion.
- Make sure that there is no carbon accumulation.
- Make sure that blades of turbine wheel (1) are not bent or broken.
- Make sure that turbine wheel (1) does not interfere with turbine housing (2).



Compressor Wheel

- Make sure that there is no engine oil adhesion inside the air inlet.
- Make sure that compressor wheel (1) does not interfere with compressor housing (2).
- Make sure that compressor wheel (1) is not bent or broken.



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TURBO CHARGER

Turbocharger Boost Control Actuator

- Connect the handy vacuum pump (B) to the turbocharger boost control actuator (1), and make sure that the rod (2) strokes smoothly in compliance with the following pressure.

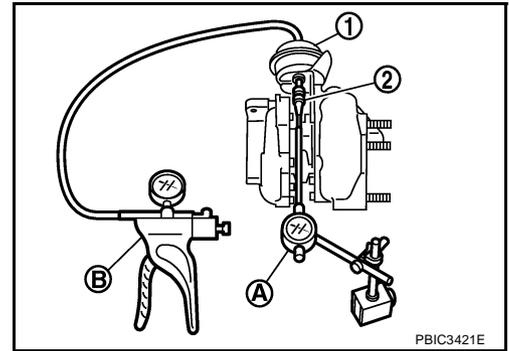
A : Dial gauge

- Pressure to be applied at the turbocharger boost control actuator (1) part to move rod (2) end as follows:

Standard (Pressure/rod stroke amount):

: -52.0 to -54.6 kPa (-520 to -546 mbar, -390 to -410 mmHg, -15.4 to -16.1 inHg)/0.2 mm (0.0079 in)

: -32.0 to -40.0 kPa (-320 to -400 mbar, -240 to -300 mmHg, -9.45 to -11.8 inHg)/5.0 mm (0.197 in)



TROUBLE DIAGNOSIS OF TURBOCHARGER

Preliminary check:

- Make sure that the engine oil level is between MIN and MAX of the oil level gauge. (When engine oil amount is more than MAX, engine oil flows into the inlet duct through blow-by gas passage, and turbocharger is misjudged malfunction.)
- Ask the customer if he/she always runs the vehicle in idle engine speed to cool the engine oil down after driving.
- Replace the turbocharger assembly when any malfunction is found after unit inspections specified in the table below.
- If no malfunction is found after the unit inspections, judge that the turbocharger body has no malfunction. Check the other parts again.

Inspection item	Inspection result	Symptom (when each inspection item meets each inspection result)			
		Engine oil leakage	Smoke	Noise	Insufficient power/acceleration malfunction
Turbine wheel	Engine oil leaks	C	A	C	C
	Carbon is accumulated	C	A	B	B
	Friction with housing	C	B	A	B
	Blades are bent or broken	—	—	A	A
Compressor wheel	Inside the air inlet is seriously contaminated by engine oil.	B	B	—	—
	Friction with housing	C	B	A	B
	Blades are bent or broken	—	—	A	A
After checking both turbine and compressor, inspect rotor shaft end play.	There is resistance when the rotor shaft is rotated by your fingertips.	—	C	C	B
	The rotor shaft sometimes does not rotate by your fingertips.	—	—	—	A
	There is too much play in the bearing.	C	C	B	C
Oil return port	Carbon or sludge is accumulated in the waste oil hole.	C	A	C	C

A: Large possibility

B: Medium possibility

C: Small possibility

TURBO CHARGER

INSTALLATION

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

- When a stud bolt is pulled out, replace it with a new one and tighten it to the following torque.

: **25.5 N·m (2.6 kg-m, 19 ft-lb)**

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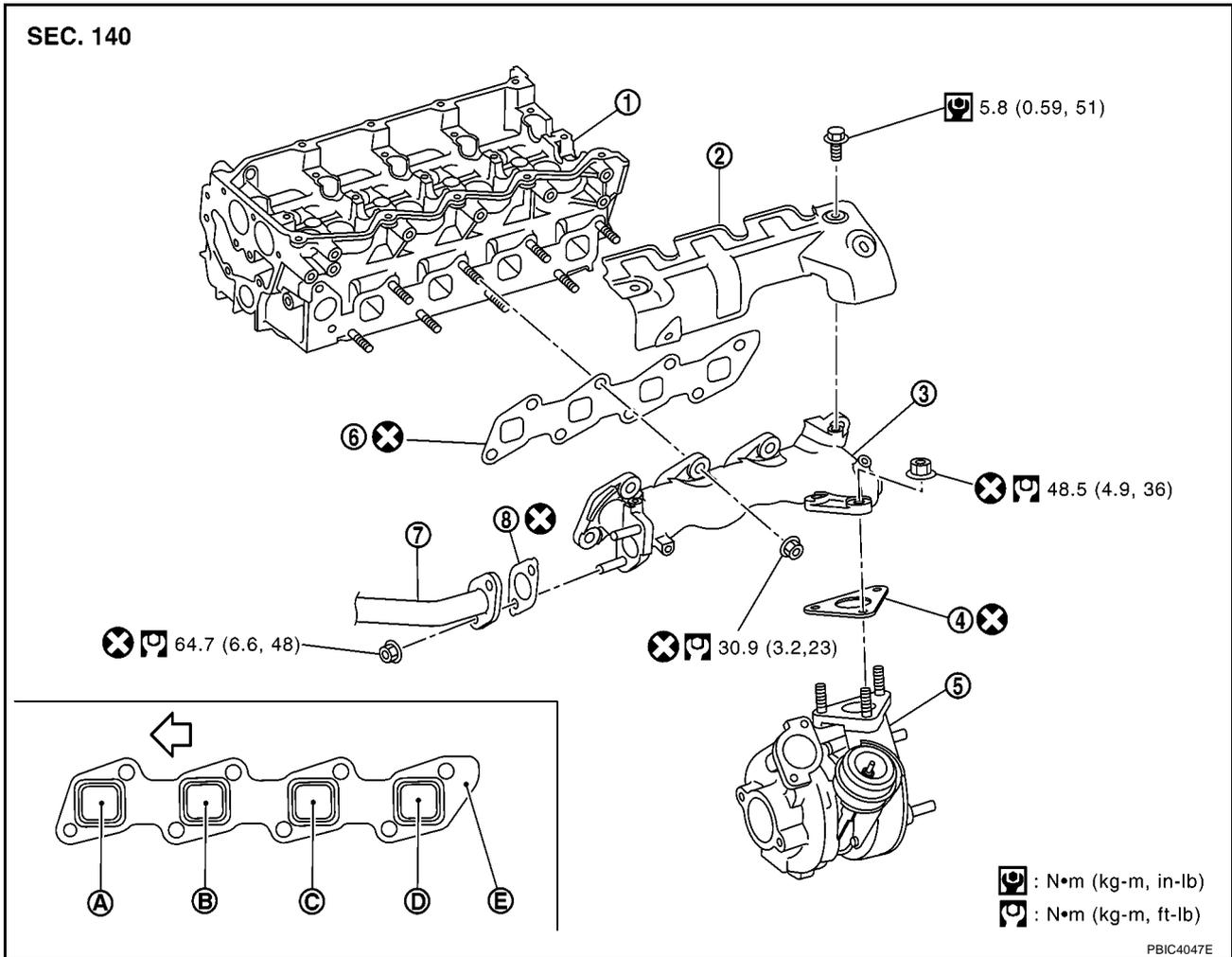
EXHAUST MANIFOLD

EXHAUST MANIFOLD

PFP:14004

Components

EBS01EJJ



- | | | |
|------------------|---------------------------|---------------------|
| 1. Cylinder head | 2. Exhaust manifold cover | 3. Exhaust manifold |
| 4. Gasket | 5. Turbocharger | 6. Gasket |
| 7. EGR tube | 8. Gasket | |
| A. No.1 port | B. No.2 port | C. No.3 port |
| D. No.4 port | E. Alignment protrusion | |
- ← Vehicle front

- Refer to [GI-10, "Components"](#) for symbol marks except in the above.

Removal and Installation

REMOVAL

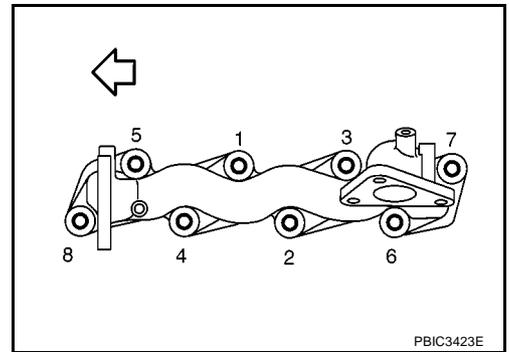
EBS01EJJ

1. Drain engine coolant. Refer to [CO-7, "Changing Engine Coolant"](#).
2. Remove exhaust manifold cover.
3. Remove turbocharger. Refer to [EM-28, "TURBO CHARGER"](#).
4. Remove EGR tube (M/T models) or EGR cooler (A/T models). Refer to [EM-20, "INTAKE MANIFOLD"](#).

EXHAUST MANIFOLD

5. Loosen exhaust manifold mounting nuts in the reverse order in the figure.

← : Vehicle front



6. Rotate exhaust manifold.

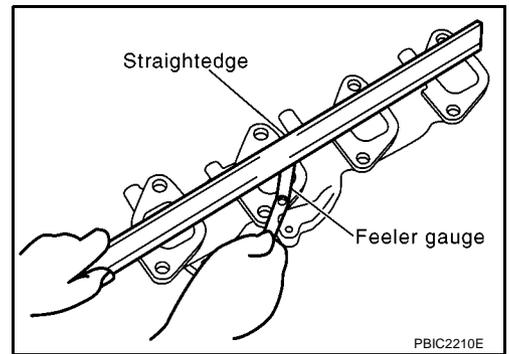
INSPECTION AFTER REMOVAL

Surface Distortion

- Use a reliable straight edge and feeler gauge to check the flatness of exhaust manifold fitting surface.

Limit :0.3 mm (0.012 in)

- If it exceeds the limit, replace exhaust manifold.



INSTALLATION

- If stud bolts were removed, replace them with new ones, and tighten them to the specified torque:

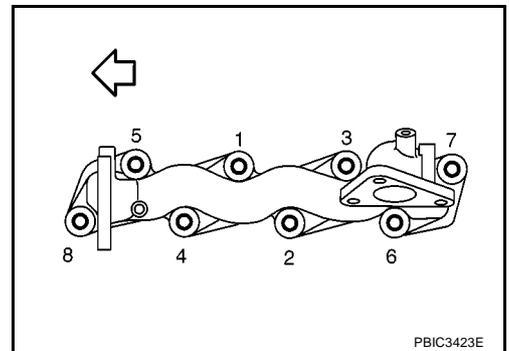
: **14.7 N·m (1.5 kg-m, 11 ft-lb)**

- Tighten the exhaust manifold mounting nuts in the following procedure:

- Install gasket so that the alignment protrusion faces the No. 4 port. Refer to [EM-34, "Removal and Installation"](#).
- Tighten the nuts in order specified in the figure.

← : Vehicle front

- Re-tighten the nuts 1 to 8.
- Install in the reverse order of removal.



INSPECTION AFTER INSTALLATION

Start engine and raise engine speed to check no exhaust gas and engine oil leaks.

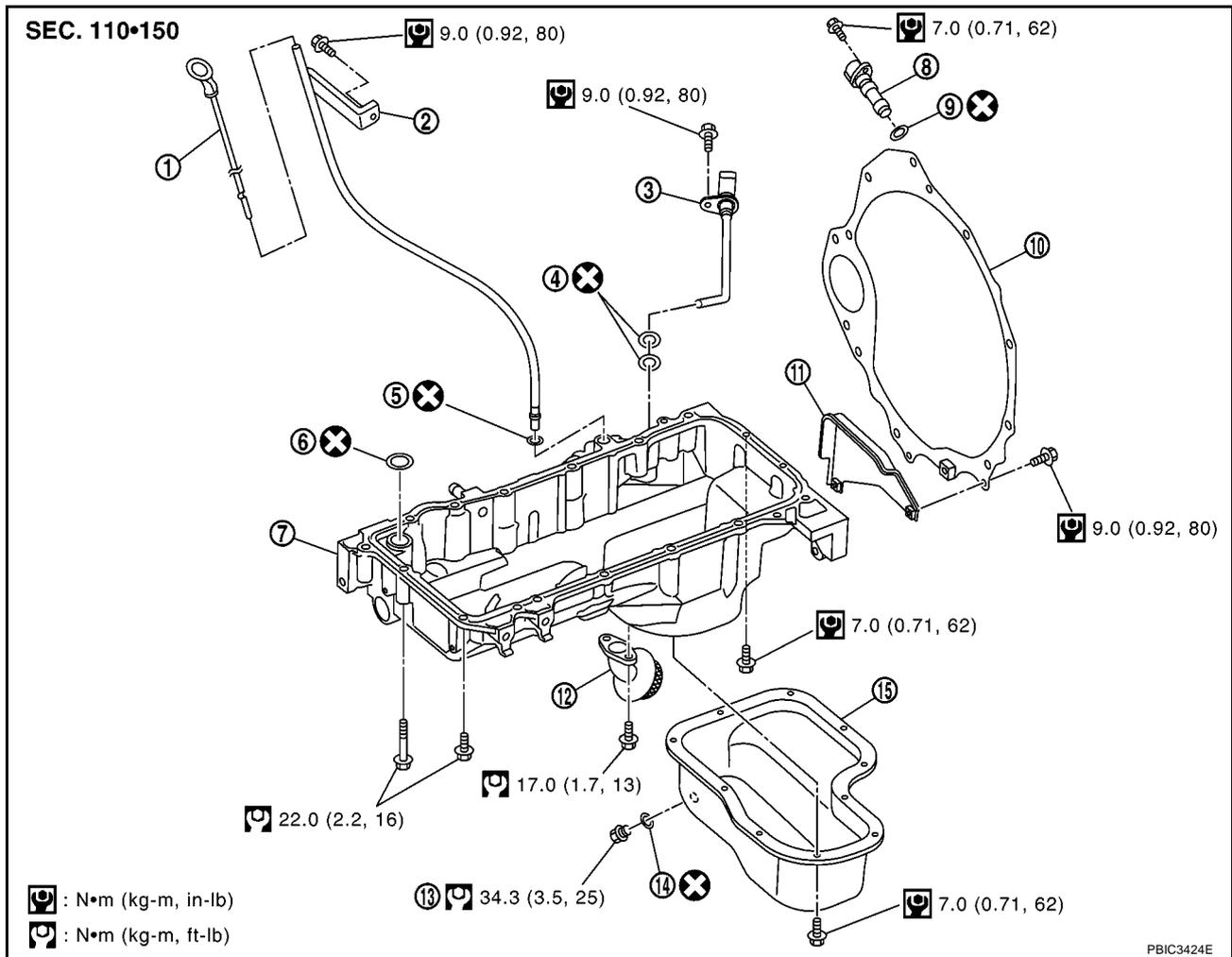
OIL PAN AND OIL STRAINER

OIL PAN AND OIL STRAINER

PF11110

Components

EBS01EJK



- | | | |
|------------------------|-------------------------------|---------------------|
| 1. Oil level gauge | 2. Oil level gauge guide | 3. Oil level sensor |
| 4. O-ring | 5. O-ring | 6. O-ring |
| 7. Oil pan upper | 8. Crankshaft position sensor | 9. O-ring |
| 10. Rear plate | 11. Rear plate cover | 12. Oil strainer |
| 13. Oil pan drain plug | 14. Drain plug washer | 15. Oil pan lower |

- Refer to [GI-10, "Components"](#) for symbol marks in the figure.

Removal and Installation

REMOVAL

WARNING:

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

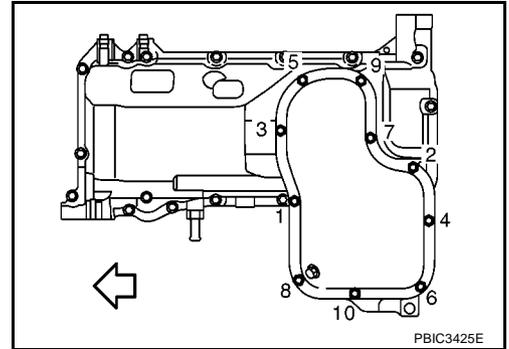
- Remove engine undercover front and engine undercover middle. Refer to [EI-17, "REAR BUMPER"](#).
- Drain engine oil. Refer to [LU-6, "Changing Engine Oil"](#).

EBS01E5Z

OIL PAN AND OIL STRAINER

3. Remove oil pan lower bolts, loosen bolts in the reverse order of that shown in the figure.

← : Vehicle front



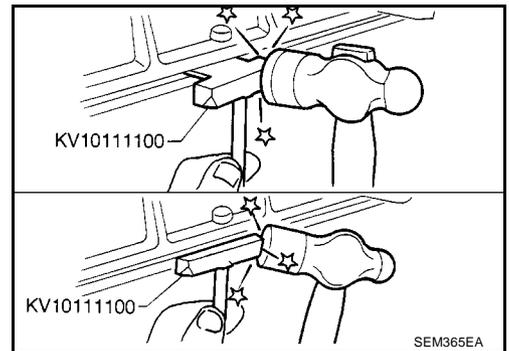
4. Remove oil pan lower.

- a. Insert the seal cutter [SST] between oil pan upper and oil pan lower.

CAUTION:

- Be careful not to damage aluminum mating surface.
- Do not insert screwdriver, or oil pan flange will be deformed.

- b. Slide the seal cutter by tapping on the side of the seal cutter with a hammer.
c. Remove oil pan lower.



5. Remove oil strainer.

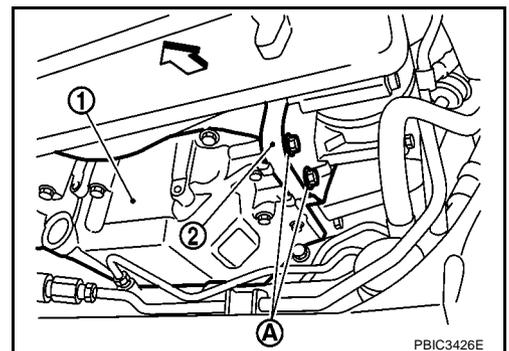
6. Remove power steering oil pump belt. Refer to [EM-12, "DRIVE BELTS"](#) .

7. Remove power steering oil pump bracket and move power steering oil pump aside with its piping connected. Temporarily secure it on the vehicle side with a rope to avoid putting load on it. Refer to [PS-25, "POWER STEERING OIL PUMP"](#) .

8. Disconnect oil return hose (vacuum pump) from oil pan upper. Refer to [EM-42, "VACUUM PUMP"](#) .

9. Remove A/C compressor bracket mounting bolts (A).

- 1 : Oil pan upper
2 : A/C compressor bracket
← : Vehicle front



10. Remove crankshaft position sensor and oil level sensor.

CAUTION:

- Avoid impacts such as a dropping.
- Do not disassemble.
- Keep it away from metal particles.
- Do not place sensor close to magnetic materials.

11. Remove front propeller shaft (4WD models). Refer to [PR-3, "FRONT PROPELLER SHAFT"](#) .

12. Remove RH and LH front drive shaft (4WD models). Refer to [FAX-7, "DRIVE SHAFT"](#) .

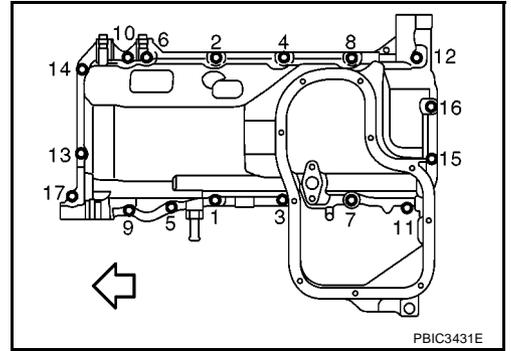
13. Remove front final drive assembly (4WD models). Refer to [FFD-15, "FRONT FINAL DRIVE ASSEMBLY"](#) .

14. Remove rear plate cover and transmission joint bolts.

OIL PAN AND OIL STRAINER

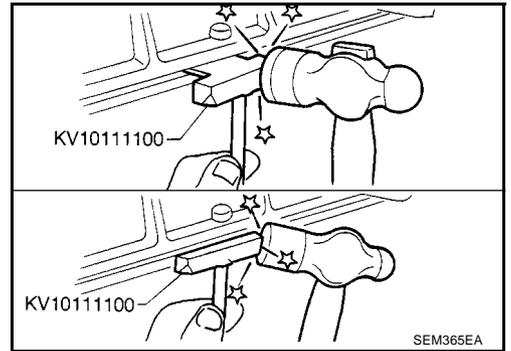
15. Loosen bolts in the reverse order of illustration to remove oil pan upper.

← : Vehicle front



16. Remove oil pan upper.

- Insert the seal cutter [SST] between oil pan upper and cylinder block. Slide the seal cutter by tapping on the side of the seal cutter with a hammer. Remove oil pan upper.
- **Be careful not to damage aluminum mating surface.**
- **Do not insert screwdriver, or oil pan flange will be deformed.**



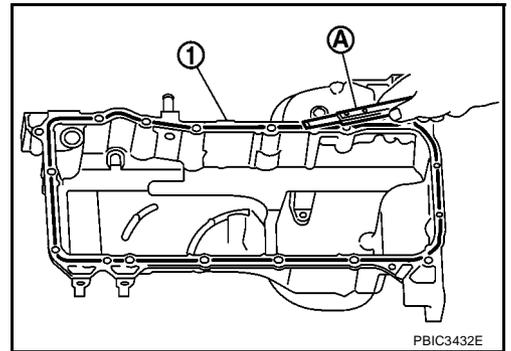
INSPECTION AFTER REMOVAL

Clean oil strainer if any object attached.

INSTALLATION

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

- Install oil pan upper with the following procedure.
 - Use the scraper (A) to remove old liquid gasket from mating surface of oil pan upper (1).
- **Also remove old liquid gasket from mating surface of cylinder block and rear chain case.**
- **Remove old liquid gasket from the bolt hole and thread.**



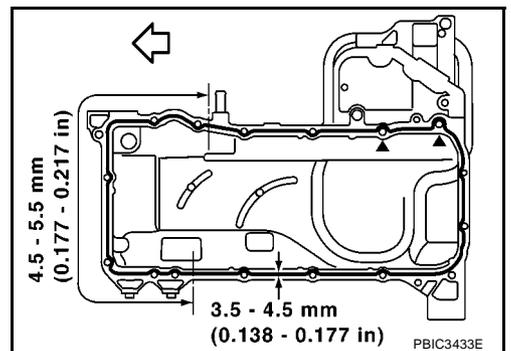
- Apply a continuous bead of liquid gasket with the tube presser [SST: WS39930000] to areas shown in the figure.

← : Vehicle front

Use Genuine Liquid Gasket or equivalent.

CAUTION:

- **At the 2 bolt holes marked ▲, liquid gasket should be applied outside holes.**
- **Be sure liquid gasket is 3.5 to 4.5 mm (0.138 to 0.177 in) or 4.5 to 5.5 mm (0.177 to 0.217 in) wide. (Be careful that the diameter of the liquid gasket bead is different around the front.)**
- **Attaching should be done within 5 minutes after coating.**
- Install oil pan upper.



OIL PAN AND OIL STRAINER

CAUTION:

Install avoiding misalignment of O-ring.

- Tighten bolts in numerical order to the specified torque.

← : Vehicle front

- Bolt dimensions vary depending on the installation location. Refer to the following and use appropriate bolts.

M6 x 30 mm (1.18 in) : Bolt No. 15, 16

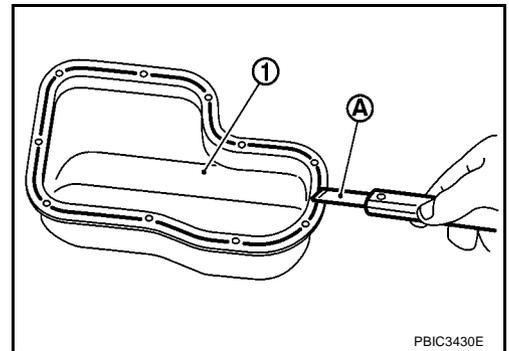
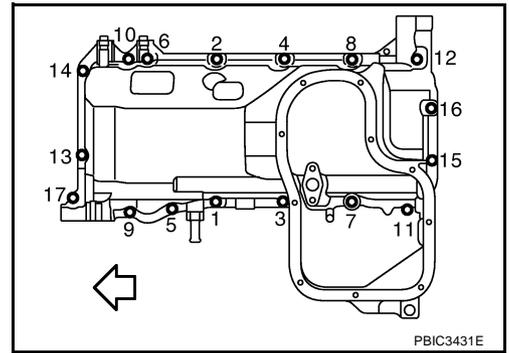
M8 x 25 mm (0.98 in) : Bolt No. 2, 4, 5, 8, 9, 10, 14

M8 x 60 mm (2.36 in) : Bolt No. 1, 3, 6, 7, 11, 12, 13, 17

- The shank length under the bolt neck above is the length of the threaded part (pilot portion not included).
- Install oil pan lower with the following procedure.
- Use a scraper (A) to remove old liquid gasket from mating surface of oil pan lower (1).

CAUTION:

- Also remove old liquid gasket from mating surface of oil pan upper.
- Remove old liquid gasket from bolt hole and thread.

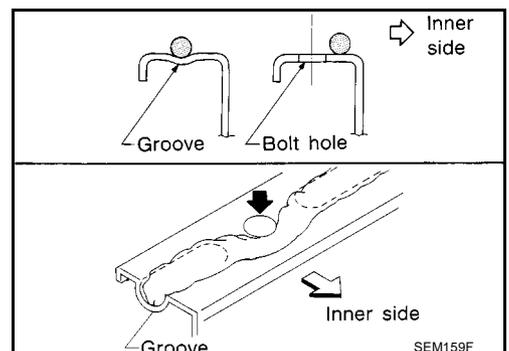
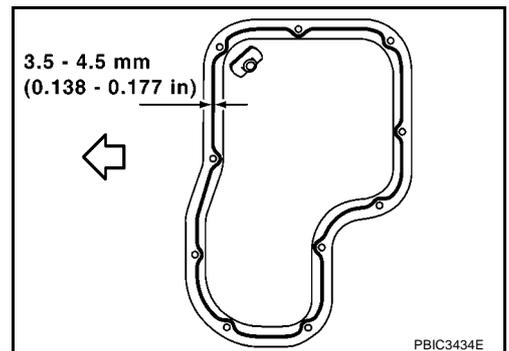


- Apply a continuous bead of liquid gasket with the tube presser [SST: WS39930000] as shown in the figure.

← : Vehicle front

Use Genuine Liquid Gasket or equivalent.

- Be sure liquid gasket is 3.5 to 4.5 mm (0.138 to 0.177 in) wide.
- Attaching should be done within 5 minutes after coating.



- Install oil pan lower.

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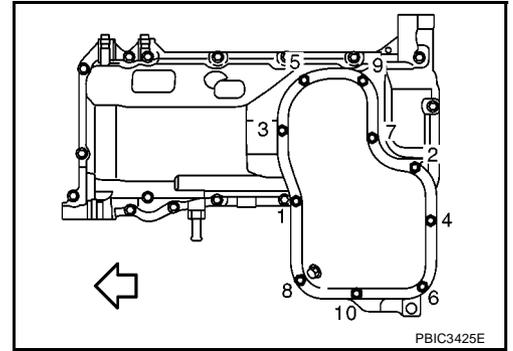
OIL PAN AND OIL STRAINER

- Tighten bolts in numerical order to the specified torque.

← : Vehicle front

NOTE:

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



INSPECTION AFTER INSTALLATION

1. Check engine oil level and add engine oil. Refer to [LU-5, "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-5, "ENGINE OIL"](#) .

GLOW PLUG

PFP:22401

A

GLOW PLUG

Components

EBS01EJL

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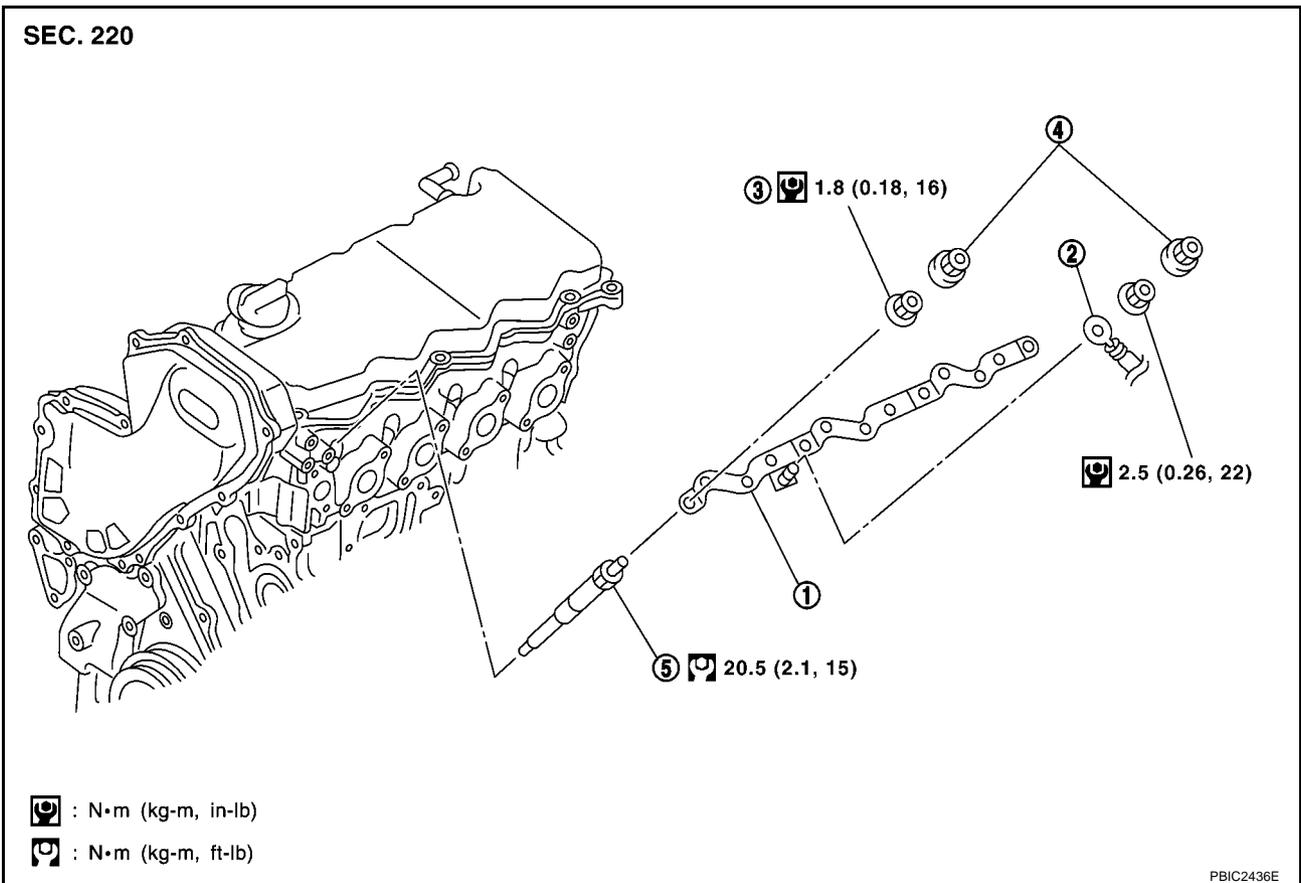
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1. Glow plate

2. Glow harness

3. Glow nut

4. Cap

5. Glow plug

Removal and Installation

REMOVAL

EBS01E60

CAUTION:

Remove glow plug only if necessary. If carbon adheres, it may be stuck and broken.

1. Disconnect glow harness from glow plate.
2. Remove glow nut to remove glow plate.
3. 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 the reverse order of removal.

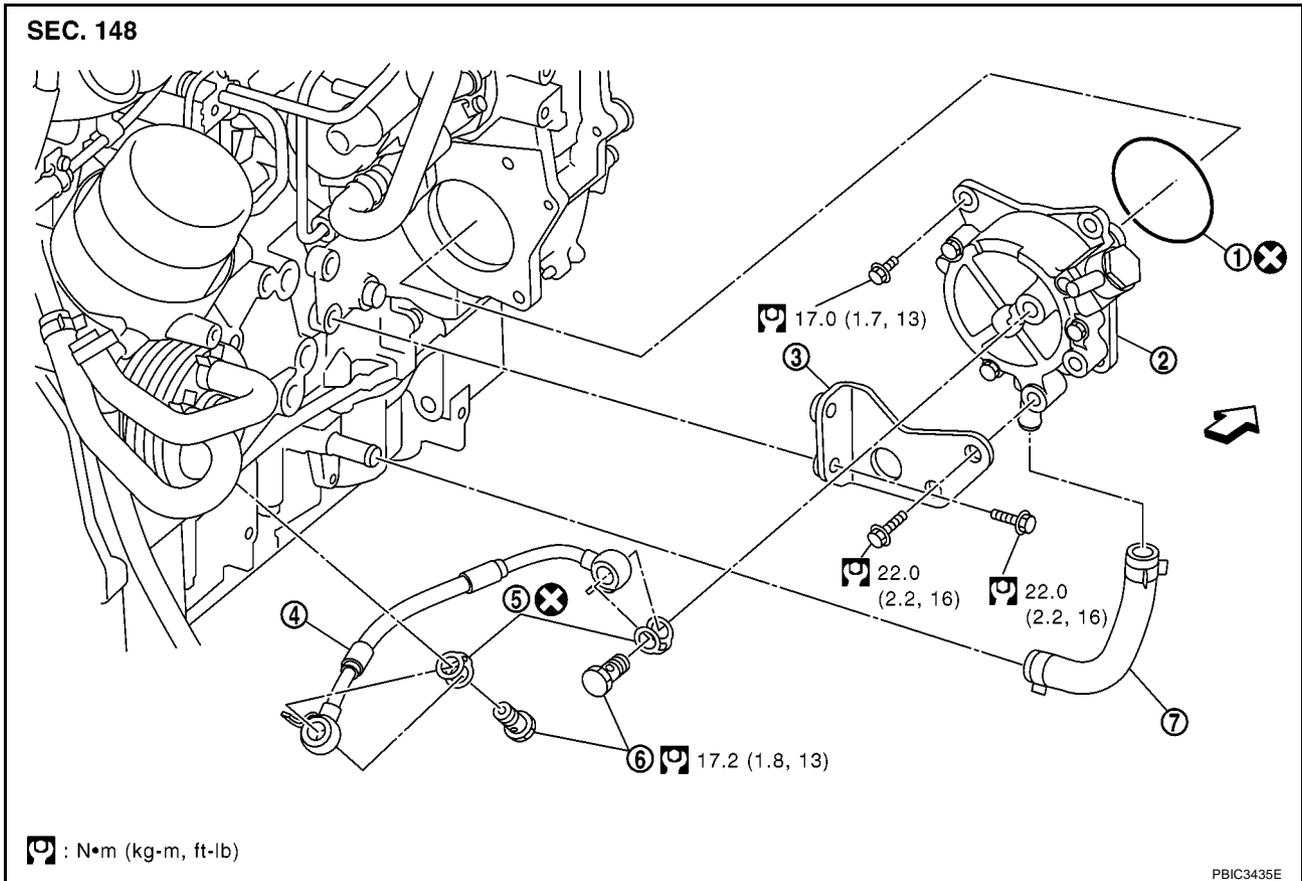
VACUUM PUMP

PFP:41920

VACUUM PUMP

Components

EBS01EJM



- | | | |
|------------------|------------------|-------------|
| 1. O-ring | 2. Vacuum pump | 3. Bracket |
| 4. Oil feed tube | 5. Cooper washer | 6. Eye-bolt |

7. Oil return hose

← Vehicle front

- Refer to [GI-10, "Components"](#) for symbol marks except in the above.

Removal and Installation

INSPECTION BEFORE REMOVAL

EBS01E61

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:

-94.0 to -96.1 kPa (-940 to -961 mbar, -705 to -721 mmHg, -27.76 to -28.38 inHg)

- If out of standard, check for air suction in vacuum route, and measure again.
- If still outside of standard, replace vacuum pump.

REMOVAL

1. Drain engine oil. Refer to [LU-6, "Changing Engine Oil"](#).
2. Remove primary timing chain. Refer to [EM-79, "PRIMARY TIMING CHAIN"](#).
3. Disconnect vacuum hose from vacuum pump side.
4. Remove oil feed tube and oil return hose.
5. Remove bracket.
6. Remove vacuum pump and O-ring.

VACUUM PUMP

INSTALLATION

Installation is the reverse order of removal.

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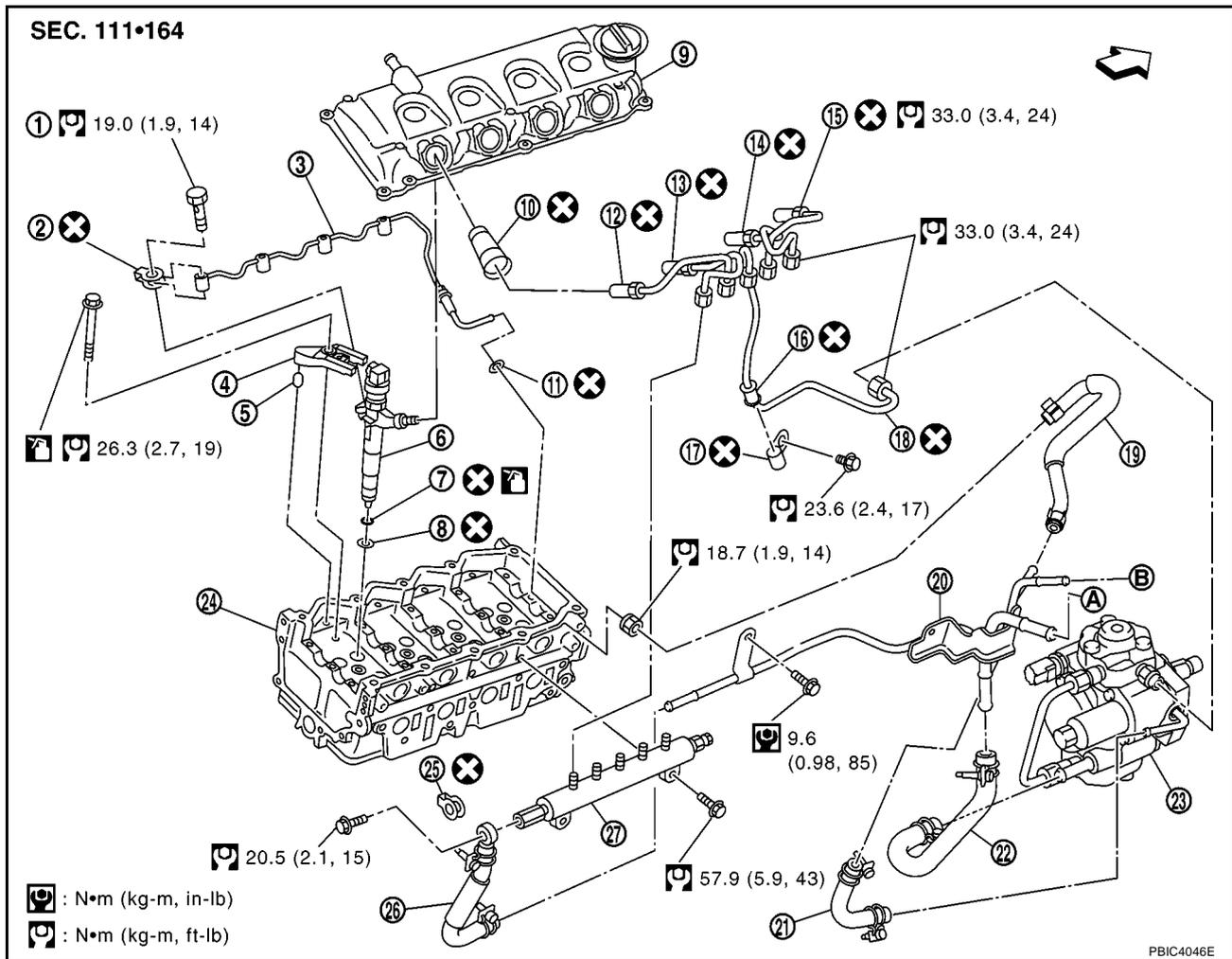
INJECTION TUBE AND FUEL INJECTOR

PFP:00018

INJECTION TUBE AND FUEL INJECTOR

Components

EBS01EK6



- | | | |
|--------------------------|--------------------------|---------------------------|
| 1. Eye-bolt | 2. Cooper washer | 3. Spill tube |
| 4. Nozzle support | 5. Pin | 6. Fuel injector |
| 7. O-ring | 8. Nozzle gasket | 9. Rocker cover |
| 10. Nozzle oil seal | 11. Washer | 12. Injection tube No. 4 |
| 13. Injection tube No. 3 | 14. Injection tube No. 2 | 15. Injection tube No. 1 |
| 16. Insert rubber | 17. Clip | 18. Injection tube center |
| 19. Spill hose | 20. Fuel gallery | 21. Spill hose |
| 22. Fuel hose | 23. Fuel pump | 24. Cylinder head |
| 25. Cooper washer | 26. Fuel hose | 27. Fuel rail |

- A. To fuel filter
- B. To fuel cooler (under floor) (4WD models)
To fuel tank (2WD models)

← Vehicle front

- Refer to [GI-10, "Components"](#) for symbol marks except in the above.

Removal and Installation

REMOVAL

- Remove engine cover. Refer to [EM-20, "INTAKE MANIFOLD"](#).
- Remove fuel filter. Refer to [FL-4, "FUEL FILTER"](#).

CAUTION:

Be careful not to allow leaked fuel to contaminate engine room. Especially, ensure to keep engine mounting insulator clear of fuel.

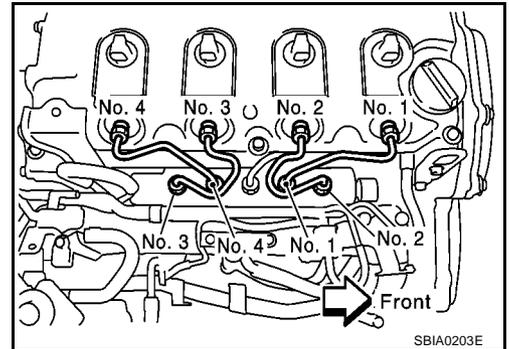
EBS01E63

INJECTION TUBE AND FUEL INJECTOR

3. Disconnect harness connector from fuel injector.
4. Remove spill hose.
5. Following steps below, remove injection tubes.
 - a. Put a paint mark or tag on injection tubes to identify each cylinder.
 - Use a fuel-resistant method.
 - b. Remove injection tubes in order of 2-1-4-3 individually.

CAUTION:

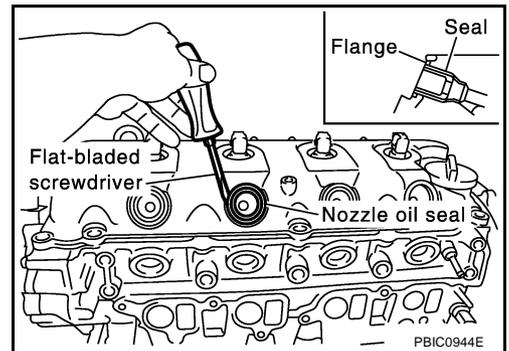
Be careful not to allow leaked fuel to contaminate engine room. Especially, ensure to keep engine mounting insulator clear of fuel.



6. Remove nozzle oil seal.
 - Using the flat-bladed screwdriver, pry flange to remove oil seal.

NOTE:

Nozzle oil seal seals between fuel injector and rocker cover. If only injection tube shall be removed and installed, nozzle oil seal replacement is not required.

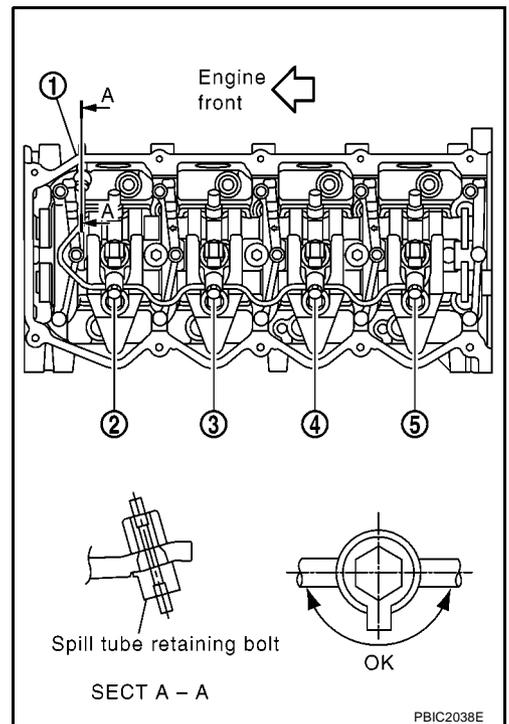


7. Remove rocker cover. Refer to [EM-56. "ROCKER COVER"](#).

8. Remove spill tube mounting bolts and nut.
 - Loosen bolts and nut to the reverse order in the figure and remove them.

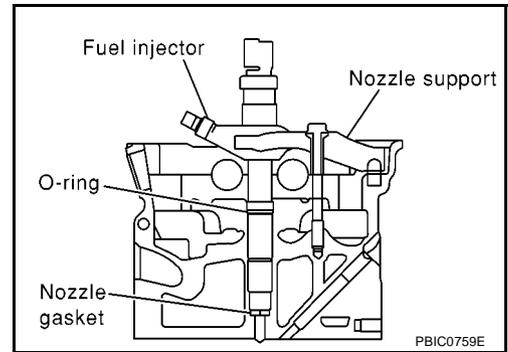
CAUTION:

When loosening nut, fix spill tube retaining bolt with spanner.



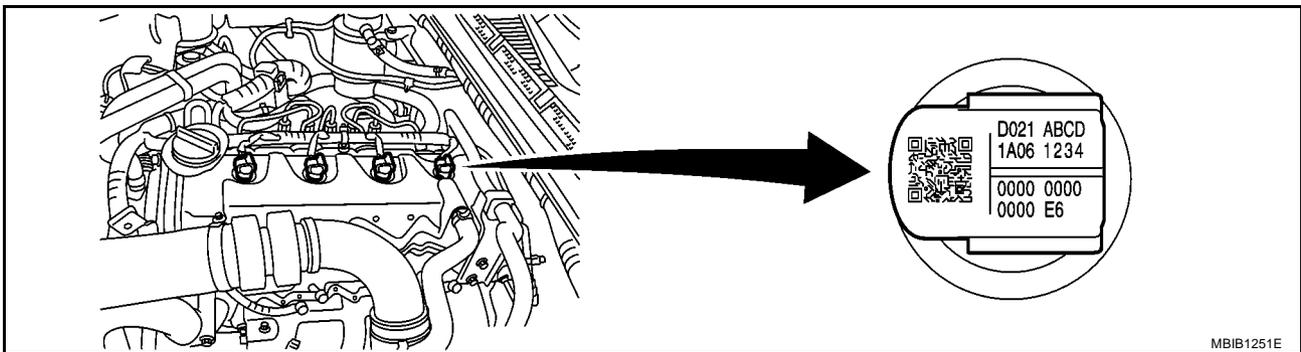
INJECTION TUBE AND FUEL INJECTOR

9. Following steps below, remove fuel injector.
 - a. Remove nozzle support.
 - b. Remove fuel injector. While rotating it to left and right, raise it to remove.
- CAUTION:**
- Handle fuel injector carefully without giving any impact.
 - Do not disassemble fuel injector.
- c. If nozzle gasket remains in cylinder head, hook it with tip of a flat-bladed screwdriver and pull it out.
 - d. Remove O-ring from fuel injector.



INSTALLATION

1. Record "INJECTOR ADJUSTMENT VALUE" on the top surface when replacing fuel injector.
 - Refer to [EC-25, "Injector Adjustment Value Registration"](#) for use of "INJECTOR ADJUSTMENT VALUE".



Example: Injector Adjustment value = D021ABCD1A061234000000000000E6

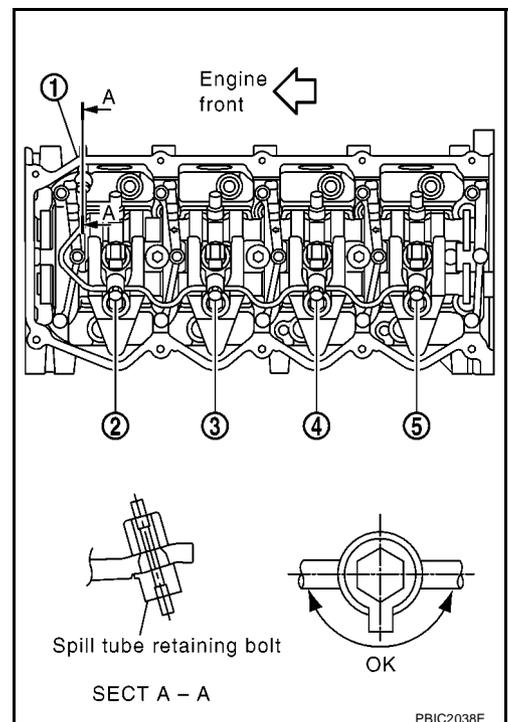
2. Following steps below, install fuel injector.
 - a. Install O-ring and nozzle gasket to fuel injector, and insert them into cylinder head.
 - b. Tighten injection tubes temporarily in the order of 3-4-1-2.
 - c. Be sure to fit nozzle support and pin without looseness.
 - d. Tighten nozzle support bolts.
 - e. Loosen injection tubes in the order of 2-1-4-3.
3. Connect spill tube.
 - Tighten fixing bolts and nut in numerical order shown in the figure.

CAUTION:

When tightening nut, fix spill tube retaining bolt with spanner.

NOTE:

Connection of spill tube gasket may be broken, even if it is tighten to the specified torque. It does not affect performance.



INJECTION TUBE AND FUEL INJECTOR

4. Perform air tightness test for spill tube.
 - Connect a handy vacuum pump to spill connector. Make sure that vacuum is retained while applying following vacuum.

Standard:

- 53.3 to - 66.7 kPa (- 533 to - 667 mbar, - 400 to - 500 mmHg, - 15.75 to - 19.69 inHg)

- If outside of standard, reconnect spill tube. (Replace gasket in this case.)

5. Install rocker cover. Refer to [EM-56, "Removal and Installation"](#).

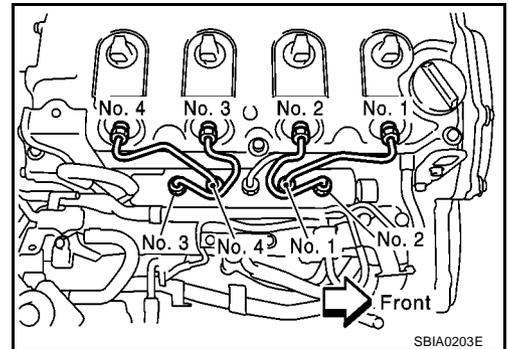
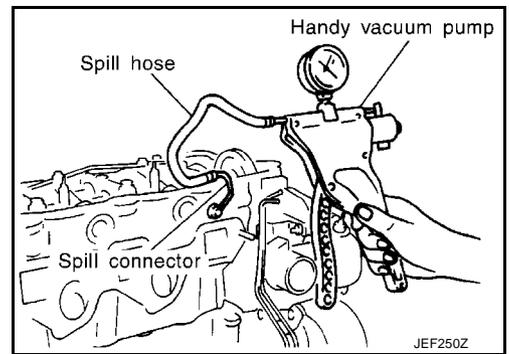
6. Install nozzle oil seal.

- Insert it straight until its flange fully contacts rocker cover.

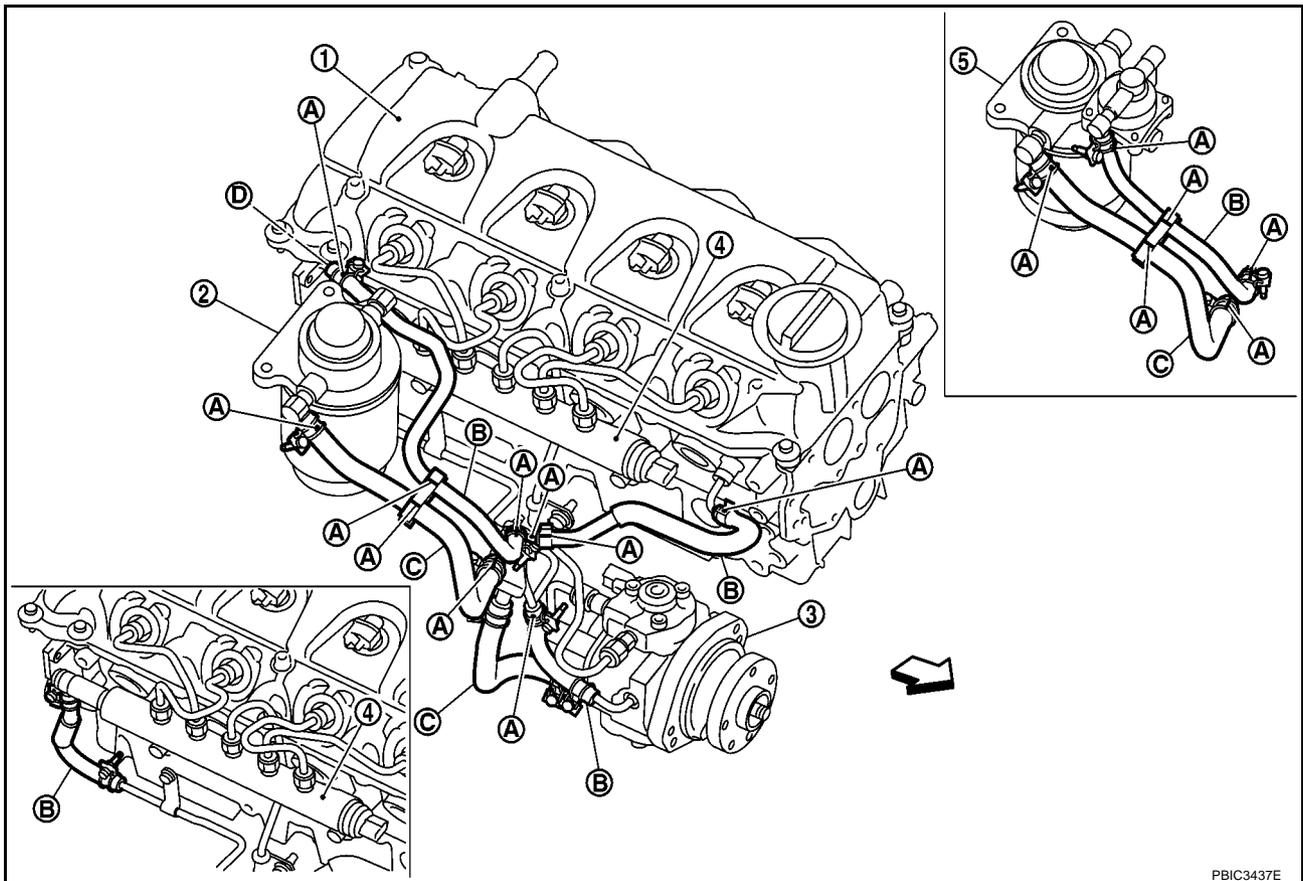
CAUTION:

- **Check gutter spring in nozzle oil seal on fuel injector for missing.**

7. Connect injection tubes individually to each cylinder in order of 3-4-1-2.



8. Install fuel hoses, spill hose and fuel gallery as shown in the figure.



- | | | |
|-----------------|---------------------------------------|--------------|
| 1. Rocker cover | 2. Fuel filter (standard models) | 3. Fuel pump |
| 4. Fuel rail | 5. Fuel filter (models for cold area) | |

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INJECTION TUBE AND FUEL INJECTOR

- A. Align paint mark
 - B. Insert the hose up to 26 mm (1.02 in)
 - C. Insert the hose up to 28 mm (1.10 in)
 - D. To fuel cooler (under floor)
- ↶ Vehicle front

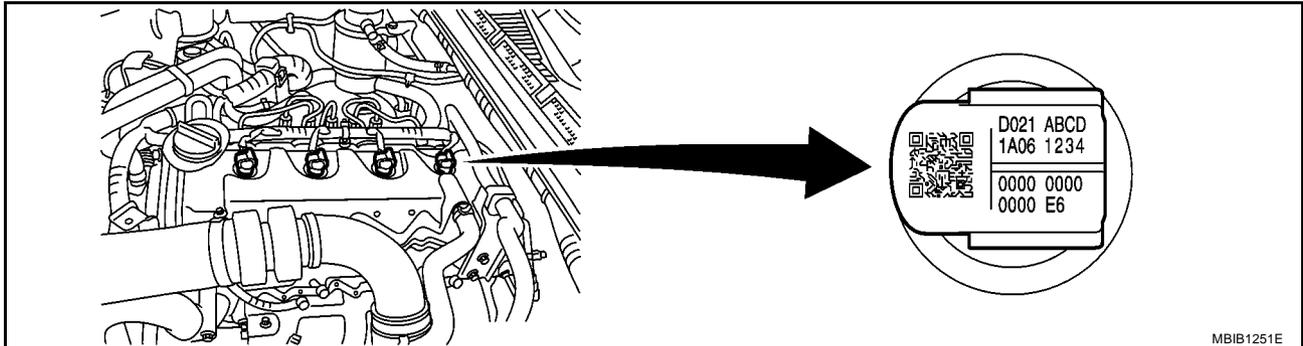
NOTE:

Intake manifold and other related parts are omitted for explanation.

- 9. Install remaining parts in the reverse order of removal.

INSPECTION AFTER INSTALLATION

- Input "INJECTOR ADJUSTMENT VALUE" to ECM after installing to the vehicle when replacing fuel injector. Refer to [EC-25, "Injector Adjustment Value Registration"](#) .



Example: Injector Adjustment value = D021ABCD1A061234000000000000E6

- Start engine and increase engine speed to check for fuel leak.

CAUTION:

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

FUEL PUMP

FUEL PUMP Components

PFP:17042

EBS01EK3

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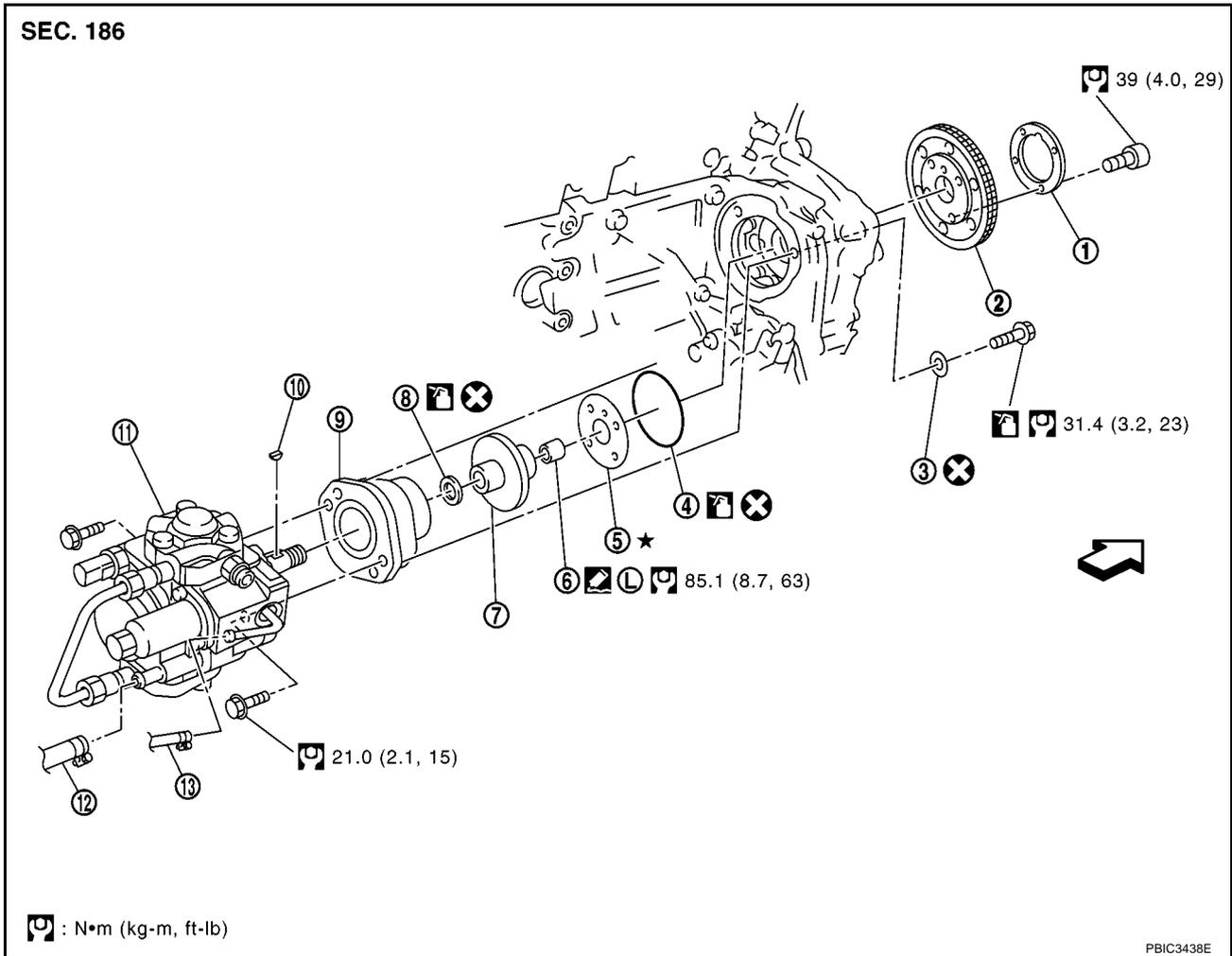
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|----------------|-----------------------|-----------------|
| 1. Washer | 2. Fuel pump sprocket | 3. Seal washer |
| 4. O-ring | 5. Adjusting shim | 6. Sprocket nut |
| 7. Coupling | 8. Oil seal | 9. Spacer |
| 10. Key | 11. Fuel pump | 12. Fuel hose |
| 13. Spill hose | | |
- ← Engine front

- Refer to [GI-10, "Components"](#) for symbol marks except in the above.

Removal and Installation

EBS01E64

CAUTION:

- Before removing and installing fuel pump, be sure to remove sprocket. Do not loosen or remove installation nut in the center of fuel pump. If loosened or removed, replace fuel pump.
- After removing timing chain, do not turn crankshaft and camshaft separately, or valves will strike piston heads.
- When installing camshafts, chain tensioners, oil seals, or other sliding parts, lubricate contacting surfaces with new engine oil.
- When fuel pump is replaced with new one or another one, perform fuel pump leaning value cleaning before starting engine. Refer to [EC-24, "Fuel Pump Learning Value Clearing"](#).

REMOVAL

- Remove engine cover, vacuum gallery and heater feed pipe. Refer to [EM-20, "INTAKE MANIFOLD"](#).

FUEL PUMP

- Remove fuel hose and spill hose from fuel pump. Refer to [EM-44, "INJECTION TUBE AND FUEL INJECTOR"](#).

CAUTION:

Be careful not to spill fuel in the engine component.

- Disconnect harness connectors from fuel pump.
- Remove injection tube center, clip and insert rubber. Refer to [EM-44, "INJECTION TUBE AND FUEL INJECTOR"](#).

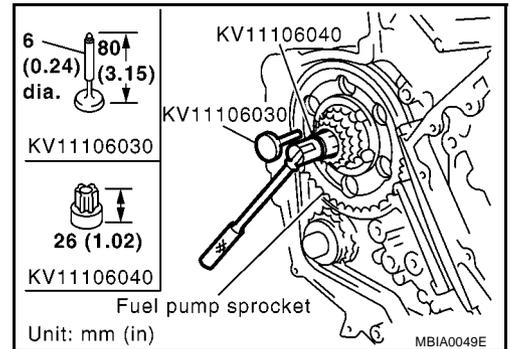
CAUTION:

Be careful not to spill fuel in the engine component.

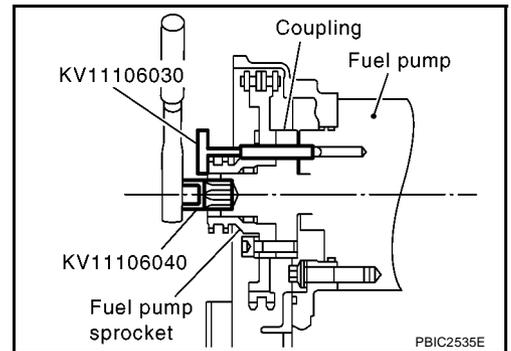
- Remove secondary timing chain. Refer to [EM-73, "SECONDARY TIMING CHAIN"](#).

- Hold fuel pump sprocket and remove bolt.

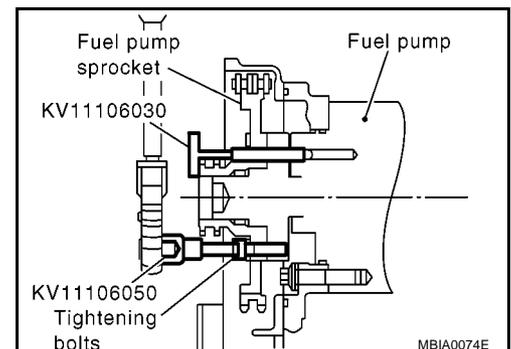
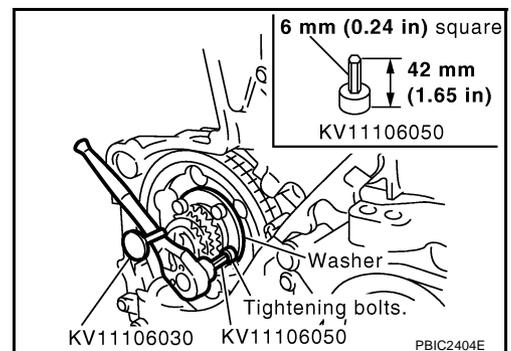
- Insert the positioning stopper pin [SST] into the hole 6 mm (0.24 in) in the diameter on the fuel pump sprocket.
- Using the TORX wrench [SST], turn pump shaft little by little to adjust the position of fuel pump sprocket so that the holes align.
- Push the positioning stopper pin [SST] through fuel pump sprocket to fuel pump body to hold fuel pump sprocket.



- Insert the positioning stopper pin until its flange contacts the fuel pump sprocket.

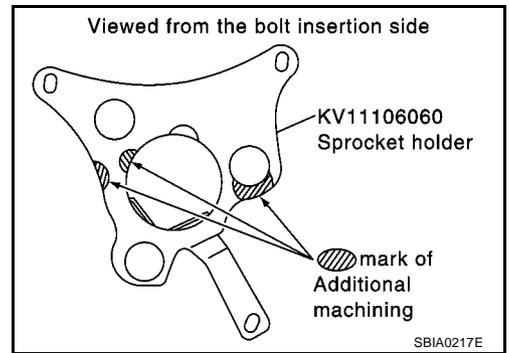


- Using the hexagon wrench [SST] remove tightening bolts of fuel pump sprocket.



FUEL PUMP

8. Using the sprocket holder [SST], hold fuel pump sprocket to prevent falling.
- For sprocket holder, use KV11106060 machined as shown in the figure, because the previous bore is not fitting.

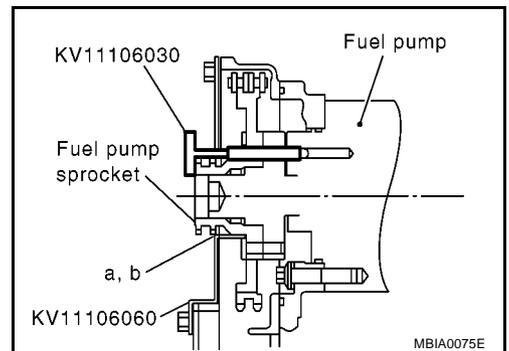
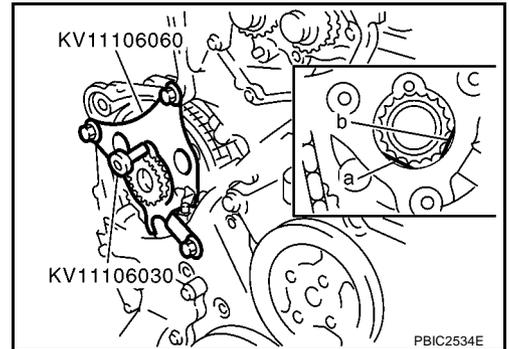


- When the sprocket holder is installed, if the positioning stopper pin [SST] interferes, pull out the positioning stopper pin approximately 10 mm (0.39 in), then install it.
- After the sprocket holder is installed temporarily, tighten the sprocket holder after making extension bar and TORX socket (size: E10) (commercial service tool) insert into the machined bore.
- The length of the sprocket holder mounting bolts should be approximately 15 mm (0.59 in) (M6 thread length).
- Make sure that the a- and b-faces of the sprocket holder contact the bottom side of the sprocket (small diameter side).

CAUTION:

Do not remove the sprocket holder [SST] until fuel pump is installed.

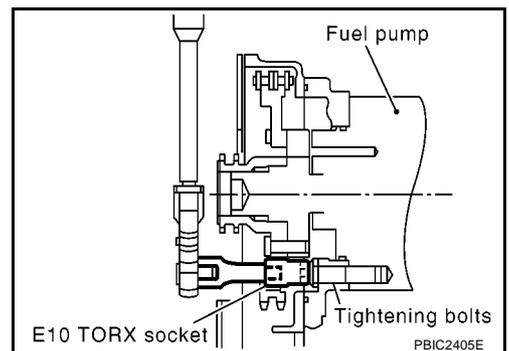
- After the sprocket holder is installed, pull out the positioning stopper pin from fuel pump sprocket.



9. Using the extension bar and the TORX socket (size: E10) (commercial service tool), remove the tightening bolts.

CAUTION:

Do not disassemble or adjust fuel pump.



10. Remove the fuel pump toward the rear of engine.

CAUTION:

For removal, be careful not to drop the seal washer into the engine.

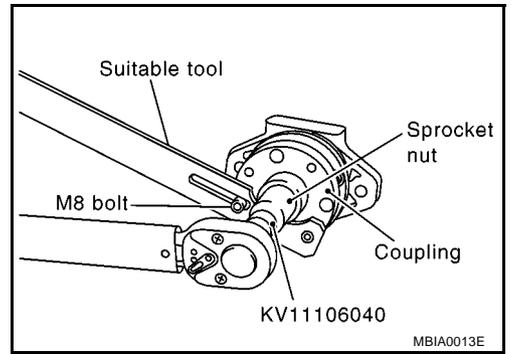
NOTE:

The seal washer of the tightening bolts cannot be reused.

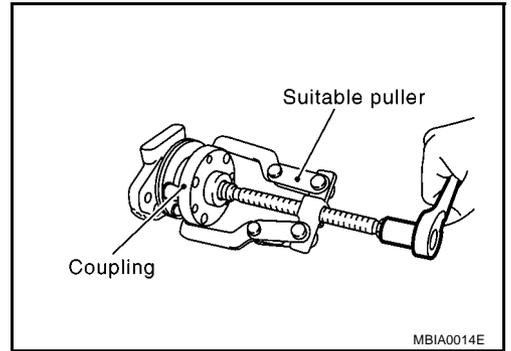
11. Remove adjusting shim.
12. Attach a suitable tool in the M8 bolt hole on coupling.

FUEL PUMP

13. Loosen sprocket nut with the TORX wrench [SST].



14. Remove coupling with a suitable puller.



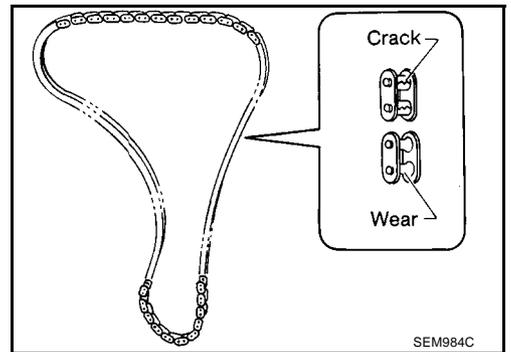
15. Remove spacer from fuel pump.

16. Remove oil seal from spacer.

INSPECTION AFTER REMOVAL

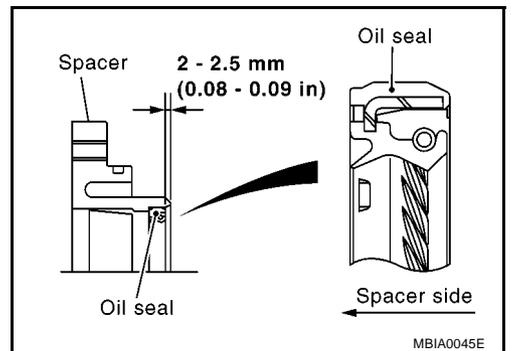
Timing Chain

Check for cracks and excessive wear at roller links. Replace timing chain if necessary.



INSTALLATION

1. Install new oil seal to spacer.

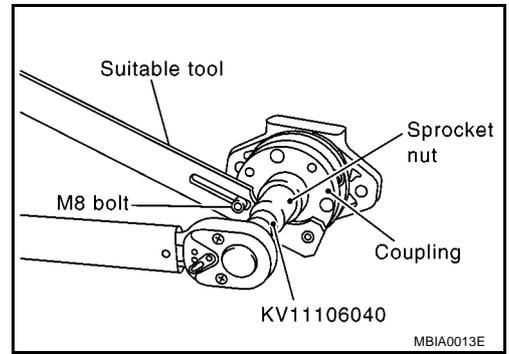


2. Install spacer to fuel pump.

FUEL PUMP

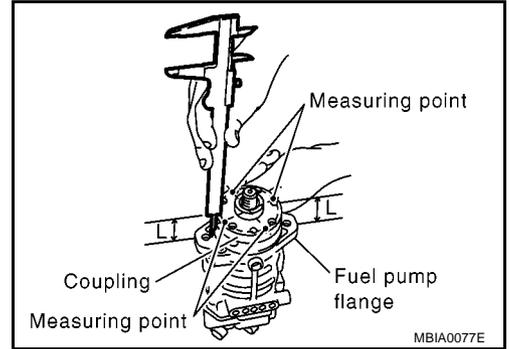
3. Install coupling to fuel pump of spacer.

- Using the TORX wrench [SST], tighten the sprocket nut to fix the coupling.

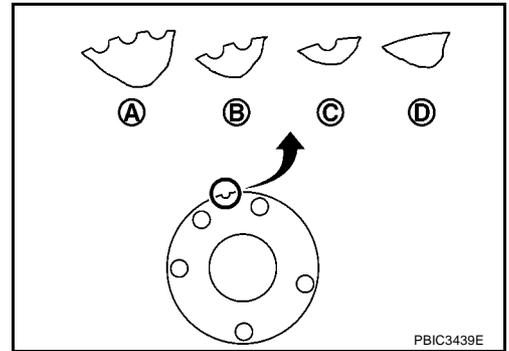


4. Install adjusting shim.

- For shim adjustment, measure dimension L [Distance between front surface of coupling and the fuel pump flange (spacer)] at two opposing points near the coupling bolt center. Use the average of these two measurements to select the shim grade that marked on adjusting shim.



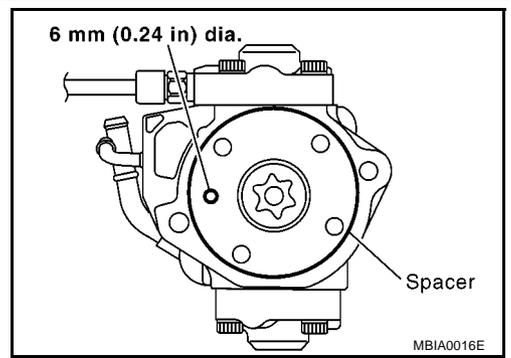
- The shim adjustment is required only when the fuel pump is replaced.



Part No. of adjusting shim	Grade number	Measuring dimension L mm (in)	Type
16614 8H800	0.5 t	38.23 - 39.77 (1.5051 - 1.5657)	A
16614 8H810	1.0 t	38.76 - 38.23 (1.5260 - 1.5051)	B
16614 8H860	1.2 t	38.57 - 38.76 (1.5185 - 1.5260)	C
16614 8H820	1.6 t	38.18 - 38.57 (1.5031 - 1.5185)	D
16614 8H800 + 16614 8H860	0.5 t + 1.2 t	38.09 - 38.18 (1.4996 - 1.5031)	A + C
16614 8H810 + 16614 8H810	1.0 t + 1.0 t	37.80 - 38.09 (1.4882 - 1.4996)	B + B
16614 8H860 + 16614 8H810	1.2 t + 1.0 t	37.60 - 37.80 (1.4803 - 1.4882)	C + B
16614 8H820 + 16614 8H810	1.6 t + 1.0 t	37.21 - 37.60 (1.4650 - 1.4803)	D + B

FUEL PUMP

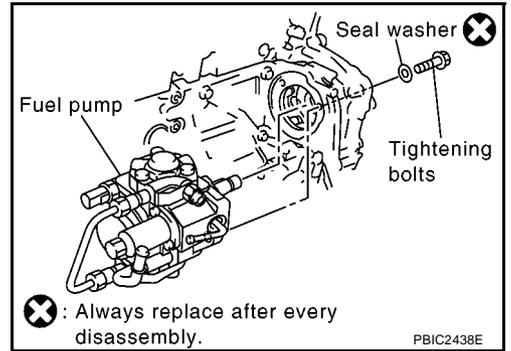
- Before fuel pump is installed, make sure that spacer and the 6 mm (0.24 in) dia. hole on coupling are aligned.



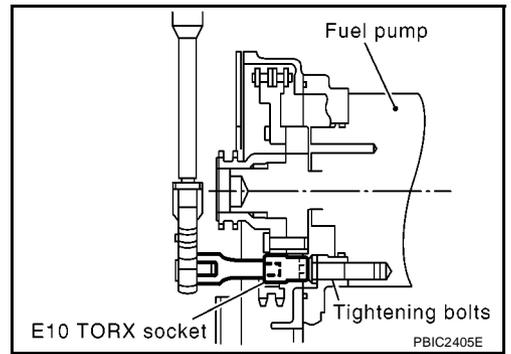
- Insert fuel pump to the mounting position from the rear side of the engine, and install the tightening bolts with seal washer.

CAUTION:

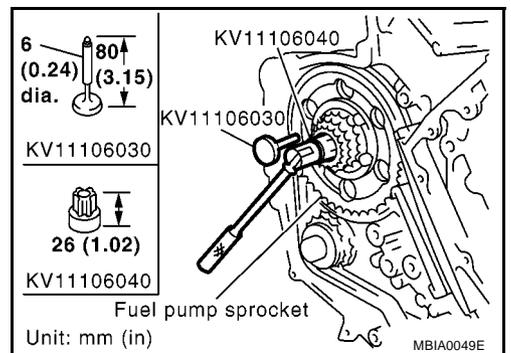
Be careful not to drop the seal washer into engine.



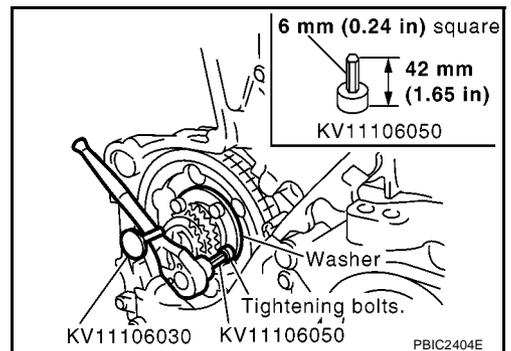
- Using the extension bar and the TORX socket (size: E10) (commercial service tool), tighten the tightening bolts of fuel pump.
- Remove the sprocket holder [SST].



- Using the TORX wrench [SST], turn the pump shaft gradually to adjust the position of fuel pump sprocket. Then, insert the positioning stopper pin [SST] to the 6 mm (0.24 in) dia. hole of the fuel pump sprocket through the pump body.
- Remove the TORX wrench [SST].



- Using the hexagon wrench [SST], tighten the sprocket tightening bolt.
 - When the washer of the fuel pump sprocket is removed, install it with the marking "F" (front) facing the front of the engine.
- Pull out the positioning stopper pin [SST].



FUEL PUMP

-
13. Install secondary timing chain. Refer to [EM-73, "SECONDARY TIMING CHAIN"](#) .
 14. Following steps below, install injection tube center. Refer to [EM-44, "INJECTION TUBE AND FUEL INJECTOR"](#) .
 - a. Pre-set clip and insert rubber to injection tube center.
 - b. Pre-tight nut of injection tube center to fuel pump and fuel rail by hand. (until seal surface touched)
 - c. Adjust clip dimension and tight bolt for clip to intake manifold by tool.
 - d. Tight nut of injection tube center to fuel pump by tool.
 - e. Tight nut of injection tube center to fuel rail by tool.
 15. Connect the harness connector to fuel pump.
 16. Install fuel hoses. Refer to [EM-44, "INJECTION TUBE AND FUEL INJECTOR"](#) .
 17. Hereafter, install in the reverse order of removal.

CAUTION:

When fuel pump is replaced with new one or another one, perform fuel pump leaning value cleaning before starting engine. Refer to [EC-24, "Fuel Pump Learning Value Clearing"](#) .

A

EM

C

D

E

F

G

H

I

J

K

L

M

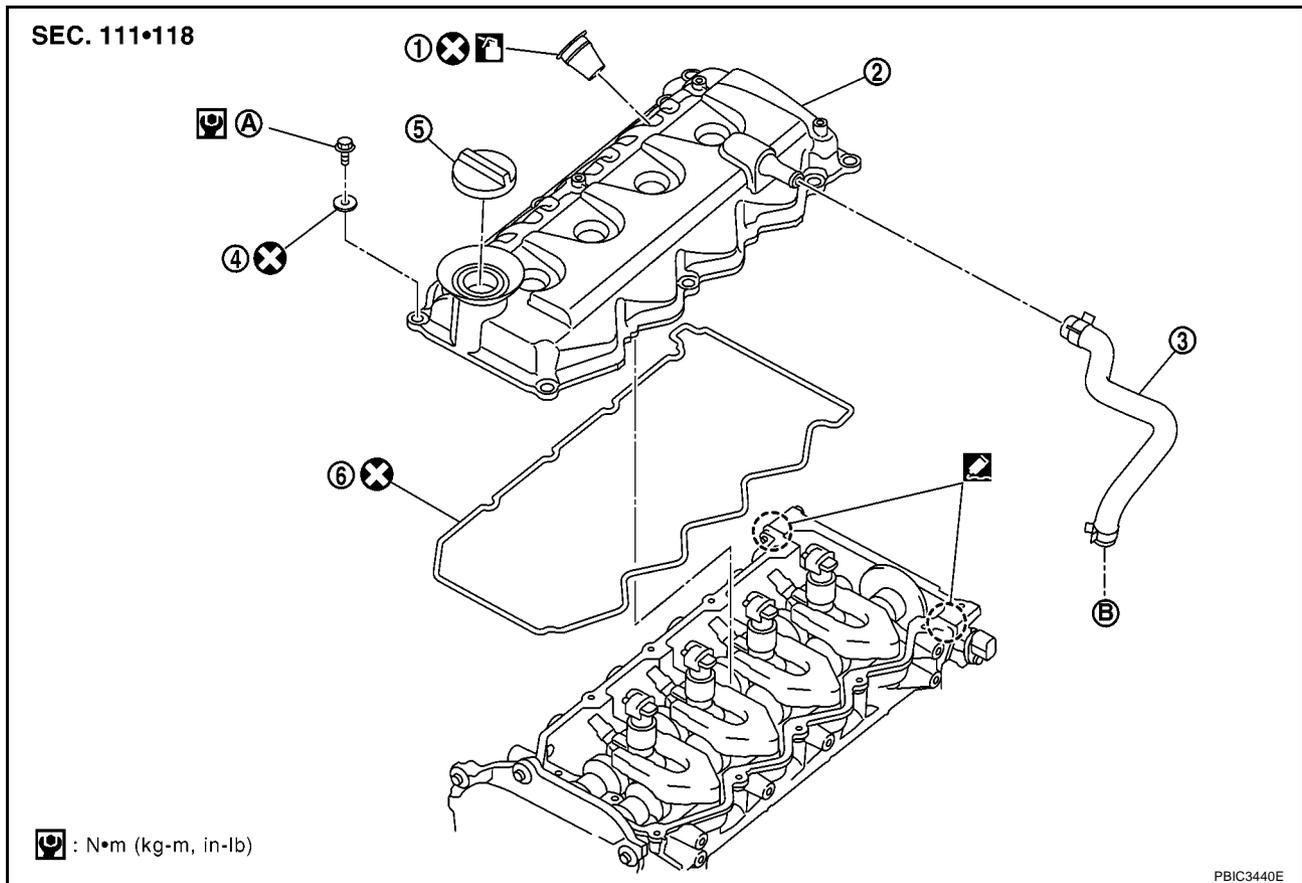
ROCKER COVER

PFP:13264

ROCKER COVER

Components

EBS01EK4



- | | | |
|--|-------------------|------------------------|
| 1. Nozzle oil seal | 2. Rocker cover | 3. Ventilation hose |
| 4. Washer | 5. Oil filler cap | 6. Gasket |
| A. Refer to "INSTALLATION" in "ROCKER COVER" | | B. To ventilation hose |

- Refer to [GI-10, "Components"](#) for symbol marks in the figure.

Removal and Installation

REMOVAL

EBS01E65

1. Remove engine cover. Refer to [EM-20, "INTAKE MANIFOLD"](#).
2. Remove vacuum gallery and engine cover bracket on rocker cover and ventilation hose. Refer to [EM-20, "INTAKE MANIFOLD"](#) and [EM-15, "AIR CLEANER AND AIR DUCT"](#).
3. Disconnect harness connector from fuel injector. Refer to [EM-44, "INJECTION TUBE AND FUEL INJECTOR"](#).
4. Following steps below, remove injection tube. Refer to [EM-44, "INJECTION TUBE AND FUEL INJECTOR"](#).
 - a. Put a paint mark or tag on injection tubes to identify each cylinder.
 - Use a fuel-resistant method.
 - b. Remove injection tubes in order of 2-1-4-3 individually.

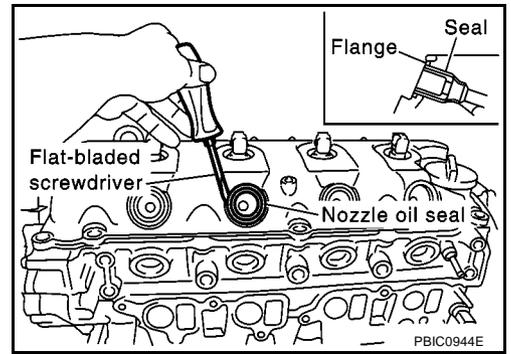
CAUTION:

Be careful not to allow leaked fuel to contaminate engine room. Especially, ensure to keep engine mounting insulator clear of fuel.

5. Remove injection nozzle oil seal.

ROCKER COVER

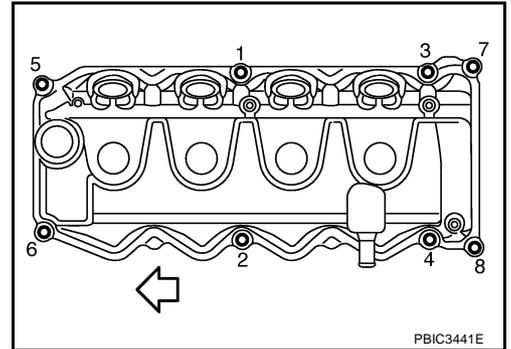
- Using the flat-bladed screwdriver, pry flange to remove nozzle oil seal.



6. Remove rocker cover.

- Loosen holding bolts in the reverse order of that shown in the figure and remove.

← : Engine front



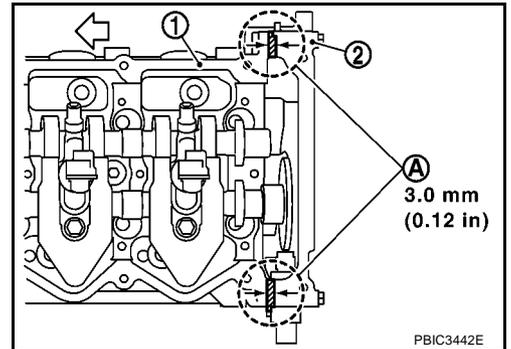
7. Remove gasket from rocker cover.

INSTALLATION

- Install new gasket to rocker cover.
- Apply liquid gasket with tube presser [SST: WS39930000] on locations shown in the figure.

- Use Genuine Liquid Gasket or equivalent.**

1 : Cylinder head
 2 : Cylinder head rear cover
 A : Liquid gasket application area
 ← : Engine front

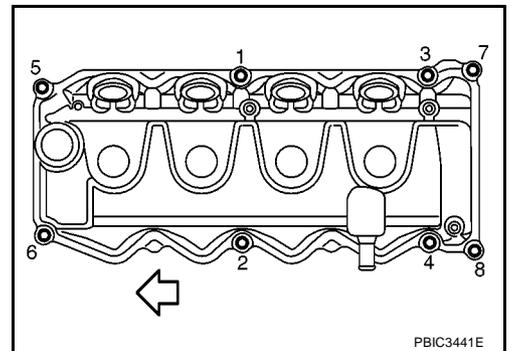


3. Tighten holding bolts in numerical order shown in the figure.

← : Engine front

: **7.8 N·m (0.8 kg·m, 69 in·lb)**

Re-tighten to the same torque in the same order as above.



4. Install nozzle oil seal.

- Insert it straight until flange fully contacts rocker cover.

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

6. Before starting engine, bleed air from fuel piping. Refer to [FL-5, "Air Bleeding"](#).

ROCKER COVER

INSPECTION AFTER INSTALLATION

Start engine and increase engine speed to check for fuel leak and engine oil leak.

CAUTION:

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

CAMSHAFT

CAMSHAFT Components

PF13001

EBS01EK5

A

EM

C

D

E

F

G

H

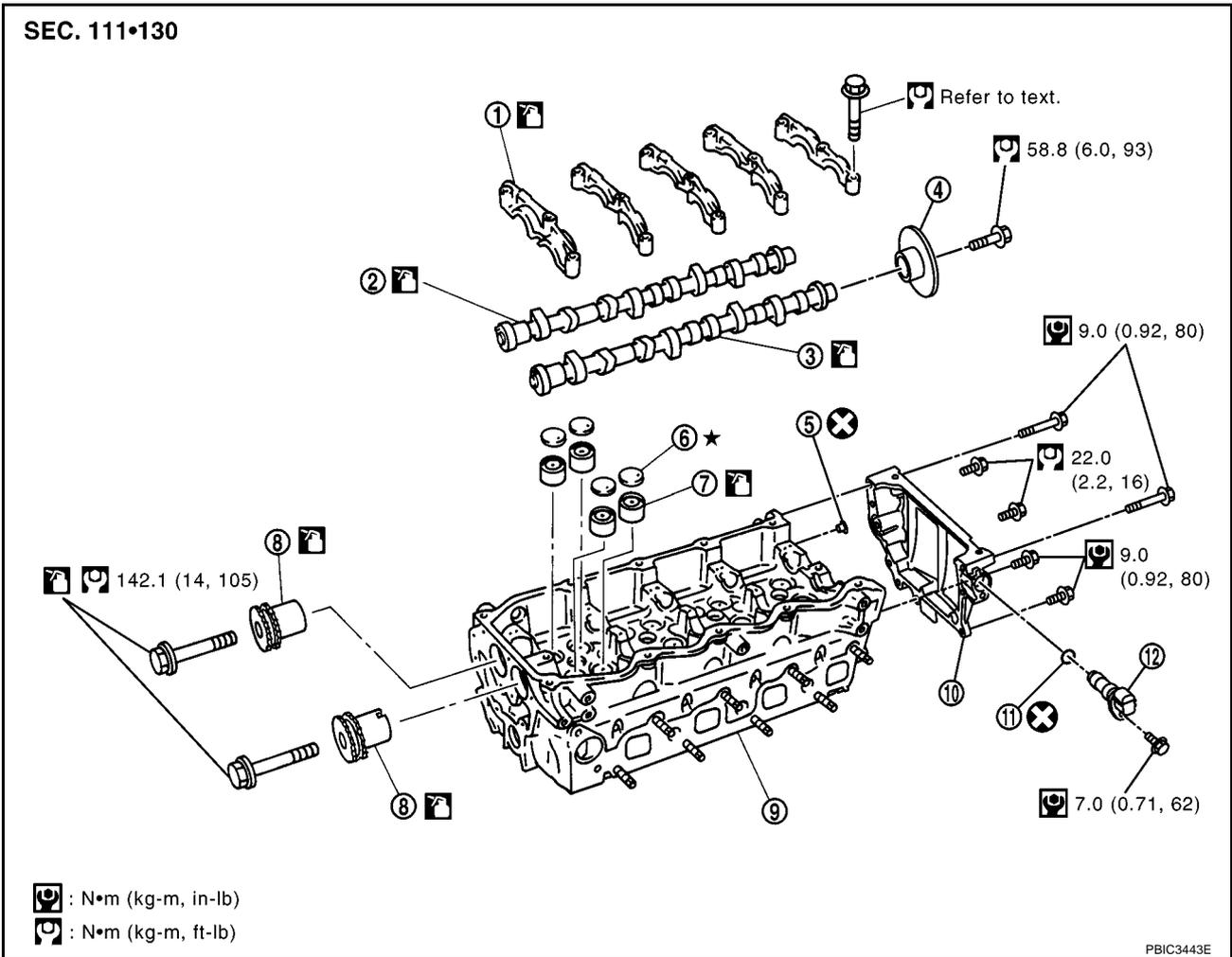
I

J

K

L

M



- | | | |
|------------------------------|--------------------------|------------------------------|
| 1. Camshaft bracket | 2. Camshaft (right side) | 3. Camshaft (left side) |
| 4. Signal plate | 5. Rubber washer | 6. Adjusting shim |
| 7. Valve lifter | 8. Camshaft sprocket | 9. Cylinder head |
| 10. Cylinder head rear cover | 11. O-ring | 12. Camshaft position sensor |

- Refer to [GI-10, "Components"](#) for symbol marks in the figure.

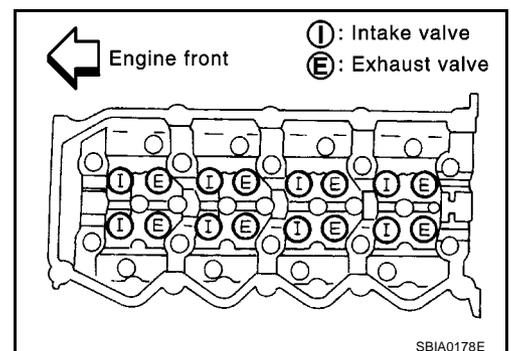
CAUTION:

- This engine will have a different valve arrangement from normal DOHC 4-valve type engines. As both camshafts on this engine have intake and exhaust camshafts, in this chapter they are named as follows:

Camshaft (right side) : Intake manifold side

Camshaft (left side) : Exhaust manifold side

- Refer to the figure for intake and exhaust valve arrangement.
(The camshafts have, alternately, either intake valve or an exhaust valve.)



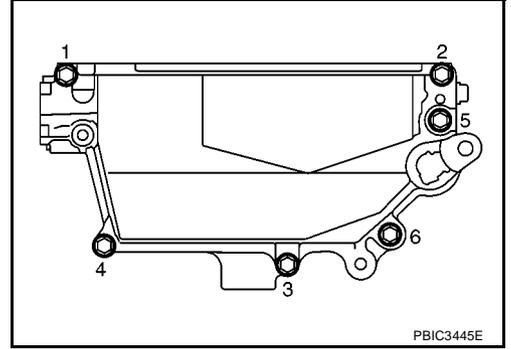
Removal and Installation REMOVAL

EBS01E66

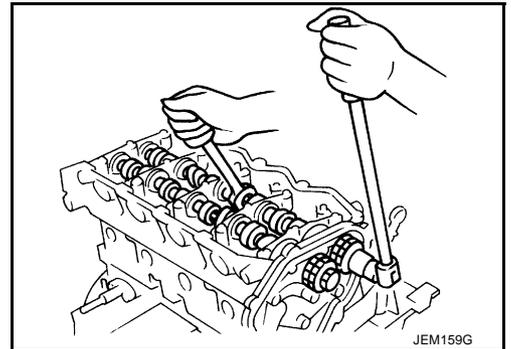
- Drain engine coolant. Refer to [CO-7, "Changing Engine Coolant"](#).
- Remove rocker cover. Refer to [EM-56, "ROCKER COVER"](#).

CAMSHAFT

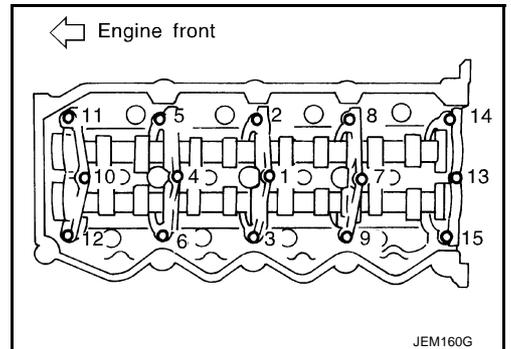
3. Remove cylinder head rear cover, camshaft position sensor and rubber washer.
Loosen cylinder head rear cover mounting bolts in the reverse order shown in the figure.



4. Remove fuel injector. Refer to [EM-44, "INJECTION TUBE AND FUEL INJECTOR"](#) .
5. Remove secondary timing chain. Refer to [EM-73, "SECONDARY TIMING CHAIN"](#) .
6. Remove camshaft sprockets and signal plate.
 - Loosen the camshaft sprocket mounting bolts and signal plate mounting bolt by fixing the hexagonal portion of camshaft.



7. Remove camshaft.
 - Place distinguishing marks on the right and left sides with paint.
 - Loosen and remove the camshaft sprocket bolts in the reverse order shown in the figure.



8. Remove adjusting shim and valve lifter.
 - Remove by taking notice of the installation position, and place outside engine in order to prevent confusion.

INSPECTION AFTER REMOVAL

Visual Check of Camshaft

- Check the camshaft for one sided wear or scratches.
- Replace the camshaft if there are abnormalities.

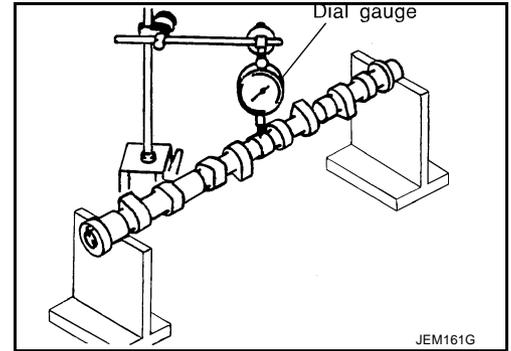
CAMSHAFT

Camshaft Runout

- Prepare V-block on a flat surface and secure camshaft journals No. 2 and No. 5.
- Set the dial gauge vertically on journal No. 3.
- Rotate camshaft in one direction by hand, then read needle movement on dial gauge. (Total indicator reading)

Limit : 0.02 mm (0.0008 in)

- If it exceeds the limit, replace camshaft.



Height of Cam Nose

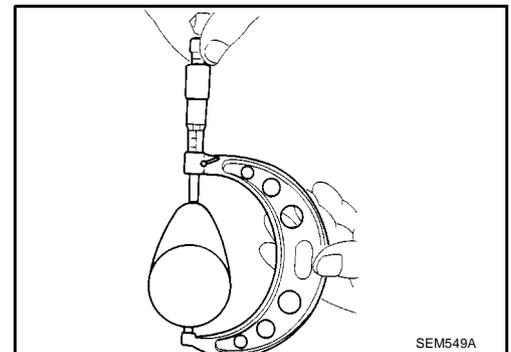
- Measure the height of cam nose using the micrometer.

Standard:

Intake : 39.505 - 39.695 mm (1.5553 - 1.5628 in)

Exhaust : 39.905 - 40.095 mm (1.5711 - 1.5785 in)

- If out of the standard, replace camshaft.



Camshaft Journal Oil Clearance

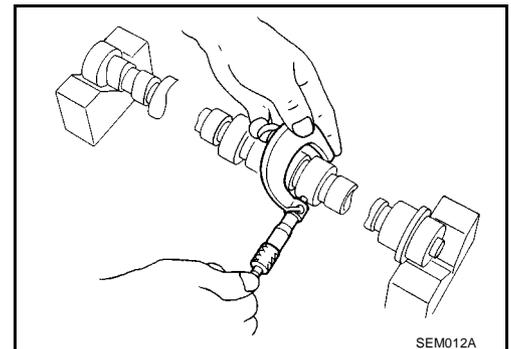
CAMSHAFT JOURNAL OUTER DIAMETER

- Measure outer diameter of camshaft journal with micrometer.

Standard:

**No. 1 : 30.435 - 30.455 mm
(1.1982 - 1.1990 in)**

**No. 2, 3, 4, 5 : 23.935 - 23.955 mm
(0.9423 - 0.9431 in)**



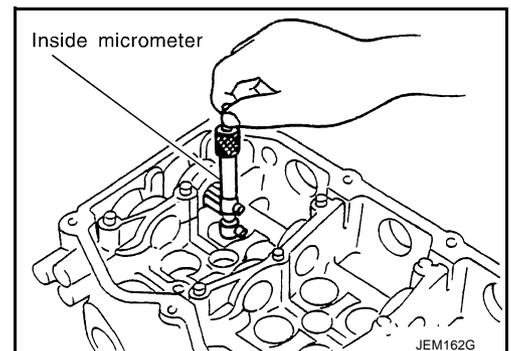
CAMSHAFT BRACKET INNER DIAMETER

- Install camshaft bracket and tighten bolts to the specified torque. Refer to [EM-63, "INSTALLATION"](#) for the tightening procedure.
- Measure inner diameter of camshaft bracket using the inside micrometer.

Standard:

**No. 1 : 30.500 - 30.521 mm
(1.2008 - 1.2016 in)**

**No. 2, 3, 4, 5 : 24.000 - 24.021 mm
(0.9449 - 0.9457 in)**



CAMSHAFT OIL CLEARANCE CALCULATIONS

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

CAMSHAFT

Standard : 0.045 - 0.086 mm (0.0018 - 0.0034 in)

- If out of standard, refer to the standard value of each unit, then replace the camshaft and/or cylinder head.

NOTE:

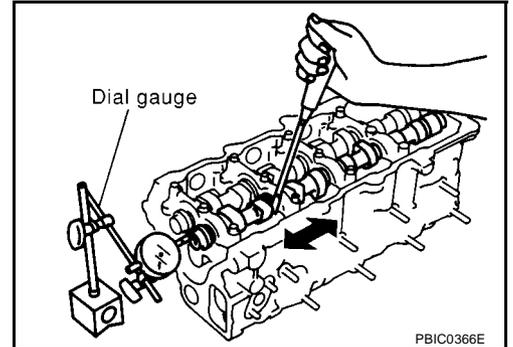
As the camshaft bracket is manufactured with the cylinder head, it is impossible to replace only the camshaft bracket.

Camshaft End Play

- Install dial gauge in thrust direction on front end of camshaft. Measure end play of dial gauge when camshaft is moved forward/backward (in direction to axis).

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

Limit : 0.24 mm (0.0094 in)



- Measure the following parts if out of the standard.

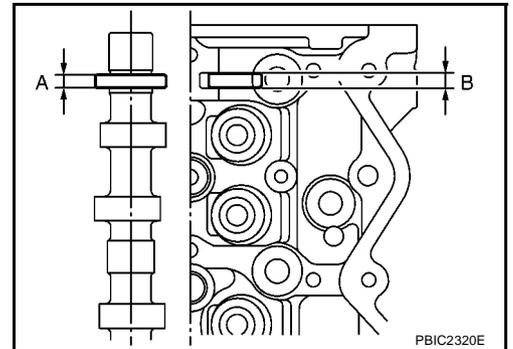
- Dimension "A" for camshaft

Standard : 6.882 - 6.930 mm (0.2709 - 0.2728 in)

- Dimension "B" for cylinder head

Standard : 7.000 - 7.030 mm (0.2755 - 0.2767 in)

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

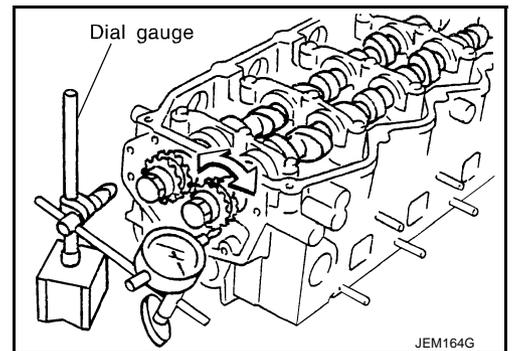


Camshaft Sprocket Runout

1. Install camshaft in cylinder head. Refer to [EM-63, "INSTALLATION"](#) for the tightening procedure.
2. Install sprocket on camshaft. Refer to [EM-63, "INSTALLATION"](#).
3. Measure camshaft sprocket runout. (Total indicator reading)

Limit : 0.15 mm (0.0059 in)

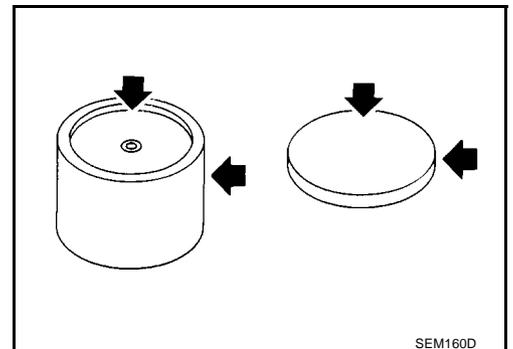
- If it exceeds the limit, replace camshaft sprocket.



Visual Inspection of Valve Lifter and Adjusting Shim

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

- If anything above is found, replace valve lifter or adjusting shim.



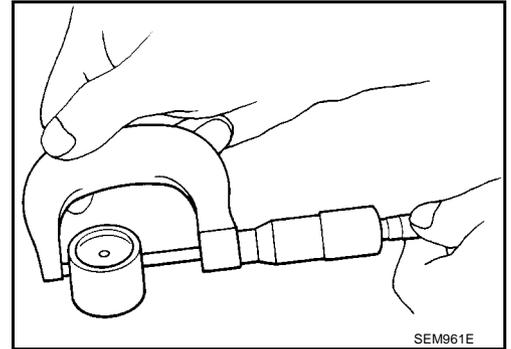
CAMSHAFT

Valve Lifter Clearance

VALVE LIFTER OUTER DIAMETER

- Measure the outer diameter of the valve lifter with the micrometer.

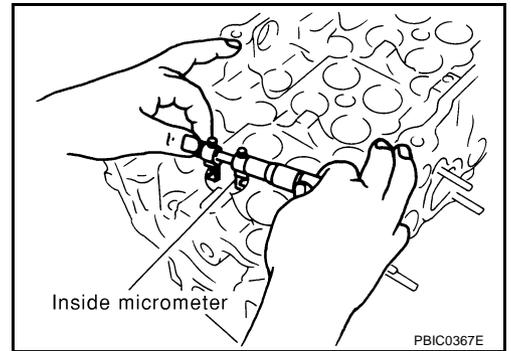
Standard : 29.960 - 29.975 mm (1.1795 - 1.1801 in)



VALVE LIFTER BORE DIAMETER

- Measure the bore diameter of the cylinder head valve lifter with the inside micrometer.

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



VALVE LIFTER CLEARANCE CALCULATIONS

- (Clearance) = (Valve lifter bore diameter) – (Valve lifter outer diameter)

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

- If out of standard, refer to the outer diameter and bore diameter standard values and replace valve lifter and/or cylinder head.

INSTALLATION

1. Install valve lifter and adjusting shim.
 - Make sure that these are installed in the same position as before the removal process.
2. Install camshaft.

⇐ : Engine front

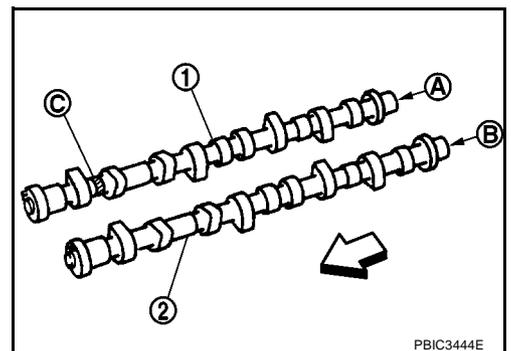
- Identify camshafts by the paint position and screw hole at the rear end.

Camshaft (right side) Intake manifold side (1):

Paint is at position (C) (Blue) without screw hole (A).

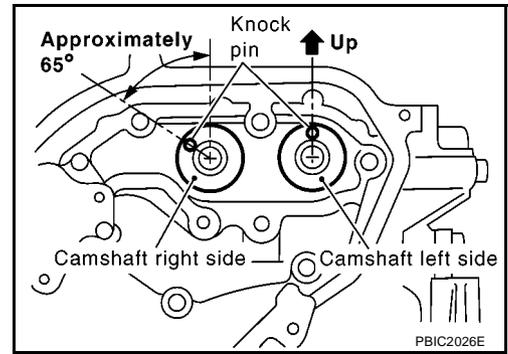
Camshaft (left side) Exhaust manifold side (2):

No paint with screw hole (B).



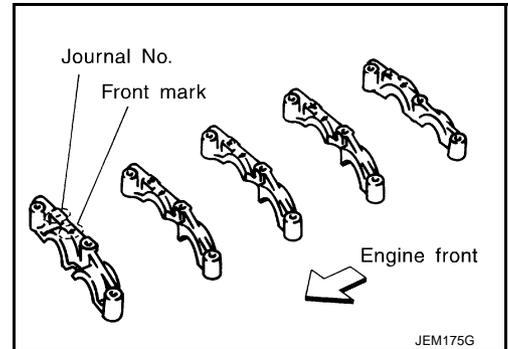
CAMSHAFT

- Install so that knock pins are positioned in the directions shown in the figure.



3. Install camshaft brackets.

- Completely remove any foreign material on back surfaces of camshaft brackets and top surface of cylinder head.
- Install correctly, identifying brackets by the journal No. and front mark on top surface.



4. Tighten bolts in the order shown in the figure according to the following procedure:

a. Tighten all bolts.

 : 2 N·m (0.2 kg·m, 1 ft·lb)

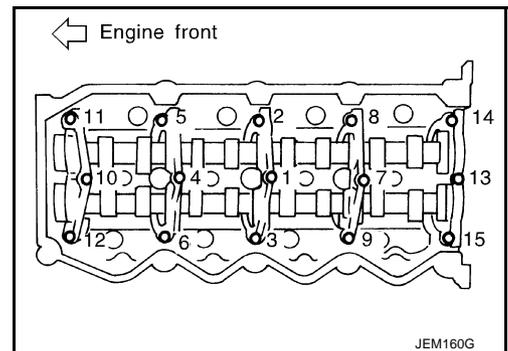
- Make sure camshaft thrusting parts (on rear side) securely fit in their mating parts on the cylinder head.

b. Tighten all bolts.

 : 6 N·m (0.6 kg·m, 4 ft·lb)

c. Tighten all bolts.

 : 12 - 13 N·m (1.2 - 1.4 kg·m, 9 - 10 ft·lb)



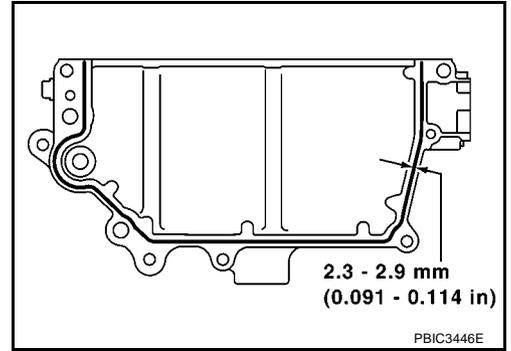
5. Install camshaft sprockets and signal plate.

- Camshaft sprockets are commonly used for right side and left side.
- Align camshaft sprocket and knock pin on camshaft, and install.
- Holding the hexagonal part of camshaft with a wrench, tighten bolt securing camshaft sprockets and signal plate.

6. Install rubber washer to cylinder head rear side.

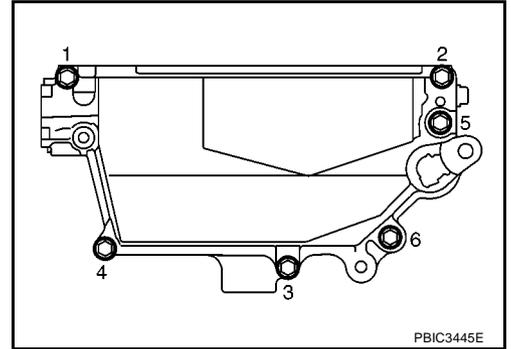
CAMSHAFT

7. Apply liquid gasket to cylinder head rear cover as shown in the figure.
Use Genuine Liquid Gasket or Equivalent.



8. Install cylinder head rear cover and tighten mounting bolts in numerical order shown in the figure.

- M6 × 50 mm : Bolt No.1, 2**
- M6 × 20 mm : Bolt No.3, 4**
- M8 × 20 mm : Bolt No.5, 6**



9. Before installing spill tube after installing secondary timing chain, check and adjust valve clearance. Refer to [EM-66, "Valve Clearance"](#).
10. Hereafter, 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-14, "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 (*2)
Other oils and fluid (*1)	Level	Leakage	Level
Fuel	Leakage	Leakage	Leakage
Exhaust gases	—	Leakage	—

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

*2: Check engine oil level 10 minutes after engine stopped.

CAMSHAFT

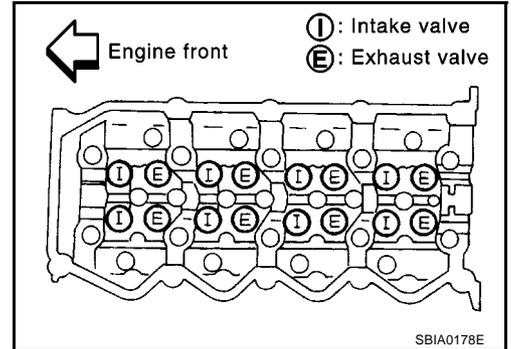
EBS01E67

Valve Clearance INSPECTION

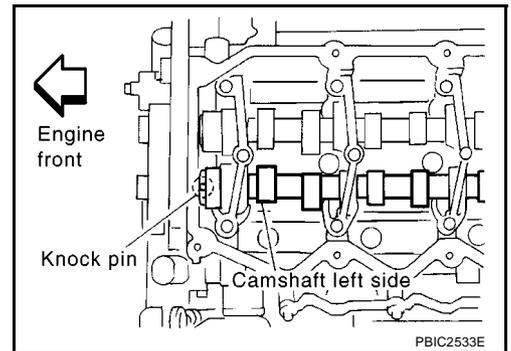
- When the camshaft or parts in connection with valves are removed or replaced, and a malfunction has occurred (poor starting, idling, or other malfunction) due to the misadjustment of the valve clearance, inspect as follows.
- Inspect and adjust when the engine is cool (at normal temperature).
- Be careful of the intake and exhaust valve arrangement. The valve arrangement is different from that in a normal engine.

NOTE:

The camshafts have, alternately, either intake valve or exhaust valve. (Refer to figure.)

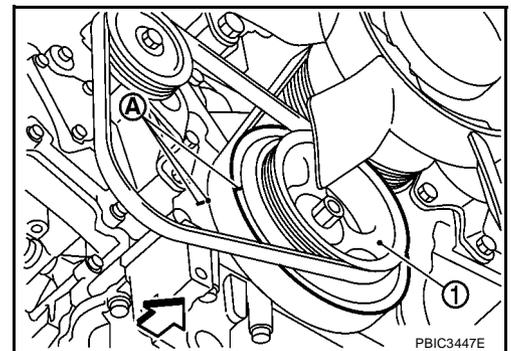


1. Remove rocker cover. Refer to [EM-56, "ROCKER COVER"](#).
2. Remove fuel injector. Refer to [EM-44, "INJECTION TUBE AND FUEL INJECTOR"](#).
3. Set the No. 1 piston to TDC on its compression stroke.
 - Turn crankshaft pulley clockwise so that the knock pin on camshaft left side faces straight above. (No position indicator, etc. is provided on the crankshaft pulley.)



4. Remove undercover, put an alignment mark with paint, etc. on crankshaft pulley and on oil pump housing as an angle indicator.

- 1 : Crankshaft pulley
- A : Alignment mark
- ↔ : Vehicle front

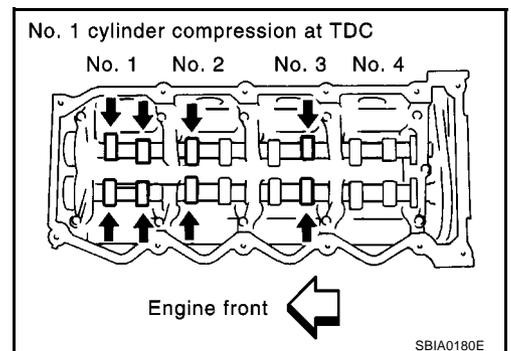


5. While referring to the figure, measure the valve clearance marked in the table below.

Measuring point	No. 1		No. 2		No. 3		No. 4	
	INT	EXH	INT	EXH	INT	EXH	INT	EXH
When the No. 1 cylinder is in the TDC	X	X	X			X		

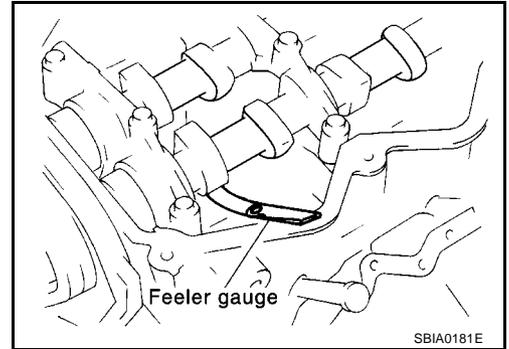
NOTE:

- The injection order is 1-3-4-2.



CAMSHAFT

- Measure the valve clearance using the feeler gauge when engine is cool (at normal temperature).



Valve clearance:

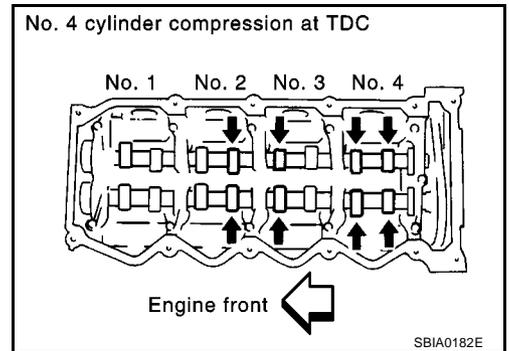
Unit: mm (in)

Item	Cold	Hot* (Reference data)
Intake	0.24 - 0.32 (0.0094 - 0.0126)	0.274 - 0.386 (0.0108 - 0.0152)
Exhaust	0.26 - 0.34 (0.0102 - 0.0134)	0.308 - 0.432 (0.0121 - 0.0170)

*: Reference data approximately 80°C (176°F)

6. Set the No. 4 cylinder at TDC by rotating the crankshaft clockwise once. (360 degrees)
7. While referring to the figure, measure the valve clearance marked in the table below.

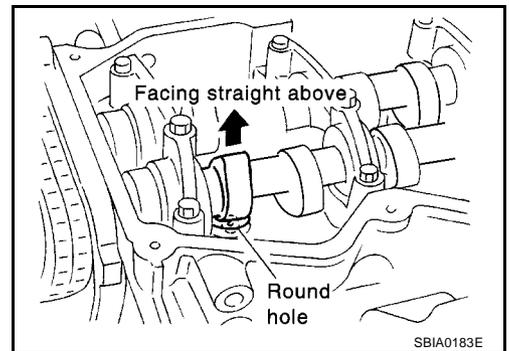
Measuring point	No. 1		No. 2		No. 3		No. 4	
	INT	EXH	INT	EXH	INT	EXH	INT	EXH
When the No. 4 cylinder is in the TDC				X	X		X	X



8. If the valve clearance is outside the specification, adjust as follows.

ADJUSTMENTS

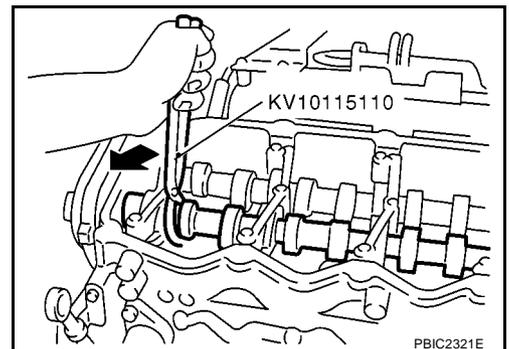
- Remove adjusting shim for parts which are outside the specified valve clearance.
1. Extract engine oil on the upper side of the cylinder head (for the air blowing in step 6).
 2. Rotate crankshaft to face the camshaft for adjusting shims that are to be removed upward.



3. Grip camshaft with the camshaft pliers [SST], then using camshaft as a support point, push adjusting shim downward to compress valve spring.

CAUTION:

Do not damage camshaft, cylinder head and the outer circumference of valve lifter.



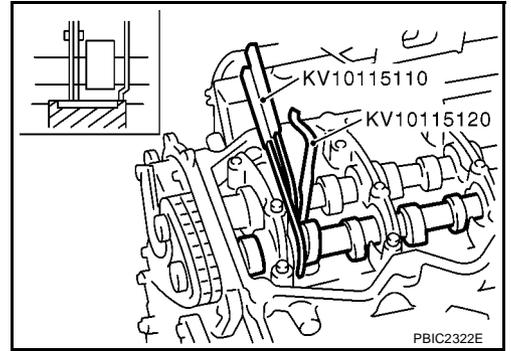
CAMSHAFT

4. With valve spring in a compressed state, remove the camshaft pliers [SST] by securely setting the outer circumference of the valve lifter with the end of the lifter stopper [SST].

- Hold the lifter stopper by hand until the shim is removed.

CAUTION:

Do not retrieve the camshaft pliers forcefully, as camshaft will be damaged.



5. Move the round hole of adjusting shim to the front with the very thin screwdriver or like that.

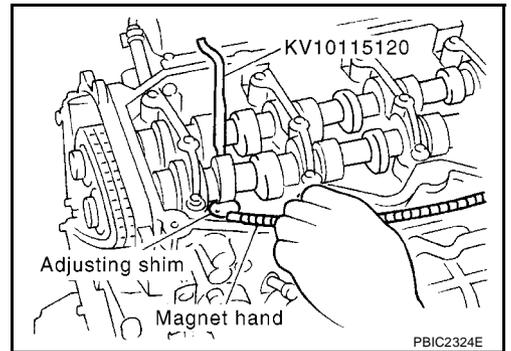
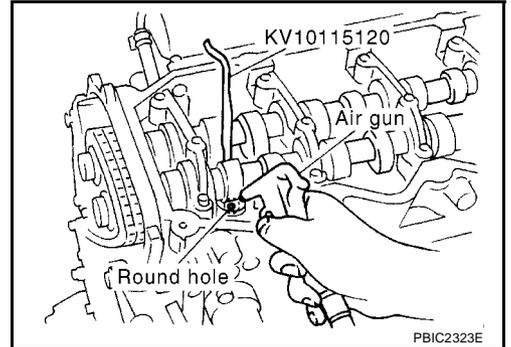
- When adjusting shim on valve lifter will not rotate smoothly, restart from step 3 to release the end of the lifter stopper [SST] from touching adjusting shim.

6. Remove adjusting shim from valve lifter by blowing air through the round hole of the adjusting shim with the air gun.

CAUTION:

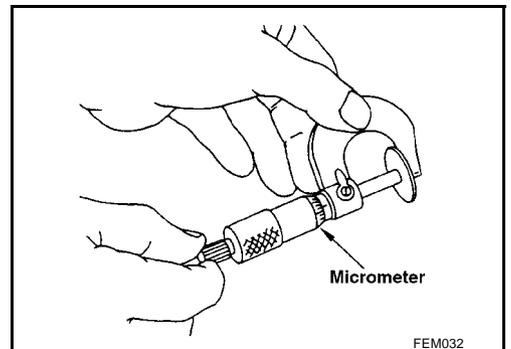
To prevent any remaining engine oil from being blown around, thoroughly wipe the area clean and wear protective goggles.

7. Remove adjusting shim by using the magnet hand.



8. Measure the thickness of adjusting shim using the micrometer.

- Measure near the center of the shim (the part that touches camshaft).



9. Select the new adjusting shim from the following methods.

Calculation method of the adjusting shim thickness:

R = Thickness of removed shim

N = Thickness of new shim

M = Measured valve clearance

Intake

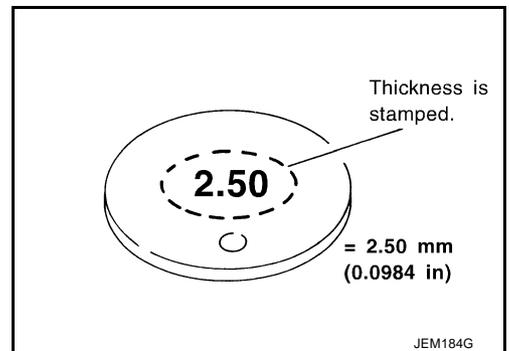
$$N = R + [M - 0.28 \text{ mm (0.0010 in)}]$$

Exhaust

$$N = R + [M - 0.30 \text{ mm (0.0118 in)}]$$

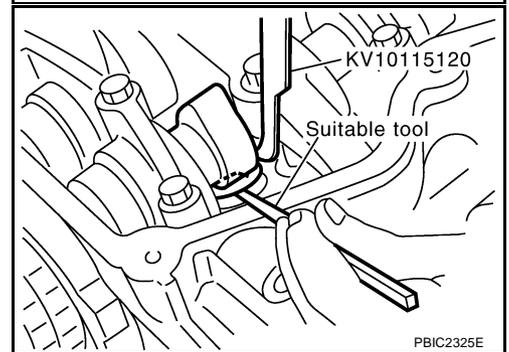
CAMSHAFT

- New adjusting shims have the thickness stamped on the rear side.
- Shims are available in 33 size from 2.10 mm (0.0827 in) to 2.74 mm (0.1079 in), in steps of 0.02 mm (0.0008 in). Refer to [EM-137, "Available Shims"](#).



10. Fit the selected adjusting shim to valve lifter.

CAUTION:
Place the stamped side of adjusting shim to valve lifter.



11. Compress valve spring using the camshaft pliers [SST: KV10115110] and remove the lifter stopper [SST].
12. Rotate crankshaft 2 to 3 turns by hand.
13. Confirm that the valve clearance is within the specification. Refer to [EM-66, "INSPECTION"](#).
14. Install remaining parts in the reverse order of removal.
15. Warm up engine, and check for unusual noise and vibration.

OIL SEAL

PDF:12279

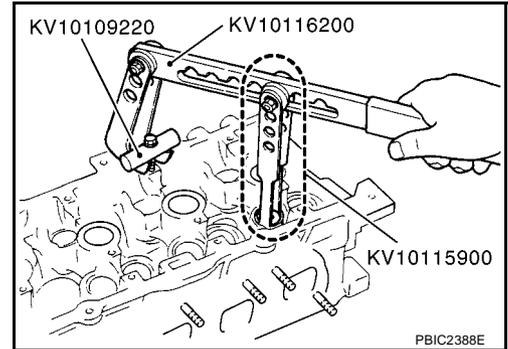
Removal and Installation of Valve Oil Seal REMOVAL

EBS01EK7

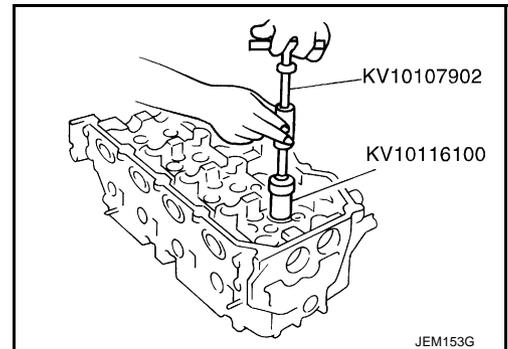
1. Turn crankshaft until the cylinder requiring new valve oil seals is at TDC. This will prevent valve from dropping into cylinder.
2. Remove camshafts. Refer to [EM-59, "CAMSHAFT"](#) .
3. Remove adjusting shims and valve lifters. Refer to [EM-59, "CAMSHAFT"](#) .
 - Check the installation positions, and keep them to avoid being confused.
4. Rotate crankshaft, and set piston whose valve oil seal is to be removed to TDC. This will prevent valve from dropping into cylinder.
5. Remove valve collet.
 - Compress the valve spring with valve spring compressor, attachment and adapter [SST]. Remove valve collet with a magnet hand.

CAUTION:

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

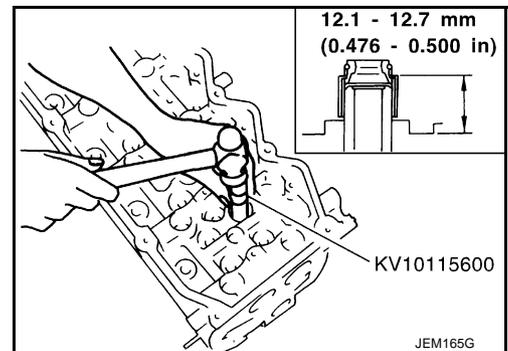


6. Remove valve spring retainer and valve spring.
7. Remove valve oil seal with the valve oil seal puller [SST].



INSTALLATION

1. Apply new engine oil to valve oil seal joint surface and seal lip.
2. Using the valve oil seal drift [SST], install valve oil seals referring to the dimension shown in the figure.



3. Install in the reverse order of removal.

OIL SEAL

EBS01EK8

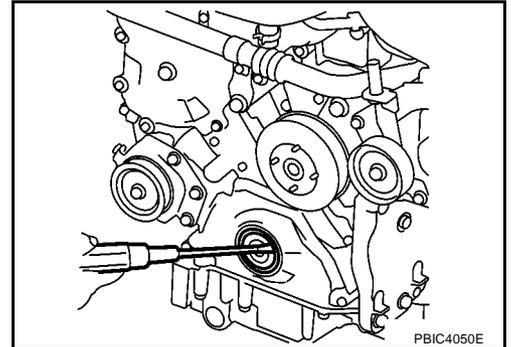
Removal and Installation of Front Oil Seal

REMOVAL

1. Remove the following parts.
 - Undercover
 - Drive belt; Refer to [EM-12, "DRIVE BELTS"](#) .
 - Crankshaft pulley; Refer to [EM-79, "PRIMARY TIMING CHAIN"](#) .
2. Remove front oil seal with a suitable tool.

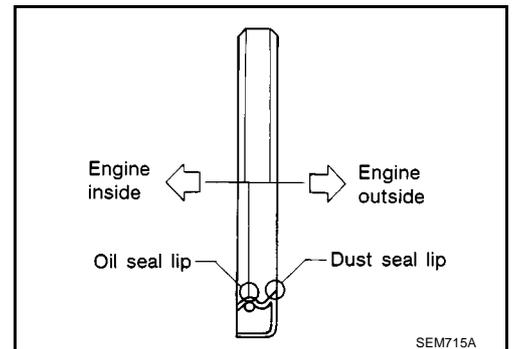
CAUTION:

Be careful not to damage oil pump housing 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.

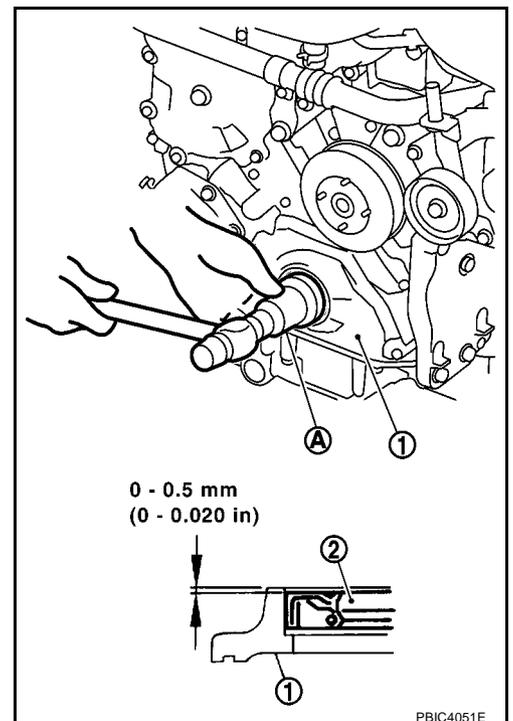


- Using the suitable drift [60 mm (2.36 in) dia.] (A), press fit the oil seal (2) so that the dimension is as specified in the figure.

1 : Oil pump

CAUTION:

Do not touch lips of oil seal. Make sure seal surfaces are free of foreign materials.



3. Install in the reverse order of removal.

OIL SEAL

EBS01EK9

Removal and Installation of Rear Oil Seal

REMOVAL

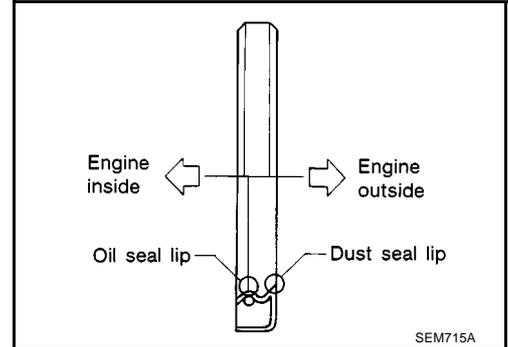
1. Remove transmission and transfer assembly. Refer to [MT-16, "TRANSMISSION ASSEMBLY"](#) (M/T models) and [AT-247, "TRANSMISSION ASSEMBLY"](#) (A/T models).
2. Remove flywheel (M/T models) or drive plate (A/T models). Refer to [EM-110, "CYLINDER BLOCK"](#).
3. Remove rear oil seal with a suitable tool.

CAUTION:

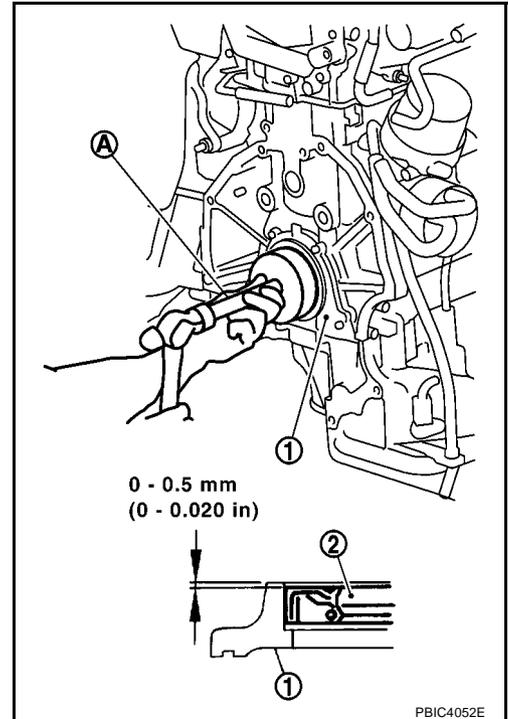
Be careful not to damage crankshaft and cylinder block.

INSTALLATION

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



- Press in rear oil seal (2) to rear oil seal retainer (1) as shown in the figure.
- Using the drift [100 mm (3.94 in) dia.] (A), press fit so that the dimension is as specified in the figure.
- Avoid inclined fitting. Force fit perpendicularly.



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

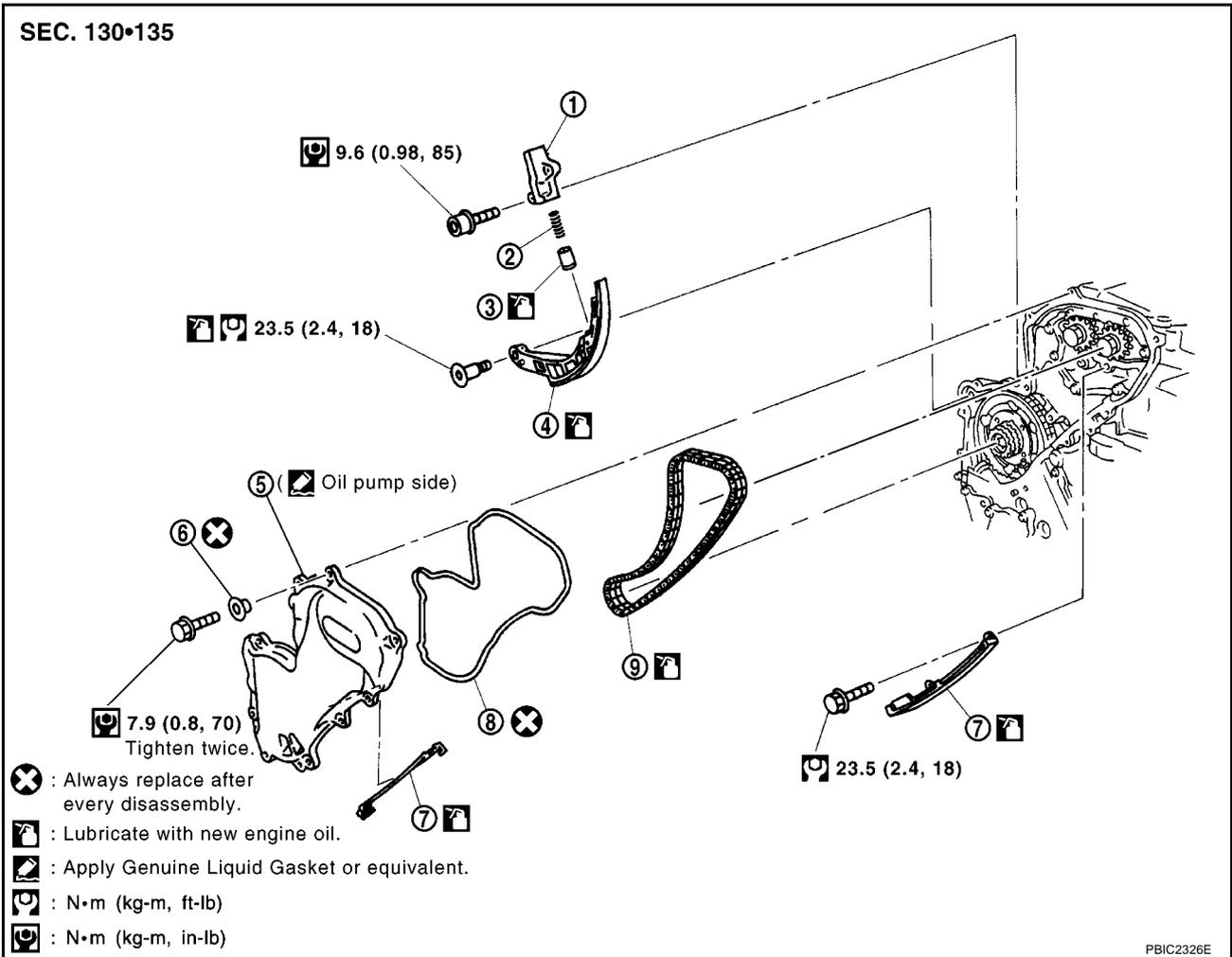
SECONDARY TIMING CHAIN

SECONDARY TIMING CHAIN

PF13028

Components

EBS01EKA



- | | | |
|--------------------|---------------------|---------------------------|
| 1. Chain tensioner | 2. Spring | 3. Plunger |
| 4. Slack guide | 5. Front chain case | 6. Rubber washer |
| 7. Tension guide | 8. Gasket | 9. Secondary timing chain |

Removal and Installation

EBS01E68

CAUTION:

- After removing timing chain, do not turn crankshaft and camshaft separately, or valves will strike piston heads.
- When installing camshafts, chain tensioners, oil seals, or other sliding parts, lubricate contacting surfaces with new engine oil.

REMOVAL

- For preparative work for removing/installing secondary timing chain to remove/install fuel pump, refer to [EM-49, "FUEL PUMP"](#).
 - To prepare for removing/installing secondary timing chain to remove/install camshaft, refer to [EM-59, "Removal and Installation"](#).
- Remove radiator shroud (upper and lower) and cooling fan (crankshaft driven type). Refer to [CO-11, "RADIATOR"](#) and [CO-19, "COOLING FAN"](#).
 - Remove EGR cooler (A/T models) and related water hoses, or EGR tube (M/T models).

CAUTION:

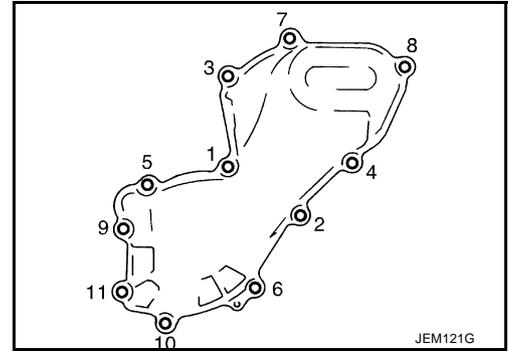
- Perform this step when engine is cold.
 - Do not spill engine coolant on drive belts.
- Remove front chain case.

SECONDARY TIMING CHAIN

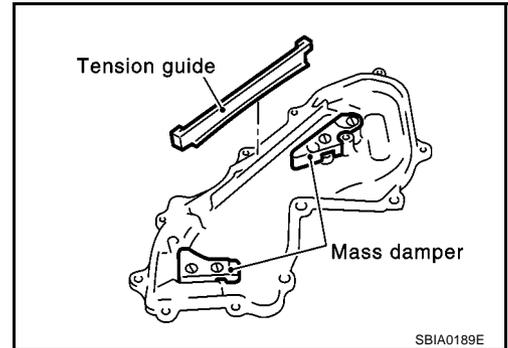
- Loosen fixing bolts in reverse order of that shown in the figure and remove them.

CAUTION:

- While front chain case is removed, cover openings to prevent entry of foreign material into engine.

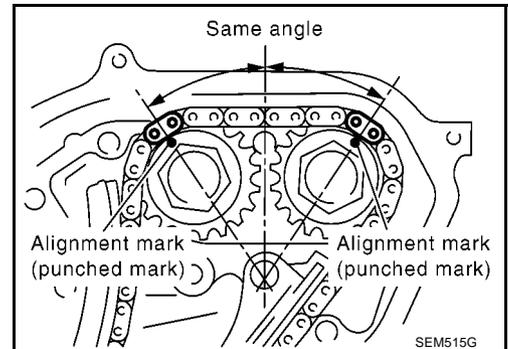


- Do not remove two mass dampers on the back of cover.



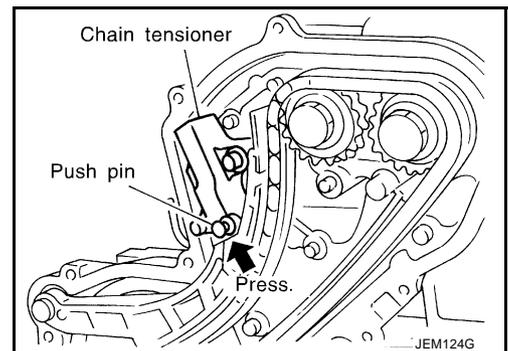
4. Set the No. 1 piston to TDC on its compression stroke.

- Turn crankshaft pulley clockwise so that the alignment mark (punched mark) on each camshaft sprocket is positioned as shown in the figure.
- No position indicator is provided on crankshaft pulley.
- When installing, color coded links on secondary timing chain can be used as alignment marks. Marking may not be necessary for removal; however, make alignment marks as required because the alignment mark on fuel pump sprocket may not be easy to see.



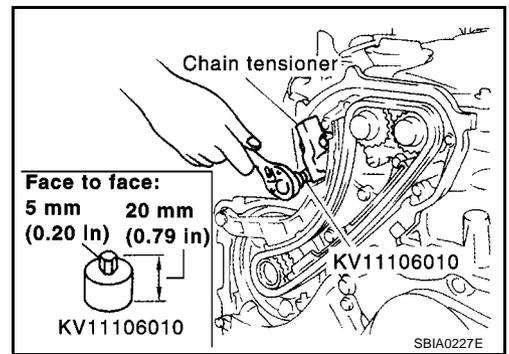
5. Remove chain tensioner.

- a. Push the plunger of chain tensioner and keep it pressed with a push pin.

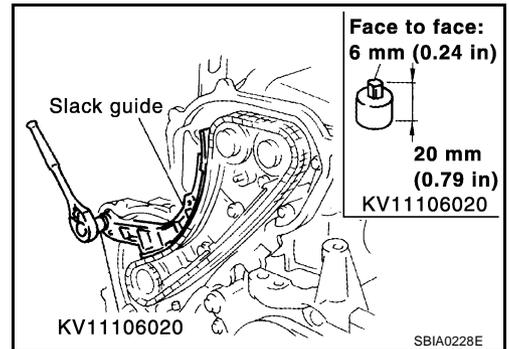


SECONDARY TIMING CHAIN

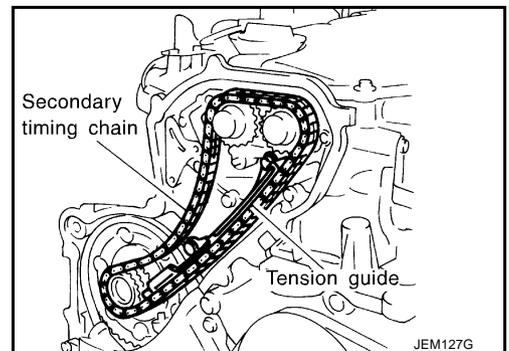
- b. Using the hexagon wrench [SST], remove bolts to remove chain tensioner.



6. Remove slack guide.
- Using the hexagon wrench [SST], remove bolt to remove slack guide.



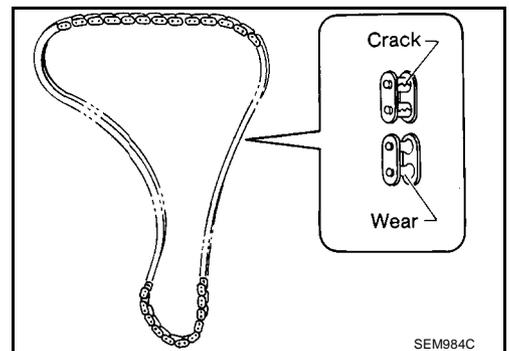
7. Remove tension guide.
8. Remove secondary timing chain.
- Timing chain alone can be removed without removing sprockets.



INSPECTION AFTER REMOVAL

Timing Chain

Check for cracks and excessive wear at roller links. Replace timing chain if necessary.



INSTALLATION

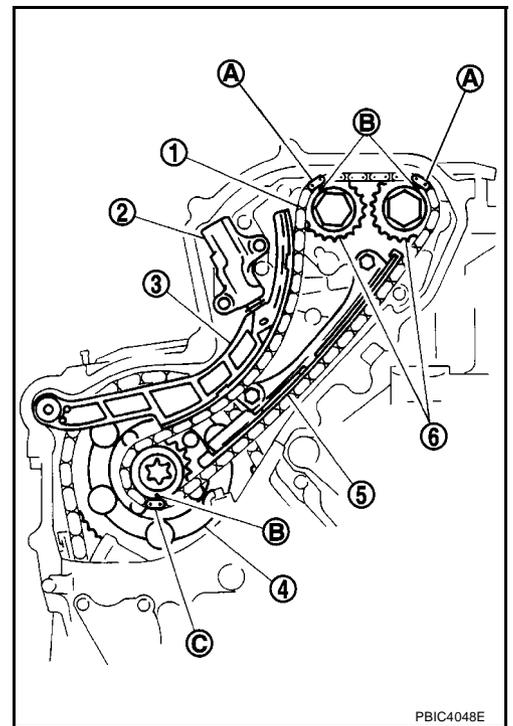
1. Install secondary timing chain.

A
EM
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D
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M

SECONDARY TIMING CHAIN

- When installing, match the alignment marks on sprockets with color coded alignment marks (colored links) on the timing chain.

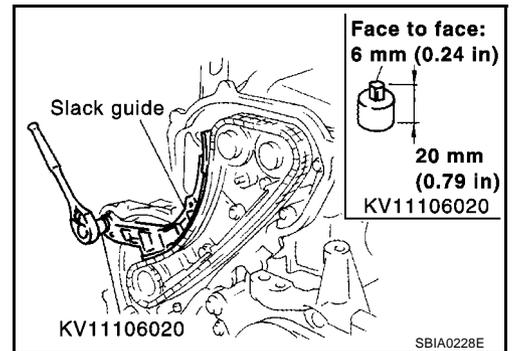
- 1 : Secondary timing chain
- 2 : Chain tensioner
- 3 : Slack guide
- 4 : Fuel pump sprocket
- 5 : Tension guide
- 6 : Camshaft sprocket
- A : Alignment mark (silver link)
- B : Alignment mark (punched mark)
- C : Alignment mark (yellow link)



2. Install tension guide.

- The upper bolt has a longer shank than the lower bolt.

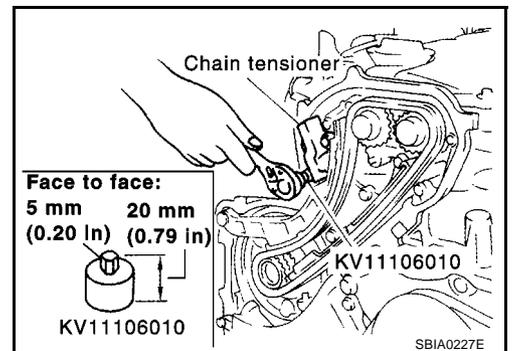
3. Using the hexagon wrench [SST], install slack guide.



4. Install chain tensioner.

- Push the plunger of chain tensioner. While holding it with a push pin, install chain tensioner.
- Using the hexagon wrench [SST], tighten bolts.
- Pull out the push pin, etc. holding the plunger.

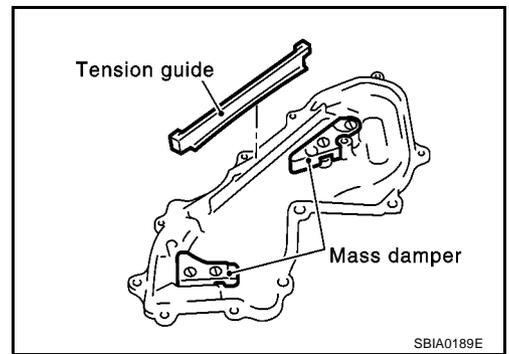
- Make sure again that the alignment marks on the sprockets and the colored alignment marks on the timing chain are aligned.**



5. Install front chain case.

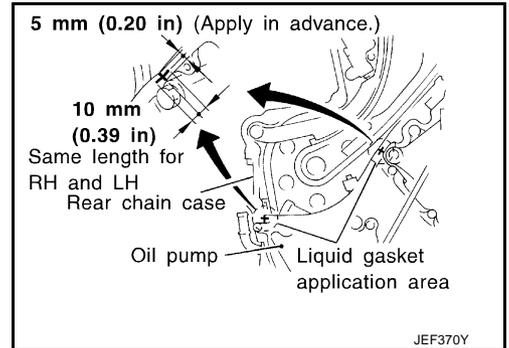
SECONDARY TIMING CHAIN

- a. Install tension guide on the back surface of front chain case.
- Hold front chain case vertically when installing. Tension guide may come off if front chain case is tilted.

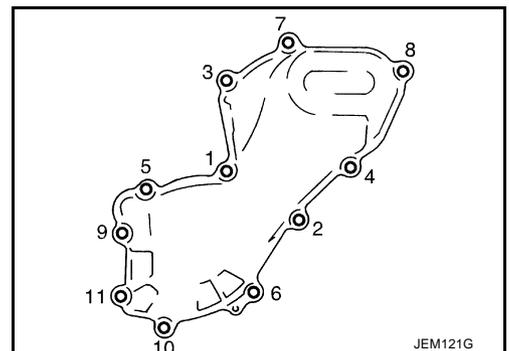


- b. Apply a continuous bead of liquid gasket on both ends of arched area (locations where rear chain case is adjoined) as shown in the figure.

- **Use Genuine Liquid Gasket or equivalent.**



- c. Install front chain case.
- When installing, align dowel pin on oil pump housing with the pin hole.
 - Install No. 6, 10 and 11 bolts with the rubber washer to front chain case.
- d. Tighten fixing bolts in numerical order shown in the figure.
- e. After tightening all the bolts, re-tighten in the same order.



6. Hereafter, 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-14, "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.

SECONDARY TIMING CHAIN

Summary of the inspection items:

Item	Before starting engine	Engine running	After engine stopped
Engine coolant	Level	Leakage	Level
Engine oil	Level	Leakage	Level (*2)
Other oils and fluid (*1)	Level	Leakage	Level
Fuel	Leakage	Leakage	Leakage
Exhaust gases	—	Leakage	—

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

*2: Check engine oil level 10 minutes after engine stopped.

PRIMARY TIMING CHAIN

PRIMARY TIMING CHAIN

PF13028

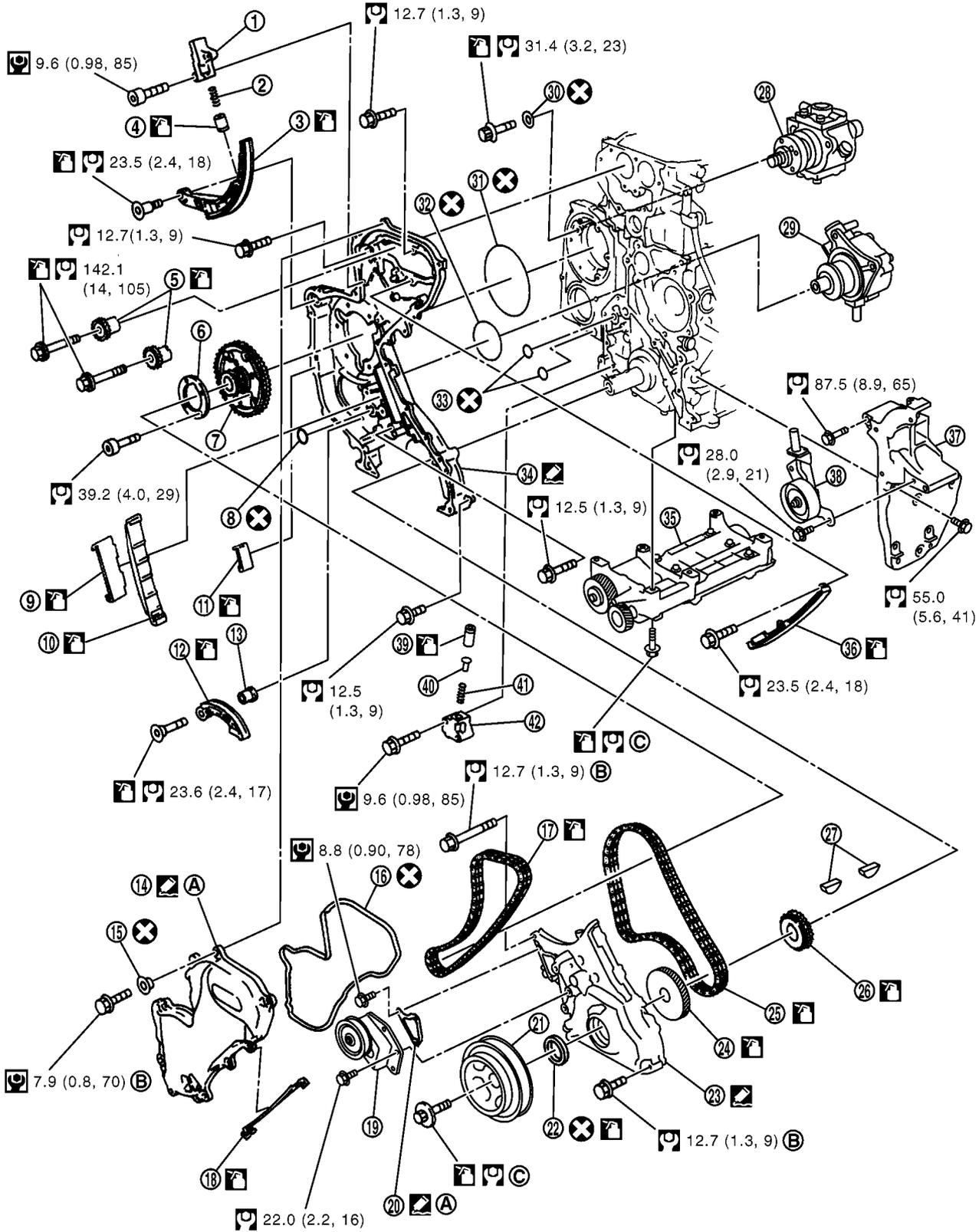
Components

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

EM

SEC. 120•130•135•150•230



☐: N•m (kg-m, ft-lb)
 ☐: N•m (kg-m, in-lb)

PBIC3468E

PRIMARY TIMING CHAIN

- | | | |
|----------------------------|--------------------------------|-----------------------|
| 1. Chain tensioner | 2. Spring | 3. Slack guide |
| 4. Plunger | 5. Camshaft sprocket | 6. Washer |
| 7. Fuel pump sprocket | 8. O-ring | 9. Tension guide |
| 10. Tension guide | 11. Chain guide | 12. Slack guide |
| 13. Spacer | 14. Front chain case | 15. Rubber washer |
| 16. Gasket | 17. Secondary timing chain | 18. Chain guide |
| 19. Idler pulley | 20. Vacuum pump cover | 21. Crankshaft pulley |
| 22. Front oil seal | 23. Oil pump housing | 24. Crankshaft gear |
| 25. Primary timing chain | 26. Crankshaft sprocket | 27. Key |
| 28. Fuel pump | 29. Vacuum pump | 30. Seal washer |
| 31. O-ring | 32. O-ring | 33. O-ring |
| 34. Rear chain case | 35. Balancer unit (4WD models) | 36. Tension guide |
| 37. A/C compressor bracket | 38. Idler pulley | 39. Plunger |
| 40. Plug | 41. Spring | 42. Chain tensioner |

- Refer to [GI-10, "Components"](#) for symbol marks in the figure.

Removal and Installation

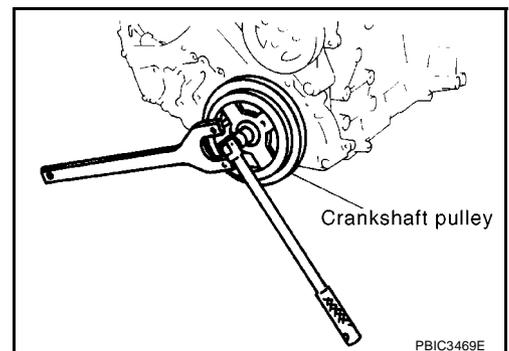
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CAUTION:

- After removing timing chain, do not turn crankshaft and camshaft separately, or valves will strike piston heads.
- When installing camshafts, chain tensioners, oil seals or other sliding parts, lubricate contacting surfaces with new engine oil.

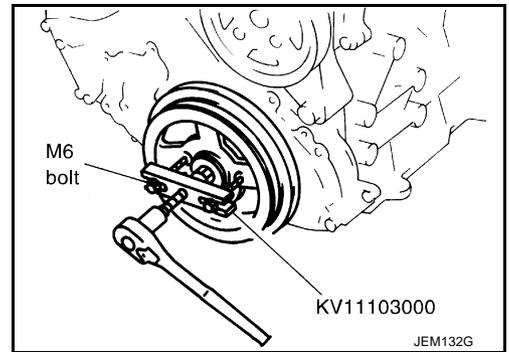
REMOVAL

1. Remove power steering oil pump and power steering oil pump bracket. Refer to [PS-25, "POWER STEERING OIL PUMP"](#).
2. Remove idler pulleys.
3. Remove rocker cover. Refer to [EM-56, "ROCKER COVER"](#).
4. Remove oil pan (upper and lower). Refer to [EM-36, "OIL PAN AND OIL STRAINER"](#).
5. Remove fuel injector. Refer to [EM-44, "INJECTION TUBE AND FUEL INJECTOR"](#).
6. Remove secondary timing chain and associated parts. Refer to [EM-73, "SECONDARY TIMING CHAIN"](#).
7. When removing rear chain case, remove camshaft sprockets. Refer to [EM-59, "CAMSHAFT"](#).
8. Remove crankshaft pulley.
 - a. Hold crankshaft pulley with the pulley holder (commercial service tool).
 - b. Loosen crankshaft pulley fixing bolt and pull out the bolt approximately 10 mm (0.39 in).

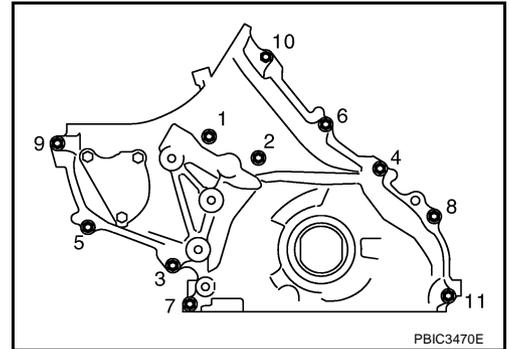


PRIMARY TIMING CHAIN

- c. Using the pulley puller [SST], remove crankshaft pulley.
- Use two M6 bolts with approx. 60 mm (2.36 in) shank length for securing crankshaft pulley.



9. Remove oil pump housing.
- Loosen bolts in reverse order of that shown in the figure and remove them.
 - Use the seal cutter [SST: KV10111100] etc. for removal.



10. Remove crankshaft gear.
- Remove crankshaft gear (1) with the following procedure (4WD models).

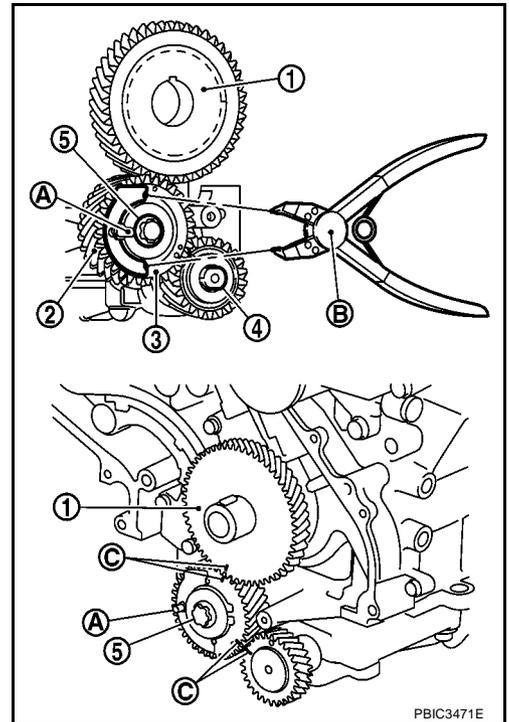
- a. Make sure that No.1 piston is TDC on its compression stroke.
- b. Turn the idler sub gear (3) counterclockwise with snap ring plier (B) or suitable tool for aligning idler sub gear (3) and idler main gear (2).
- If idler gear rotates, hold the flat faces on balancer drive shaft front end (4).

- c. Install internal mechanism securing bolt and plate (Service part: 13012 EB30A and 13013 EB30A) (A) and tighten to the specified torque.

 : 4.0 N·m (0.41 kg·m, 35 in·lb)

CAUTION:

- Do not loosen idler gear mounting bolt (5).
- Only use the genuine internal mechanism securing bolt and plate (A), or the idler gear (2) and (3) will be damaged.
- Do not remove internal mechanism securing bolt and plate (A) from idler gear (2) and (3) until crankshaft gear (1) and all of the parts in connection have been installed.
- If internal mechanism securing bolt and plate (A) is not installed, internal mechanism of idler gear (2) and (3) will disengage after crankshaft gear (1) is removed. This will prohibit the balancer unit from being reusable.



- d. Apply mating marks (C) to crankshaft gear (1) and idler sub gear (3).
- e. Remove crankshaft gear (1).

11. Remove front oil seal from oil pump housing.

- Punch out the seal off from the back surface of the oil pump housing using a flat-bladed screwdriver.

CAUTION:

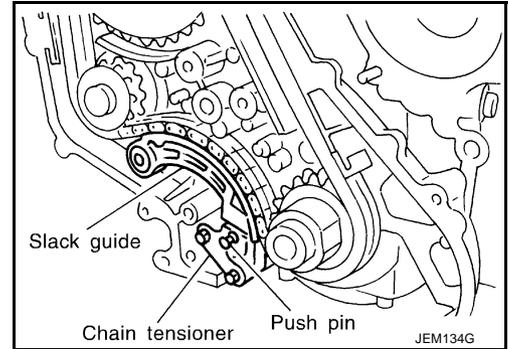
Be careful not to damage oil pump housing.

PRIMARY TIMING CHAIN

12. Remove chain tensioner.

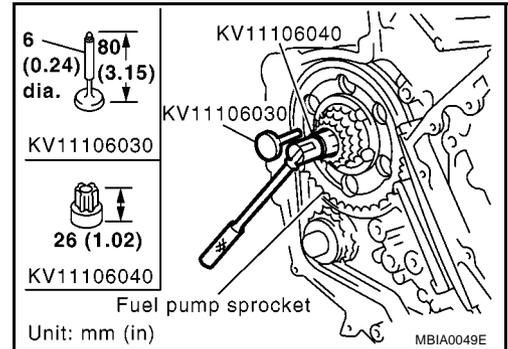
- When removing chain tensioner, push the plunger of chain tensioner and keep it pressed with a push pin, etc.

13. Remove slack guide.

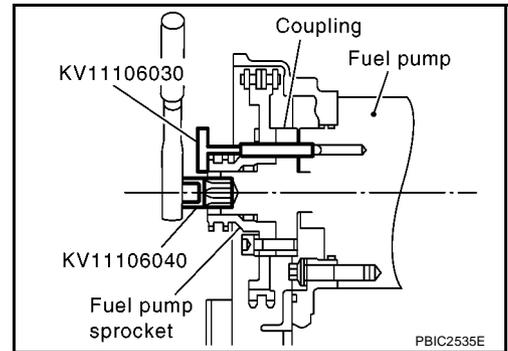


14. Hold fuel pump sprocket and remove bolt.

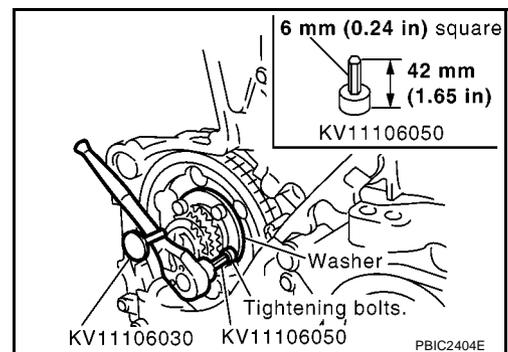
- Insert positioning stopper pin [SST] into the hole 6 mm (0.24 in) in the diameter on fuel pump sprocket.
- Using the TORX wrench, turn pump shaft little by little to adjust the position of fuel pump sprocket so that the holes align.
- Push positioning stopper pin through fuel pump sprocket to fuel pump body to hold fuel pump sprocket.



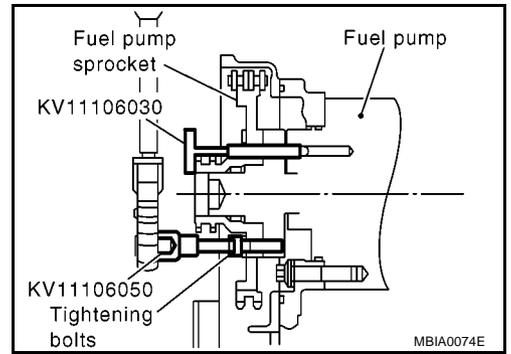
- Insert the positioning stopper pin until its flange contacts fuel pump sprocket.



15. Using the hexagon wrench [SST] remove tightening bolts to fuel pump sprocket.

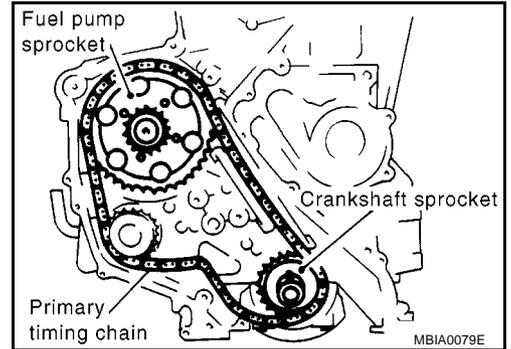


PRIMARY TIMING CHAIN

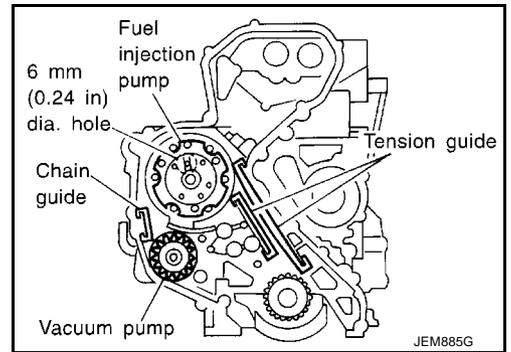


A
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16. Remove primary timing chain with fuel pump sprocket and crankshaft sprocket.



17. Remove chain guide and tension guides.



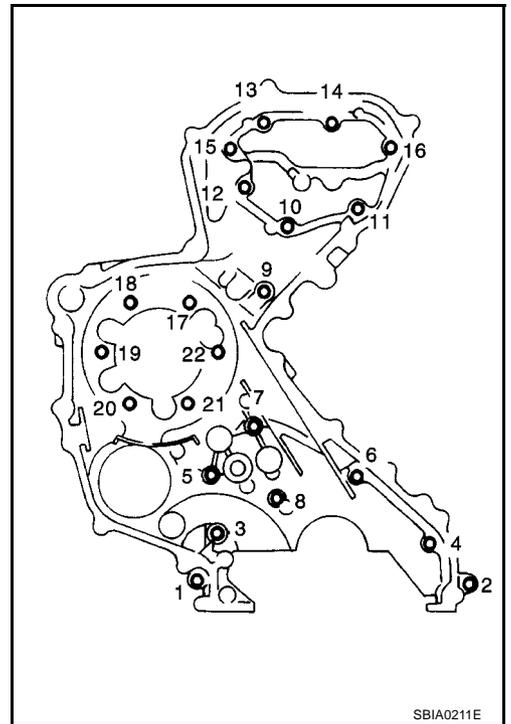
18. Remove fuel pump. Refer to [EM-49, "FUEL PUMP"](#) .

19. Remove vacuum pump. Refer to [EM-42, "VACUUM PUMP"](#) .

PRIMARY TIMING CHAIN

20. Remove rear chain case.

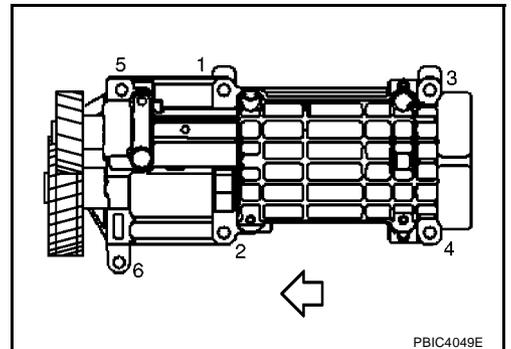
- Loosen fixing bolts in the reverse order of that shown in the figure and remove them.
- Use the seal cutter [SST: KV10111100] for removal.



21. Remove balancer unit (4WD models).

- Loosen mounting bolts in the reverse order as shown in the figure.

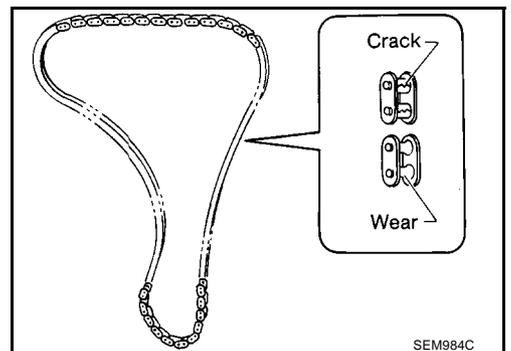
⇐ : Engine front



INSPECTION AFTER REMOVAL

Timing Chain

Check for cracks and excessive wear at roller links. Replace timing chain if necessary.



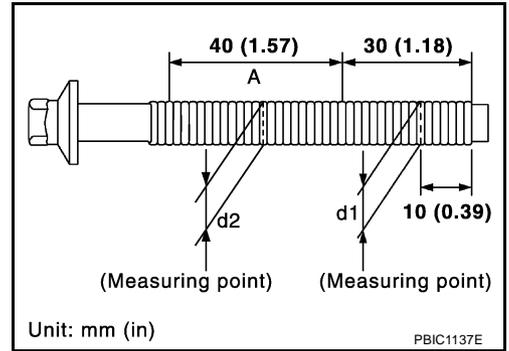
PRIMARY TIMING CHAIN

Balancer Unit Mounting Bolt Outer Diameter (4WD Models)

- Measure the outer diameters ("d1", "d2") at two positions as shown in the figure.
- If reduction appears in "A" range, regard it as "d2".

Limit ("d1" - "d2" : 0.15 mm (0.0059 in))

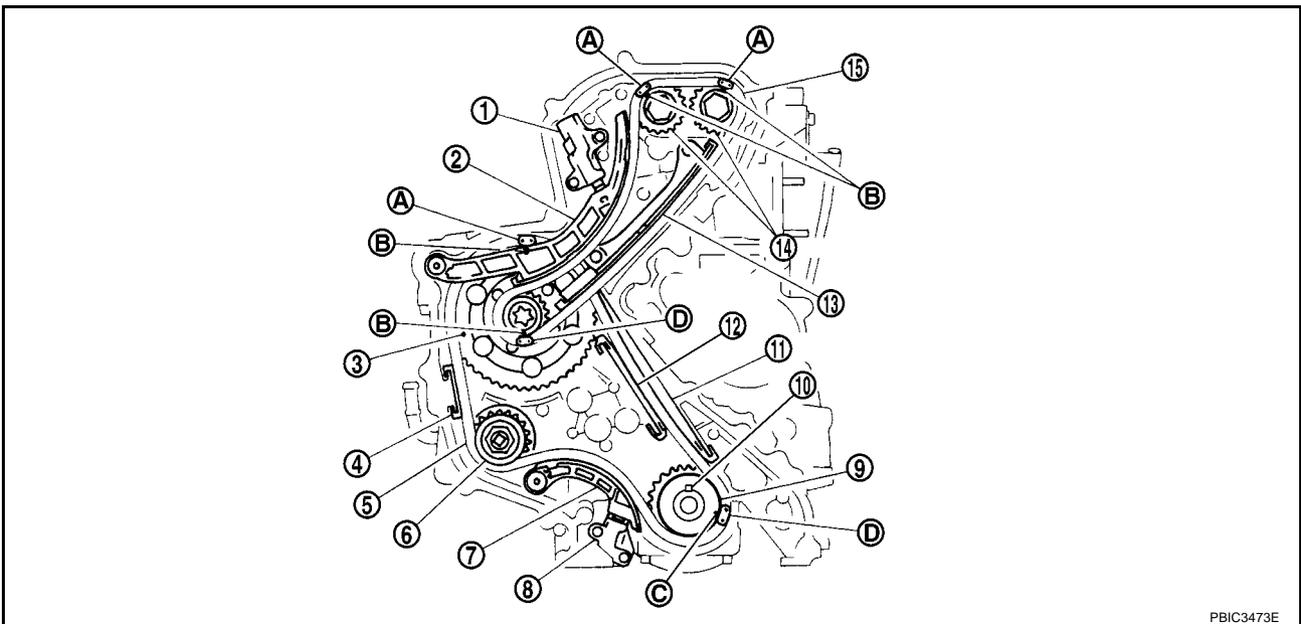
- If it exceeds the limit (large difference in dimensions), replace it with a new one.



INSTALLATION

NOTE:

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



- | | | |
|---------------------------------|----------------------------------|----------------------------------|
| 1. Chain tensioner | 2. Slack guide | 3. Fuel pump sprocket |
| 4. Chain guide | 5. Primary timing chain | 6. Vacuum pump sprocket |
| 7. Slack guide | 8. Chain tensioner | 9. Crankshaft sprocket |
| 10. Key | 11. Tension guide | 12. Tension guide |
| 13. Tension guide | 14. Camshaft sprocket | 15. Secondary timing chain |
| A. Alignment mark (silver link) | B. Alignment mark (punched mark) | C. Alignment mark (cut-out area) |
| D. Alignment mark (yellow link) | | |

CAUTION:

Before starting work, make sure that No. 1 piston is on its compression stroke.

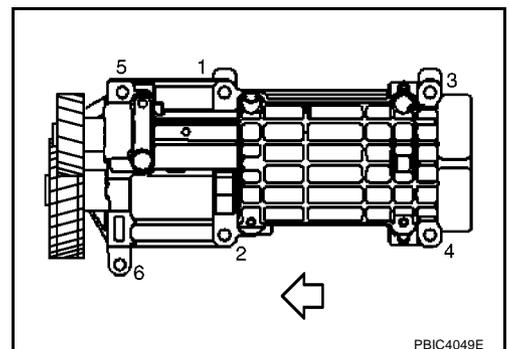
1. Install balancer unit, and tighten mounting bolts in numerical order as shown in the figure (4WD models).

← : Engine front

CAUTION:

If mounting bolts are re-used, check their outer diameter before installation. Refer to EM-85, "Balancer Unit Mounting Bolt Outer Diameter (4WD Models)".

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



PRIMARY TIMING CHAIN

: 29.4 N·m (3.0 kg-m, 22 ft-lb)

- c. Turn all bolts 65 degrees clockwise (angle tightening).

1 : Balancer unit

A : KV10112100

- d. Completely loosen.

: 0 N·m (0 kg-m, 0 ft-lb)

CAUTION:

In this step, loosen bolts in the reverse order as shown in the figure.

- e. Tighten all bolts.

: 29.4 N·m (3.0 kg-m, 22 ft-lb)

- f. Turn them another 65 degrees clockwise (angle tightening).

CAUTION:

Check tightening angle with an angle wrench [SST] (A) or a protractor. Do not make judgment by visual check alone.

2. Install rear chain case.

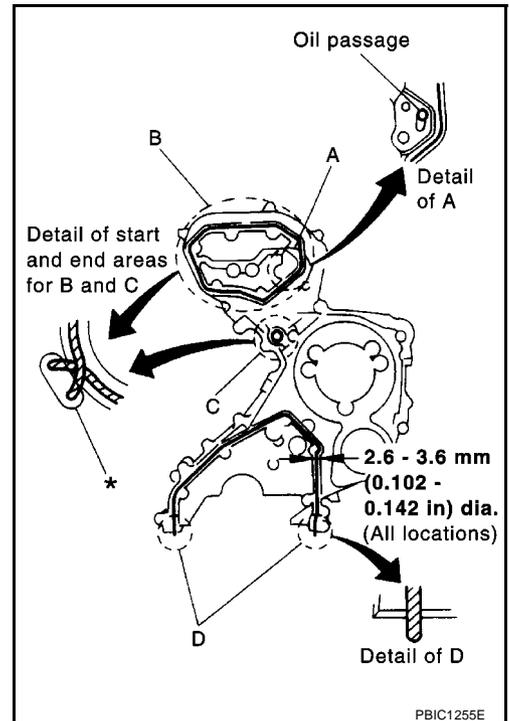
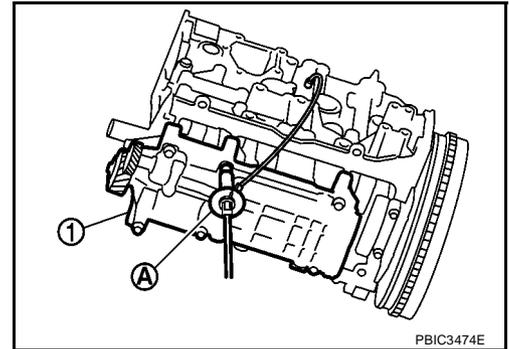
- a. Apply a continuous bead of liquid gasket with the tube presser [SST: WS39930000] on locations shown in the figure.

Use Genuine Liquid Gasket or equivalent.

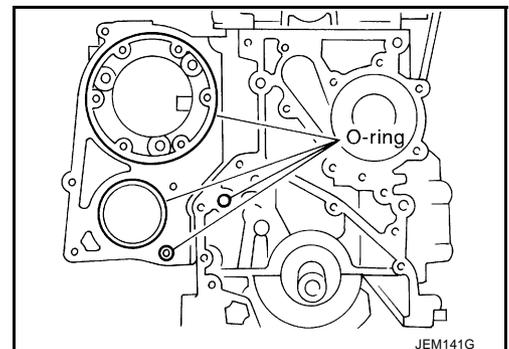
A: Apply bead so that it does not protrude into the oil passage.

B, C: Minimize overlapping area of bead, by starting and ending at areas of bead as shown in the figure. Apply so that the portion marked * comes at an external location but cannot be viewed externally after engine assembly.

D: Leave the start and end areas of the bead slightly protruding from the case surface.



- b. Install four O-rings to the grooves of the cylinder block and fuel pump bracket.

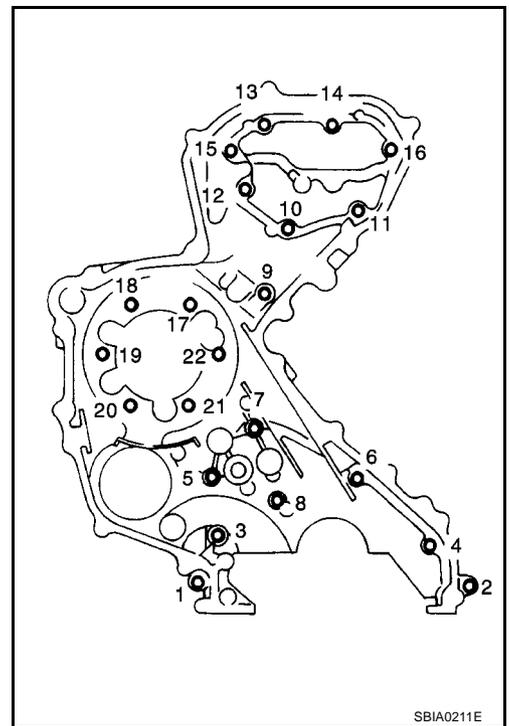


- c. Install rear chain case.

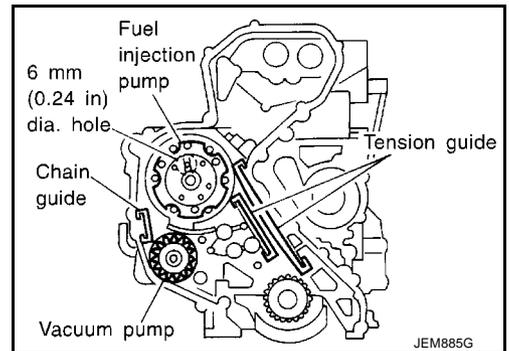
- When installing, align the dowel pin with the pin hole.

PRIMARY TIMING CHAIN

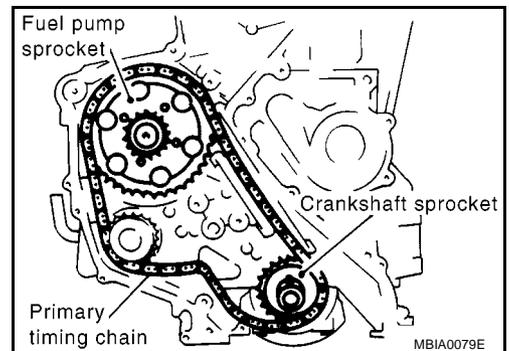
- d. Tighten bolts in numerical order shown in the figure.
- Install the following four types of bolts, referring to the figure.
 - 16 mm (0.63 in) : Bolt No. 1, 2, 16, 17, 18, 19, 20, 21, 22**
 - 20 mm (0.79 in) : Bolt No. 3, 4, 6, 9, 10, 11, 13, 14**
 - 25 mm (0.98 in) : Bolt No. 12, 15**
 - 35 mm (1.38 in) : Bolt No. 5, 7, 8**
 - The shank length under the bolt neck above is the length of threaded part (pilot portion not included).
- e. After tightening all the bolts, re-tighten in the same order.



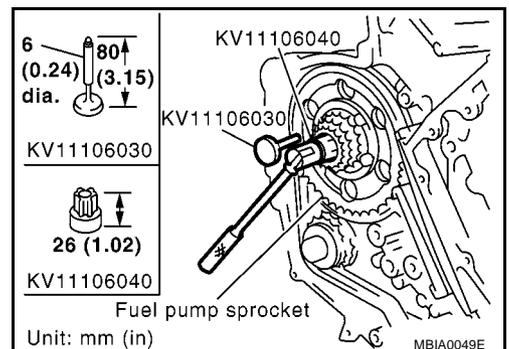
3. Install vacuum pump. Refer to [EM-42, "VACUUM PUMP"](#) .
4. Install fuel pump. Refer to [EM-49, "FUEL PUMP"](#) .
- Before installing, make sure that spacer and the hole 6 mm (0.24 in) in diameter on coupling are aligned.
5. Install chain guide and tension guides.
6. Install crankshaft sprocket, aligning it with crankshaft key on the far side.



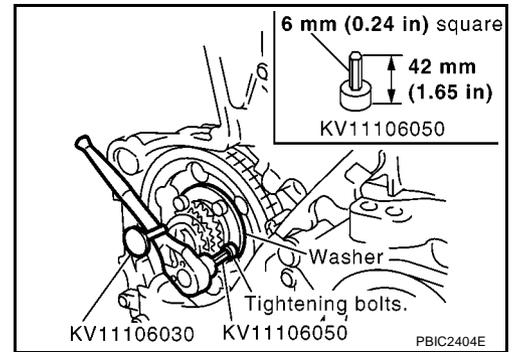
7. Install primary timing chain with fuel pump sprocket.
- When installing, match the alignment marks on sprockets with color coded alignment marks (colored links) on primary timing chain.
 - Install fuel pump sprocket washer with the surface marked "F" (front mark) facing the front of the engine.
8. Install timing chain onto power steering oil pump sprocket and through chain guide.



9. Use the positioning stopper pin [SST] to hold the fuel pump sprocket and install the bolt.
- Using the TORX wrench [SST], turn the fuel pump shaft little by little to adjust the position of the fuel pump sprocket. Insert positioning stopper pin into the hole 6 mm (0.24 in) in diameter on fuel pump sprocket so that the stopper pin goes through the fuel pump body. While the stopper pin is in place, install the bolt.



PRIMARY TIMING CHAIN



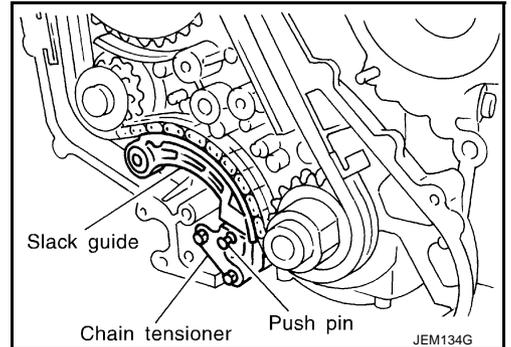
10. Install timing chain slack guide.

11. Install chain tensioner.

- Push the plunger of the chain tensioner. While keeping plunger pressed down with a push pin, etc., install chain tensioner.
- After installation, pull out the push pin holding the plunger.

CAUTION:

Make sure again that the alignment marks on sprockets and the colored alignment marks on timing chain are aligned.

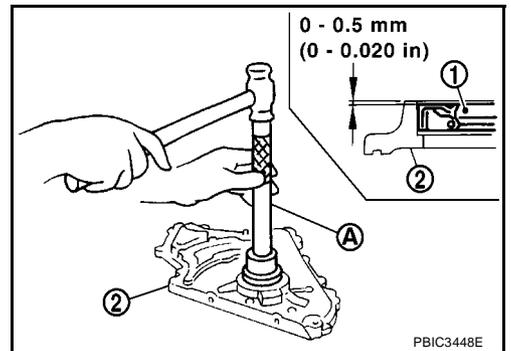


12. Install front oil seal (1) to oil pump housing (2).

- Using the suitable drift (A) [62 mm (2.44 in) dia.], force fit the seal until it hits the bottom.

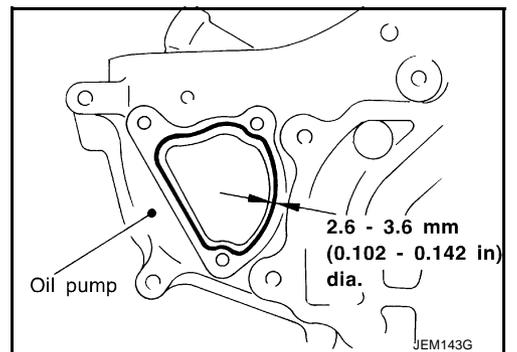
CAUTION:

Do not touch lips of oil seal. Make sure seal surfaces are free of foreign materials.



13. Install vacuum pump cover to oil pump housing.

- Apply a continuous bead of liquid gasket with the tube presser [SST: WS39930000] as shown in the figure.
Use Genuine Liquid Gasket or equivalent.
- Apply liquid gasket on oil pump-side surface.

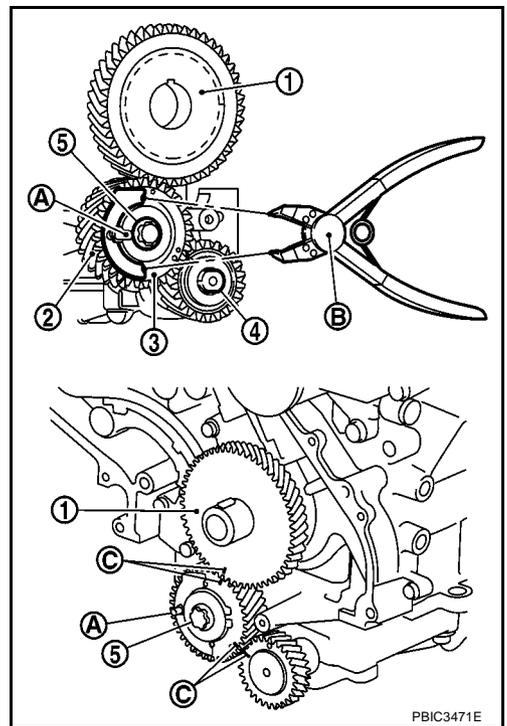


14. Install crankshaft gear.

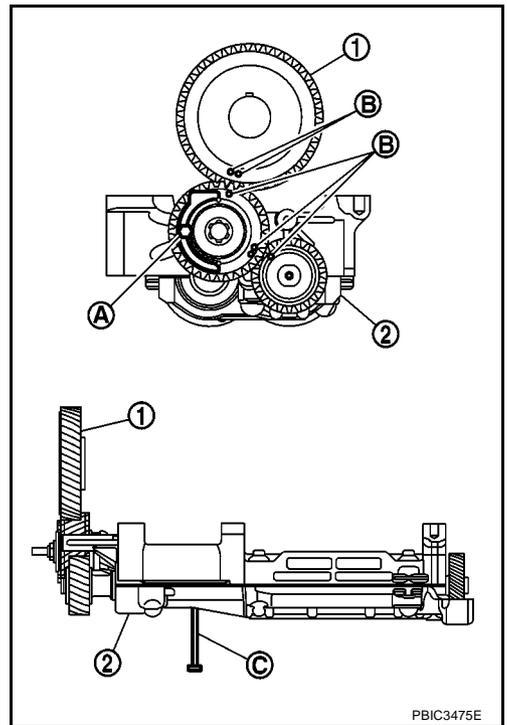
- Install crankshaft gear with the following procedure (4WD models).

PRIMARY TIMING CHAIN

- Align crankshaft gear (1) mating mark and idler sub gear (3) mating mark (C).
- 2 : Idler main gear
- 4 : Balancer drive shaft front end
- 5 : Idler gear mounting bolt (do not loosen)
- B : Snap ring plier
- Remove internal mechanism securing bolt and plate (Service part: 13012 EB30A and 13013 EB30A) (A).

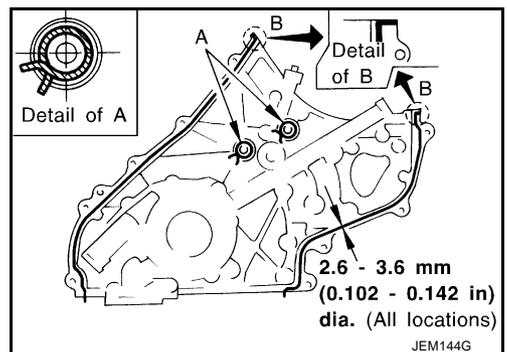


- If new balancer unit (2) is used, align matching marks (B) of each gear as shown in the figure.
- Remove securing-bolt-and-plate (A) and securing pin (C) after installing crankshaft gear (1).



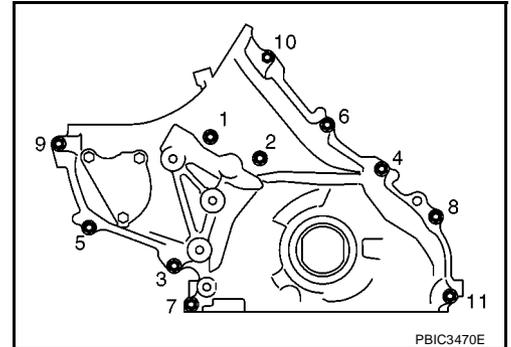
15. Install oil pump housing.

- a. Apply a continuous bead of liquid gasket with the tube presser [SST: WS39930000] as shown in the figure.
 - A: Leave the start and end areas of the bead slightly protruding from the surface.
 - B: Apply liquid gasket along upper end surface of oil pump housing.



PRIMARY TIMING CHAIN

- b. Install O-ring into the groove of rear chain case.
- c. Install oil pump housing.
 - When installing, align the inner rotor in the direction of the two facing flats of oil pump drive spacer.
 - When installing, align the dowel pin with the pin hole.
- d. Tighten fixing bolts in numerical order shown in the figure.
- e. After tightening all the bolts, re-tighten in the same order.



16. Check gaps on upper oil pan mounting surface.
 - Using straightedge and feeler gauge, measure gaps between the locations of the following parts:

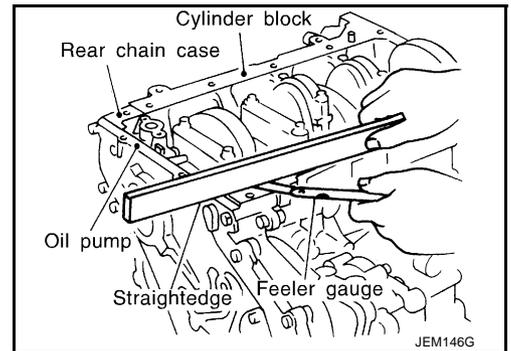
Oil pump housing and rear chain case:

Standard : – 0.09 to 0.09 mm (– 0.0035 to 0.0035 in)

Rear chain case and cylinder block:

Standard : – 0.19 to 0.07 mm (– 0.0075 to 0.0028 in)

- If the measured value is out of the standard, install again.



17. Install crankshaft pulley.

CAUTION:

Be careful not to damage front oil seal.

- a. Install crankshaft pulley to crankshaft.
- b. Apply new engine oil to thread and seat surfaces of crankshaft pulley bolt.
- c. Hold crankshaft pulley with the pulley holder [SST].
- d. Tighten crankshaft pulley fixing bolt.

 : 75.0 N·m (7.7 kg·m, 55 ft·lb)

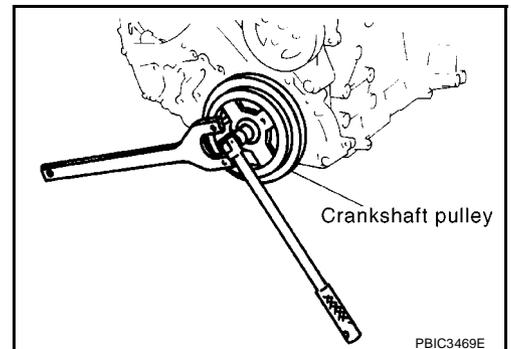
- e. Completely loosen.

 : 0 N·m (0 kg·m, 0 ft·lb)

- f. Tighten crankshaft pulley bolt.

 : 75.0 N·m (7.7 kg·m, 55 ft·lb)

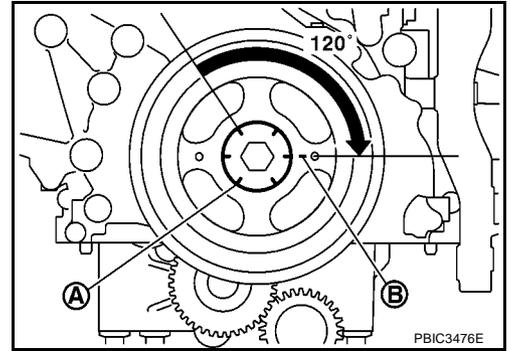
- g. Put an alignment mark on crankshaft pulley that aligns with one of the punched marks on the bolt.



PRIMARY TIMING CHAIN

- h. Tighten fixing bolt another 120 degrees (angle tightening) (turn by 2 notch).

- A** : Indicate embossments
- B** : Alignment mark



18. Install secondary timing chain and the associated parts.
Refer to [EM-75, "INSTALLATION"](#) .
19. 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-14, "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 (*2)
Other oils and fluid (*1)	Level	Leakage	Level
Fuel	Leakage	Leakage	Leakage
Exhaust gases	—	Leakage	—

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

*2: Check engine oil level 10 minutes after engine stopped.

CYLINDER HEAD

CYLINDER HEAD

PF1:11041

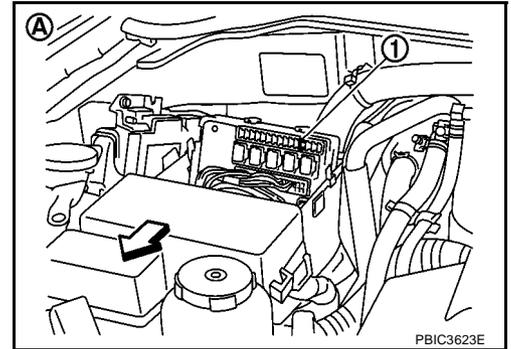
On-Vehicle Service CHECKING COMPRESSION PRESSURE

EBS01E6A

1. Warm up engine thoroughly. Then, stop it.
2. Using CONSULT-II, make sure no error codes are indicated for self-diagnosis items. Refer to [EC-38, "Basic Inspection"](#).
 - Do not disconnect CONSULT-II until the end of this operation; it will be used to check engine rpm and for error detection at the end of this operation.
3. Disconnect the battery cable from the negative terminal.
4. To prevent fuel from being injected during inspection, remove fuse [EGI (20A)] (1) from fuse box.

A : LHD models

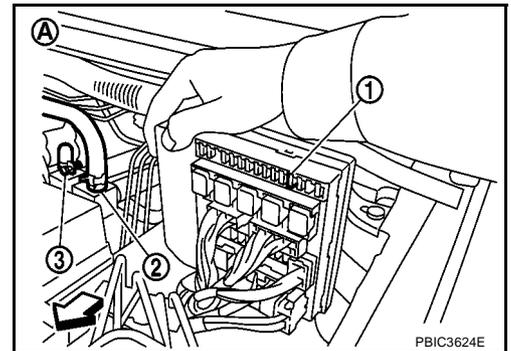
↶ : Vehicle front



A : RHD models

2 : Water hose (to reservoir tank)

3 : Air relief plug



5. Remove glow plugs from all the cylinders. Refer to [EM-41, "GLOW PLUG"](#).

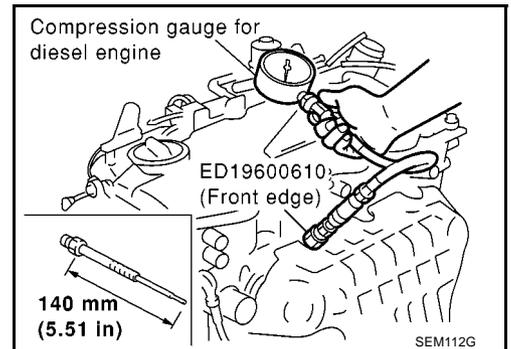
CAUTION:

- Before removal, clean the surrounding area to prevent entry of any foreign materials into engine.
- Carefully remove glow plugs to prevent any damage or breakage.
- Handle with care to avoid applying any shock to glow plugs.

6. Install compression gauge adapter [SST] to installation holes of glow plugs and connect compression gauge for diesel engine.

: 20.0 N·m (2.0 kg·m, 15 ft·lb)

7. Connect the battery cable to the negative terminal.
8. 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.
 - Always use a fully-charged battery to obtain specified engine speed.



CYLINDER HEAD

Compression pressure

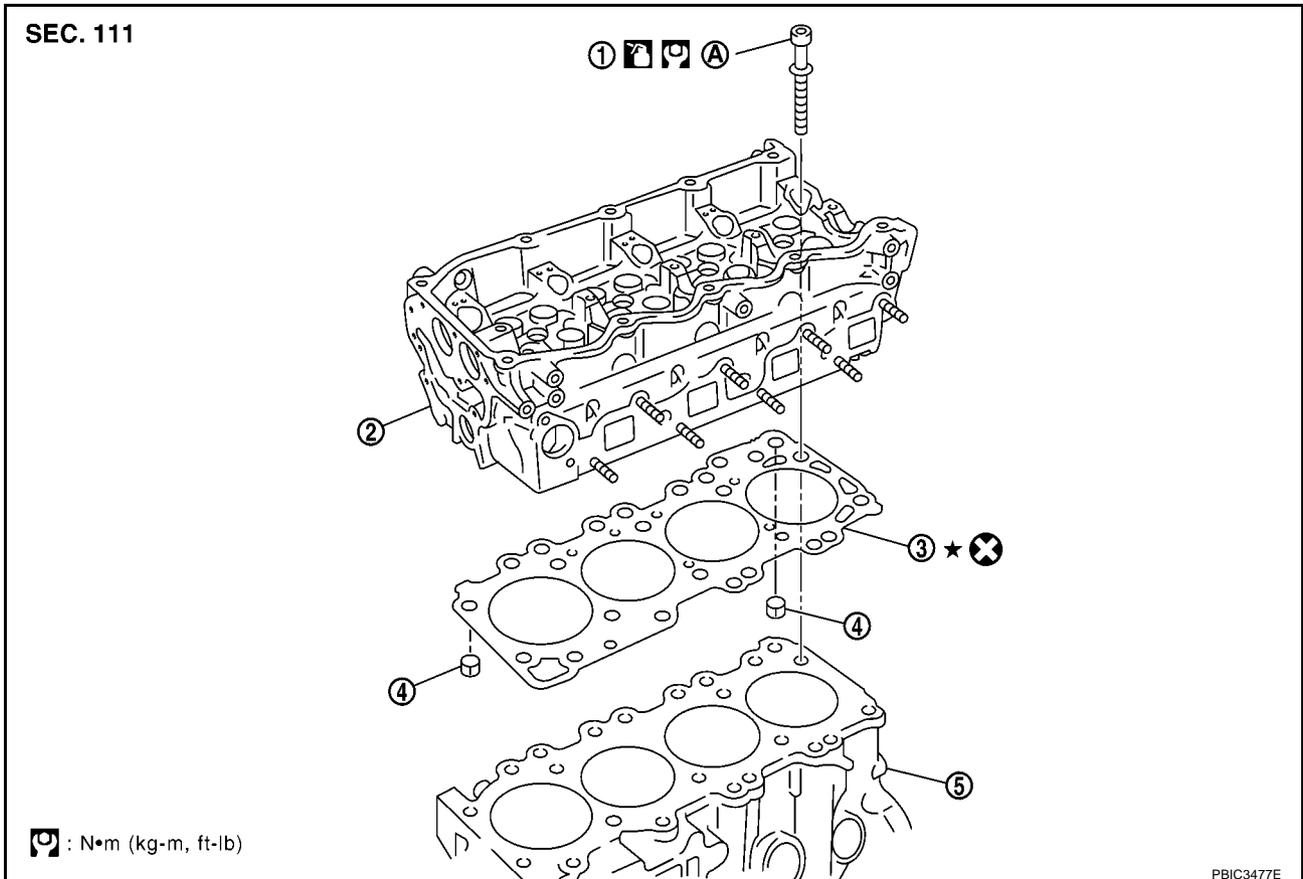
Unit: kPa (bar, kg/cm², psi)/rpm

Standard	Minimum	Difference limit between cylinders
3,100 (31, 31.6, 450)/200	2,500 (25, 25.5, 363)/200	490 (4.9, 5.0, 71)/200

- When engine rpm is out of the specified range, check the specific gravity of battery liquid. Measure again under corrected conditions.
 - If engine rpm exceeds the limit, check valve clearance and combustion chamber components (valves, valve seats, cylinder head gaskets, piston rings, pistons, cylinder bores, cylinder block upper and lower surfaces) and measure again.
 - If compression pressure is low in some cylinders, apply engine oil from glow plug installation hole. Then check pressure again.
 - If compression pressure becomes normal after applying engine oil, piston ring may be worn or damaged. Check piston ring for malfunction. If any, replace piston ring.
 - If compression pressure is still low after applying engine oil, valve may be malfunctioning. Check valve for malfunction. If contact malfunction is found, replace valve or valve seat.
 - If compression pressure in adjacent two cylinders is low after applying engine oil, pressure may be leaking from gasket. In this case, replace cylinder head gasket.
9. Complete this operation as follows:
- a. Turn the ignition switch to "OFF".
 - b. Disconnect the battery cable from the negative terminal.
 - c. Install glow plug and install all the parts removed in step 4.
 - d. Install fuse [EGI (20A)].
 - e. Connect the battery cable to the negative terminal.
 - f. Using CONSULT-II make sure no DTC is indicated for items of self-diagnosis.

Components

EBS01EKC



CYLINDER HEAD

1. Cylinder head bolt
 2. Cylinder head assembly
 3. Gasket
 4. Dowel pin
 5. Cylinder block
- A. Refer to [EM-96](#).

- Refer to [GI-10, "Components"](#) for symbol marks in the figure.

Removal and Installation

REMOVAL

EBS01E6B

1. Drain engine coolant. Refer to [CO-7, "Changing Engine Coolant"](#).
2. Remove the following:
 - Rocker cover (Refer to [EM-56, "ROCKER COVER"](#).)
 - Spill tube and fuel injector (Refer to [EM-44, "INJECTION TUBE AND FUEL INJECTOR"](#).)
 - Intake manifold (Refer to [EM-20, "INTAKE MANIFOLD"](#).)
 - Turbocharger (Refer to [EM-28, "TURBO CHARGER"](#).)
 - Exhaust manifold (Refer to [EM-34, "EXHAUST MANIFOLD"](#).)
 - Secondary timing chain (Refer to [EM-73, "SECONDARY TIMING CHAIN"](#).)
 - Camshaft (Refer to [EM-59, "CAMSHAFT"](#).)
3. Remove cylinder head assembly.

- Remove cylinder head bolts in the reverse order as shown in the figure with the cylinder head bolt wrench (commercial service tool).
- Lift up cylinder head assembly to avoid interference with dowel pins located between the cylinder block and cylinder head, and remove cylinder head assembly.

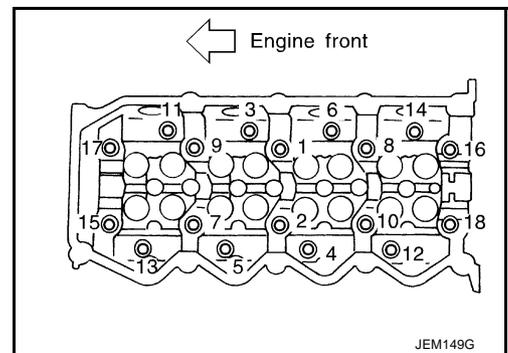
CAUTION:

Remove glow plug in advance to avoid damage as the tip of the glow plug projects from the bottom of cylinder head, or, place wood blocks beneath both ends of cylinder head to keep the cylinder bottom from any contact.

- For glow plug removal, the following shall be noted.

CAUTION:

- To avoid breakage, do not remove glow plug unless necessary.
- Perform continuity test with glow plug installed.
- Keep glow plug from any impact. [Replace if dropped from a height 10 cm (3.94 in) or higher.]
- Do not use air impact wrench.

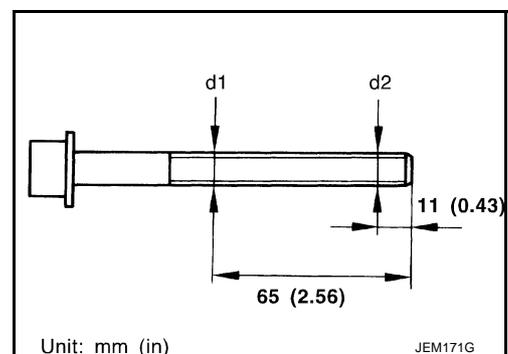


INSPECTION AFTER REMOVAL

Cylinder Head Bolt Deformation

- Using micrometer, measure the outer diameters d1 and d2 of bolt thread as shown in the figure.
- If the necking point can be identified, set it as measuring point d1.
- Calculate the difference between d1 and d2.

Limit : 0.15 mm (0.0059 in)
- If it exceeds the limit, replace cylinder head bolt.



Cylinder Head Distortion

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

CAUTION:

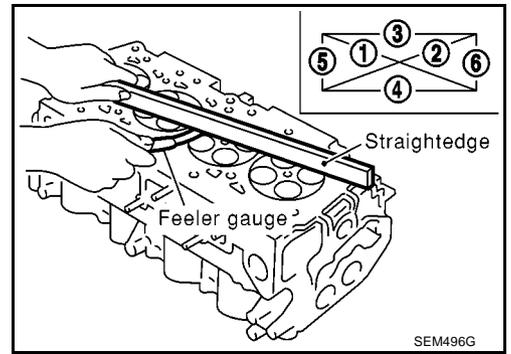
Use utmost care not to allow gasket debris to enter passages for oil or water.

CYLINDER HEAD

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

Limit : 0.1mm (0.004 in)

- If it exceeds the limit, replace cylinder head.



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CYLINDER HEAD

INSTALLATION

Before installation, remove old liquid gasket from mating surface of all liquid gasket applied parts.

1. Install cylinder head gasket.

- Cylinder head gasket to be installed is selected by its thickness through the following procedure.
- **When replacing gasket alone**
- Install a gasket with same thickness as that of the one removed.
- Identify the thickness of gasket by the number of cut-outs on the rear RH side.

Gasket thickness* mm (in)	Number of grade	Number of cut-outs
0.900 (0.0354)	1	0
0.925 (0.0364)	2	1
0.950 (0.0374)	3	2
0.975 (0.0384)	4	3
1.000 (0.0394)	5	4
1.025 (0.0404)	6	5

*: Measured with head bolts tightened

- Gasket (3) thickness can be identified at the location (A) shown in the figure by the numbers of cut-outs before removal.

- 1 : Cylinder head rear cover
- 2 : Oil filter
- ↔ : Vehicle front

- Heater return tube is omitted for explanation.

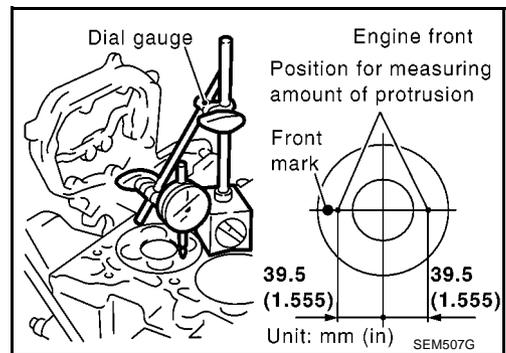
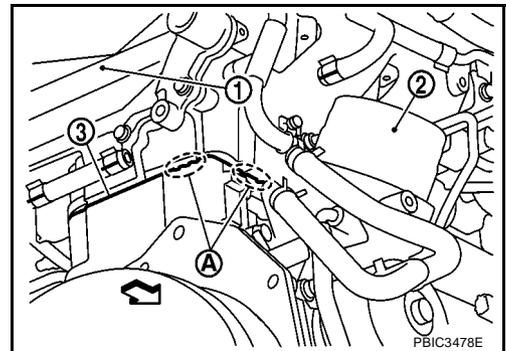
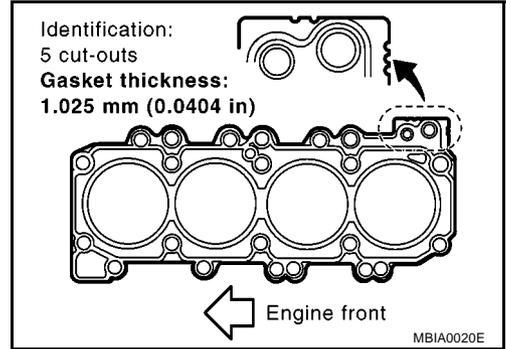
NOTE:

Use mirrors for checking at points out of clear sight.

- **When the following parts have been repaired/replaced:**

- With cylinder block upper surface and/or crankshaft pin journal ground
- With cylinder block, pistons, connecting rods, and/or crankshaft replaced

- a. Set piston at a point close to TDC.
- b. Set the dial gauge at the location as shown in the figure. Turning crankshaft gradually, set the gauge scale to "0" where the piston protrusion is maximized.
- c. Move the dial gauge stand so that the tip of dial gauge can contact cylinder block. Read the difference.
- d. Measure two points from each cylinder in order to obtain each mean value of them. Choose a properly thick gasket corresponding the highest number of the four values.



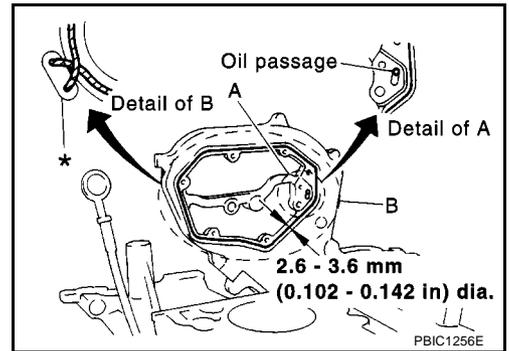
Piston protrusion mm (in)	Gasket thickness* mm (in)	Identification
		Number of cut-outs
0.230 - 0.255 (0.0091 - 0.0100)	0.900 (0.0354)	0
0.255 - 0.280 (0.0100 - 0.0110)	0.925 (0.0364)	1
0.280 - 0.305 (0.0110 - 0.0120)	0.950 (0.0374)	2
0.305 - 0.330 (0.0120 - 0.0130)	0.975 (0.0384)	3
0.330 - 0.355 (0.0130 - 0.0140)	1.000 (0.0394)	4
0.355 - 0.400 (0.0140 - 0.0157)	1.025 (0.0404)	5

CYLINDER HEAD

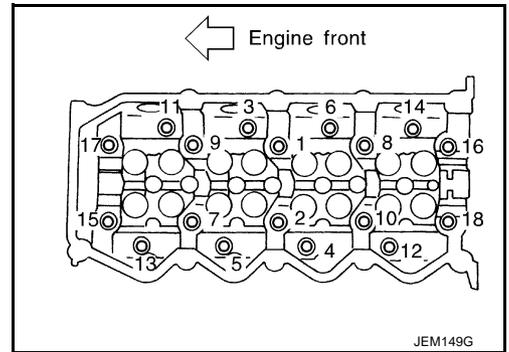
*: Measured with head bolts tightened

- e. If out of above protrusion, check replaced parts.
2. Apply a continuous bead of liquid gasket with the tube presser [SST: WS39930000] as shown in the figure.
 - A: Apply bead so that it does not protrude into oil passage.
 - B: Minimize the overlapping area of the bead, with start and end areas of bead as shown in the figure.

Apply so that the portion marked * comes at an external location but cannot be viewed externally after engine is assembled.



3. Install cylinder head assembly.
 - Tighten bolts in numerical order as shown in the figure according to the following procedure:



- a. Apply engine oil to bolt threads and seat surfaces.
- b. Tighten all bolts.

 : 39.2 N·m (4.0 kg-m, 29 ft-lb)

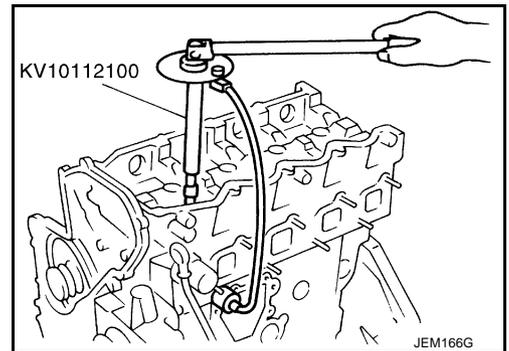
- c. Tighten 180 degrees (angle tightening).
- d. Loosen completely in the reverse order of that shown in the figure.

 : 0 N·m (0 kg-m, 0 ft-lb)

- e. Tighten all bolts.

 : 39.2 N·m (4.0 kg-m, 29 ft-lb)

- f. Tighten 90 degrees (angle tightening).
- g. Tighten another 90 degrees (angular tightening).



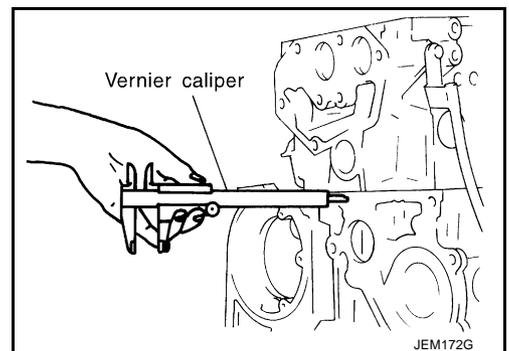
CAUTION:

- When the angle wrench [SST] is not used, paint an alignment mark on the head of cylinder head bolt and cylinder head surface before tightening. Check the angle with a protractor.

4. After installing cylinder head, measure dimension from the front end surface of cylinder block to that of cylinder head.

Standard : 23.53 - 24.07 mm (0.9264 - 0.9476 in)

- If out of the standard, check fitting of dowel pins and cylinder head.



5. Install glow plug.

CAUTION:

- To avoid damage, glow plugs should be removed only when required.
- Handle with care to avoid applying shock. When dropped from approx. 10 cm (3.94 in) or higher, always replace with a new one.

CYLINDER HEAD

- Before installing, remove carbon depositing on mounting hole of glow plug with a reamer.

6. Install engine coolant temperature sensor.

7. 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-14, "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 (*2)
Other oils and fluid (*1)	Level	Leakage	Level
Fuel	Leakage	Leakage	Leakage
Exhaust gases	—	Leakage	—

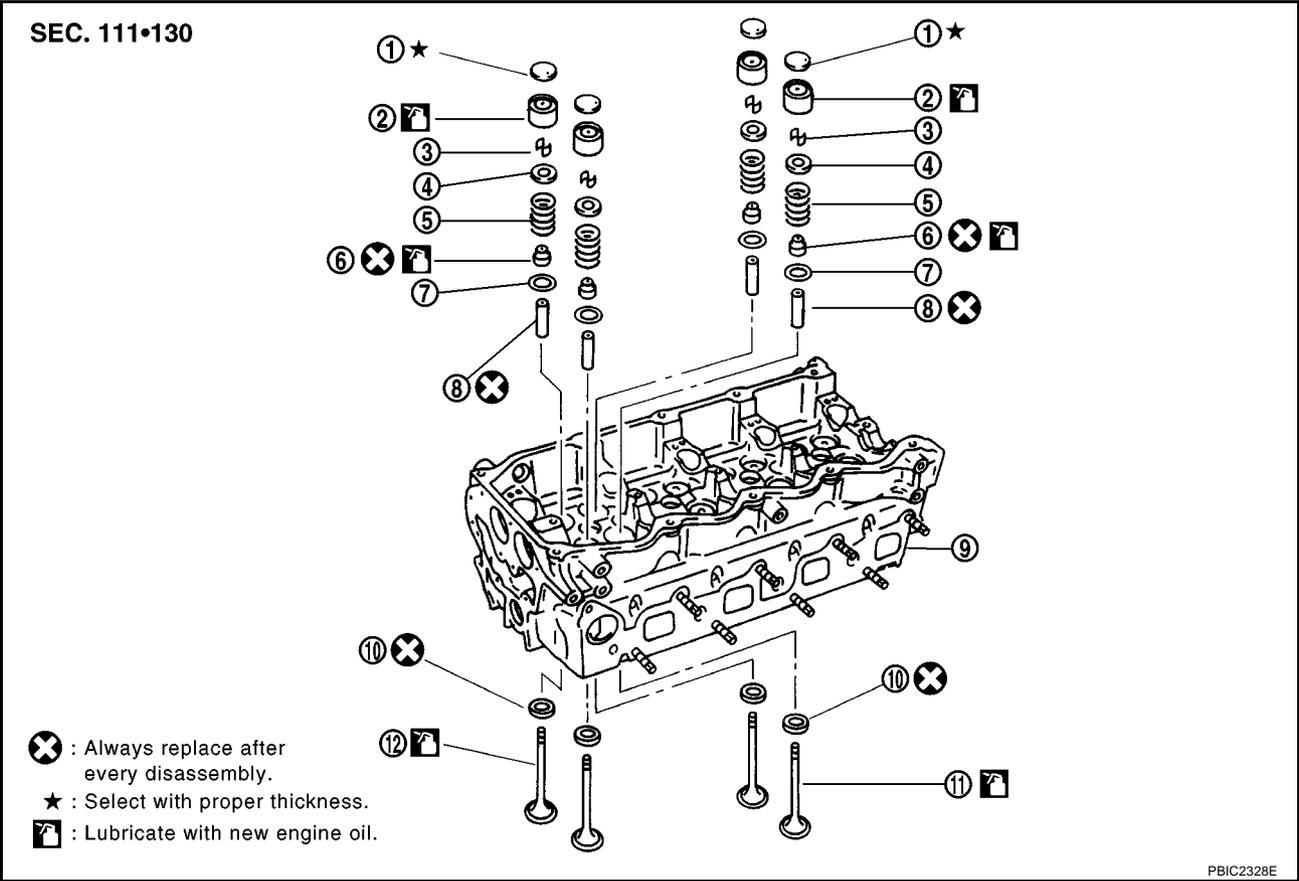
*1: Transmission/transaxle/CVT fluid, power steering fluid, brake fluid, etc.

*2: Check engine oil level 10 minutes after engine stopped.

CYLINDER HEAD

Components

EBS01EKD



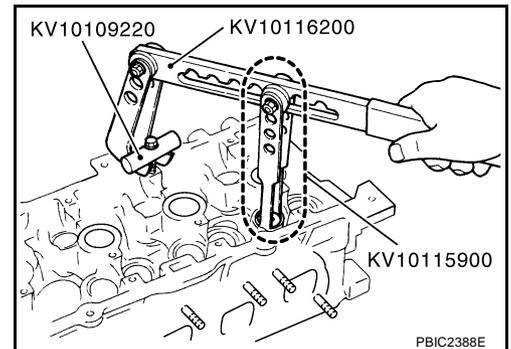
- | | | |
|--------------------------|---------------------|--------------------|
| 1. Adjusting shim | 2. Valve lifter | 3. Valve collet |
| 4. Valve spring retainer | 5. Valve spring | 6. Valve oil seal |
| 7. Valve spring seat | 8. Valve guide | 9. Cylinder head |
| 10. Valve seat | 11. Valve (Exhaust) | 12. Valve (Intake) |

Disassembly and Assembly

DISASSEMBLY

EBS01E6C

- Remove adjusting shims and valve lifters.
 - Check the installation positions, and keep them to avoid being confused.
- Remove valve collet.
 - Using the valve spring compressor [SST], compress valve spring. Using magnet hand, remove valve collets.

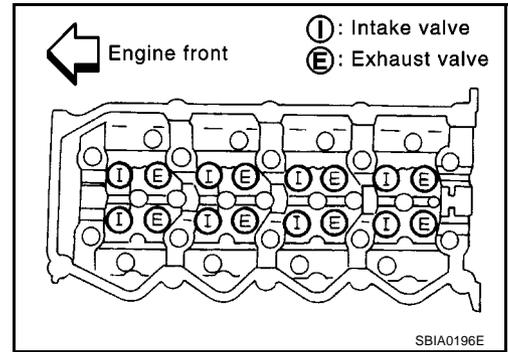


- Remove valve spring retainers and valve springs.
- Remove valves as pressing valve stems toward combustion chamber.
 - Before removing valve, check the valve guide clearance. Refer to [EM-101, "Valve Guide Clearance"](#).

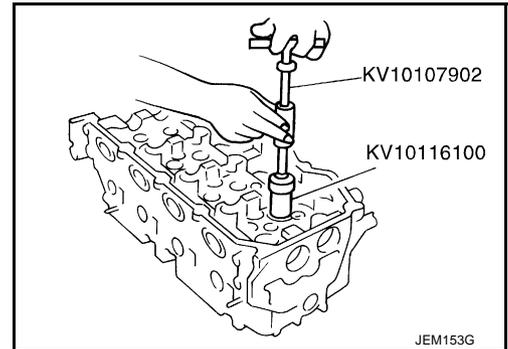
CYLINDER HEAD

NOTE:

Refer to the figure for intake and exhaust valve positions. Intake and exhaust valve driving cams are provided alternately for each camshaft.

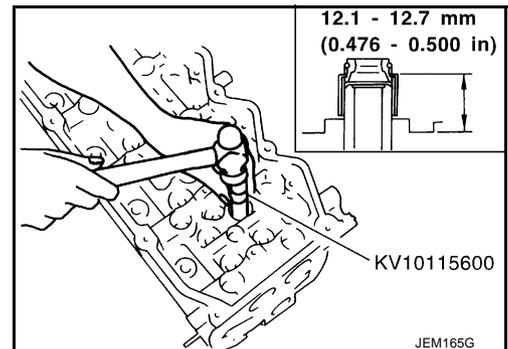


5. Remove valve oil seals using the valve oil seal puller [SST].
6. Remove valve spring seats.
7. Before removing valve seats, perform valve seat contact check. Refer to [EM-103, "Valve Seat Contact"](#).
8. Before removing valve guides, perform valve guide clearance check. Refer to [EM-101, "Valve Guide Clearance"](#).

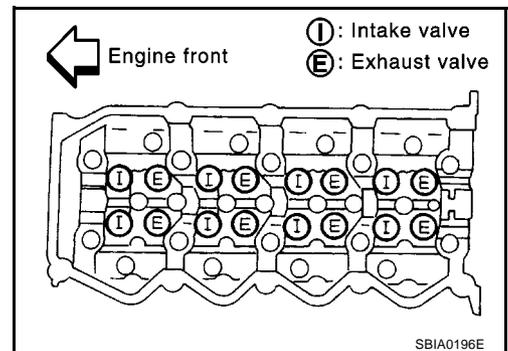


ASSEMBLY

1. Install valve guides. Refer to [EM-102, "Valve Guide Replacement"](#).
2. Install valve seats. Refer to [EM-103, "Valve Seat Replacement"](#).
3. Using the valve oil seal drift [SST], install valve oil seals referring to the dimension shown in the figure.
4. Install valve spring seats.



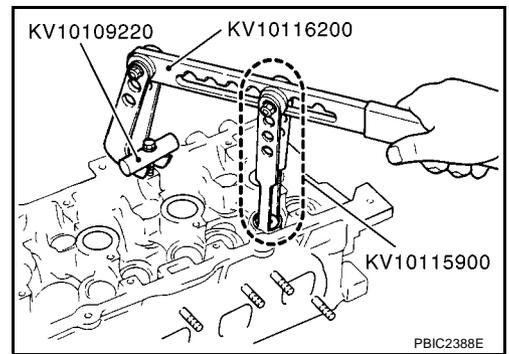
5. Install valves.
 - Install the valves with bigger outer diameter to intake valve side.
 - Note that valve layout here is different from that of conventional engine.



6. Install valve spring.
7. Install valve spring retainers.

CYLINDER HEAD

8. Using the valve spring compressor [SST], compress valve springs.
Then install valve collets using magnet hand.
- After installing valve collets, tap the stem end using the plastic hammer, and check the installation status.

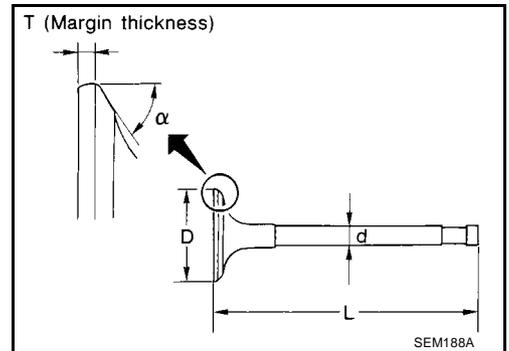


9. Install valve lifters and adjusting shims to the same positions as before.

INSPECTION AFTER DISASSEMBLY

Valve Dimension

- Check dimensions of each valve. For dimensions, refer to [EM-136, "Valve Dimensions"](#).
- If dimensions are out of the standard, replace valve.



Valve Guide Clearance

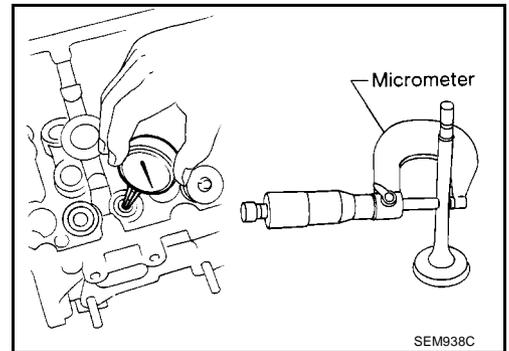
Valve Stem Diameter

- Measure diameter of valve stem with micrometer.

Standard

Intake : 5.965 - 5.980 mm (0.2348 - 0.2354 in)

Exhaust : 5.945 - 5.960 mm (0.2341 - 0.2346 in)



Valve Guide Inner Diameter

- Measure inner diameter of valve guide with inside micrometer.

Standard

Intake and Exhaust : 6.000 - 6.018 mm (0.2362 - 0.2369 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 : 0.040 - 0.073 mm (0.0016 - 0.0029 in)

Limit

Intake : 0.08 mm (0.0031 in)

Exhaust : 0.10 mm (0.0039 in)

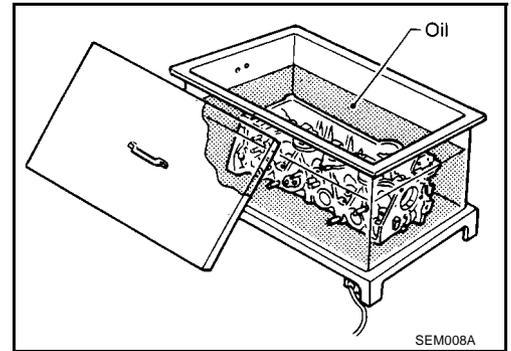
CYLINDER HEAD

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

Valve Guide Replacement

When removing valve guide, replace it with oversized [0.2 mm (0.0008 in)] valve guide.

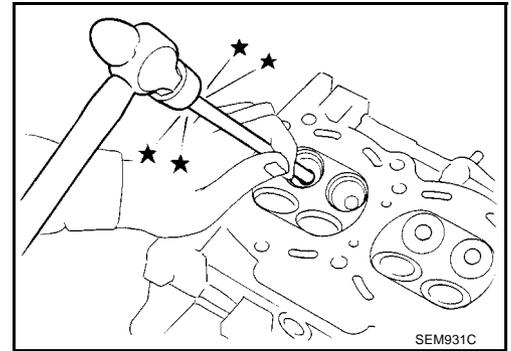
1. Heat cylinder head to 110 to 130°C (230 to 266°F) in oil bath.



2. Using the valve guide drift (commercial service tool), tap valve guides out from the combustion chamber side.

WARNING:

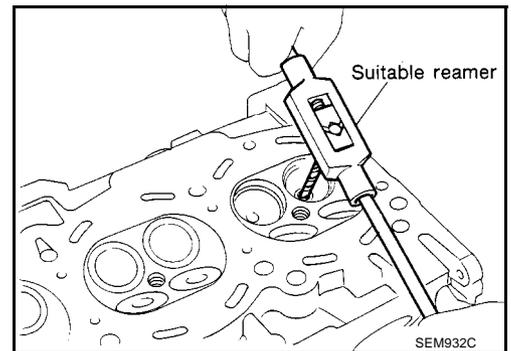
Cylinder head contains heat, when working, wear protective equipment to avoid getting burned.



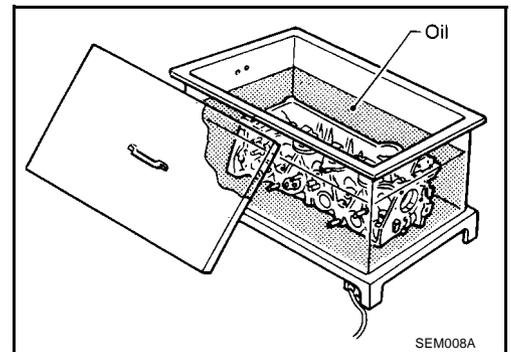
3. Ream cylinder head valve guide hole with the valve guide reamer (commercial service tool).

Valve guide hole diameter (for service parts):

10.175 - 10.196 mm (0.4006 - 0.4014 in)



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



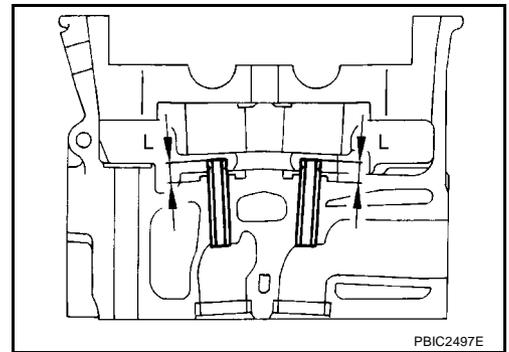
CYLINDER HEAD

5. Using the valve guide drift (commercial service tool), press fit valve guides from camshaft side, referring to the dimension shown in the figure.

Projection "L" : 10.4 - 10.6 mm (0.409 - 0.417 in)

WARNING:

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

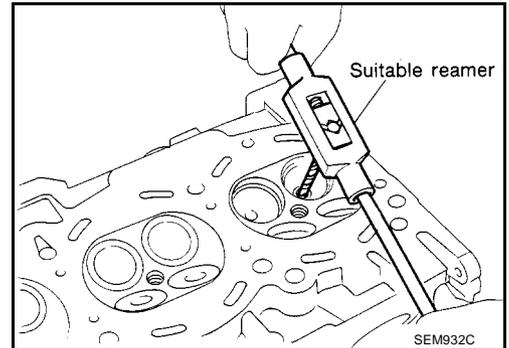


6. Using the valve guide reamer (commercial service tool), perform reaming to the press-fitted valve guides.

Reaming specifications:

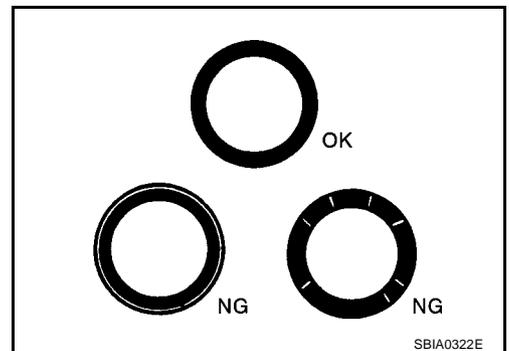
Intake and Exhaust

6.000 - 6.018 mm (0.2362 - 0.2369 in)



Valve Seat Contact

- Before starting this check, confirm that the dimension of valve guide and valves are as specified.
- Apply red lead primer on contacting surfaces of valves seat and of valve face to examine the conditions of contacting surfaces.
- Make sure that the paint on contacting surfaces is continuous along the entire circumference.
- If there are abnormal indications, grind the valve and check the contact again. If malfunction indications still persist, replace valve seat.



Valve Seat Replacement

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

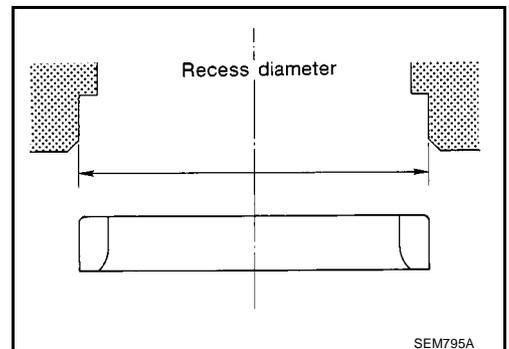
1. Bore out old seat until it collapses. Boring should not continue beyond the bottom face of the seat recess in cylinder head. Set the machine depth stop to ensure this. Refer to [EM-139, "Valve Seat"](#).
2. Ream cylinder head recess diameter for service valve seat.

Oversize [0.5 mm (0.020 in)]:

Intake : 30.500 - 30.516 mm (1.2008 - 1.2014 in)

Exhaust : 29.500 - 29.516 mm (1.1614 - 1.1620 in)

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



CYLINDER HEAD

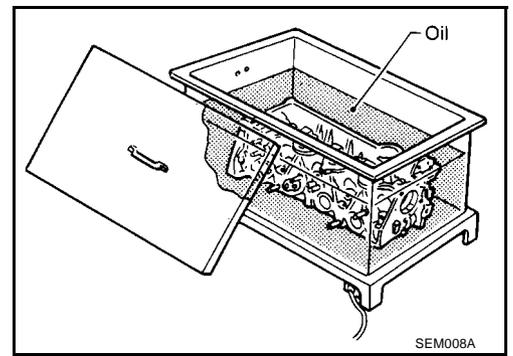
- Heat cylinder head to approximately 110 to 130°C (230 to 266°F) in oil bath.
- After cooling valve seats sufficiently with dry ice, press fit it to cylinder head.

WARNING:

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

CAUTION:

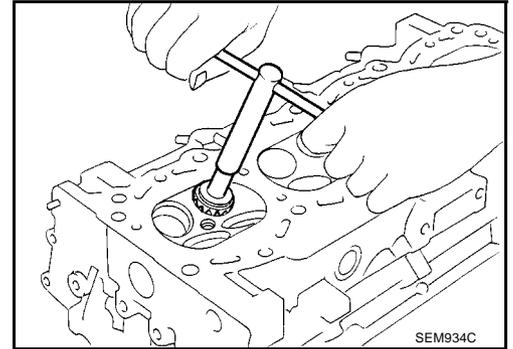
Do not touch the cooled valve seats directly by hand.



- Using the valve seat cutter set (commercial service tool), finish processing referring to the dimensions shown in the figure. Refer to [EM-139, "Valve Seat"](#).

CAUTION:

When using the valve seat cutter set, grasp cutter handle with both hands, press cutter onto contacting face all around, and cut thoroughly. If cutter is pressed unevenly or repeatedly, the valve seat surface may be damaged.

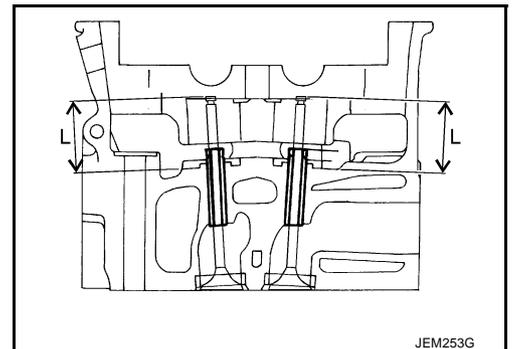


- Using compound, perform valve fitting.
- Check again to make sure that contacting status is satisfactory. For details, Refer to [EM-103, "Valve Seat Contact"](#).
- Use the depth gauge to measure the distance between the mounting surface of cylinder head spring seat and the valve stem end. If the distance is shorter than specified, repeat step 5 above to adjust it. If it is longer, replace valve seat with a new one.

Valve seat resurface limit "L":

Intake : 36.53 - 36.98 mm (1.4382 - 1.4559 in)

Exhaust : 36.53 - 37.01 mm (1.4382 - 1.4571 in)

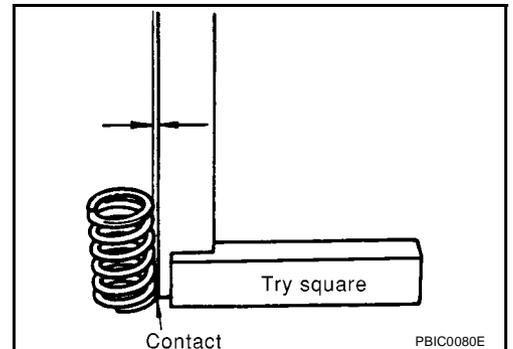


Valve Spring Square

- Position the try square to valve spring, turn the spring, and measure the maximum clearance value between top surface of spring and the try square.

Limit : 1.9 mm (0.075 in)

- If it exceeds the limit, replace valve spring.



CYLINDER HEAD

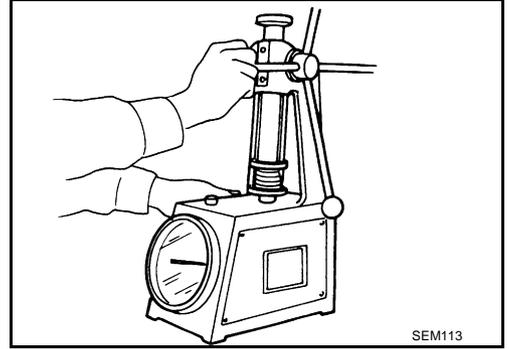
Valve Spring Dimensions and Valve Spring Pressure Load

- Using valve spring tester, check the following.

Standard:

Free height	: 44.74 mm (1.76 in)
Installation height	: 32.82 mm (1.2921 in)
Installation load	: 184 - 208 N (18.77 - 21.22 kg, 41.4 - 46.8 lb)
Height during valve open	: 24.82 mm (0.9772 in)
Load with valve open	: 320 - 360 N (32.65 - 36.73 kg, 71.9 - 80.9 lb)

- If out of the standard, replace the valve spring.



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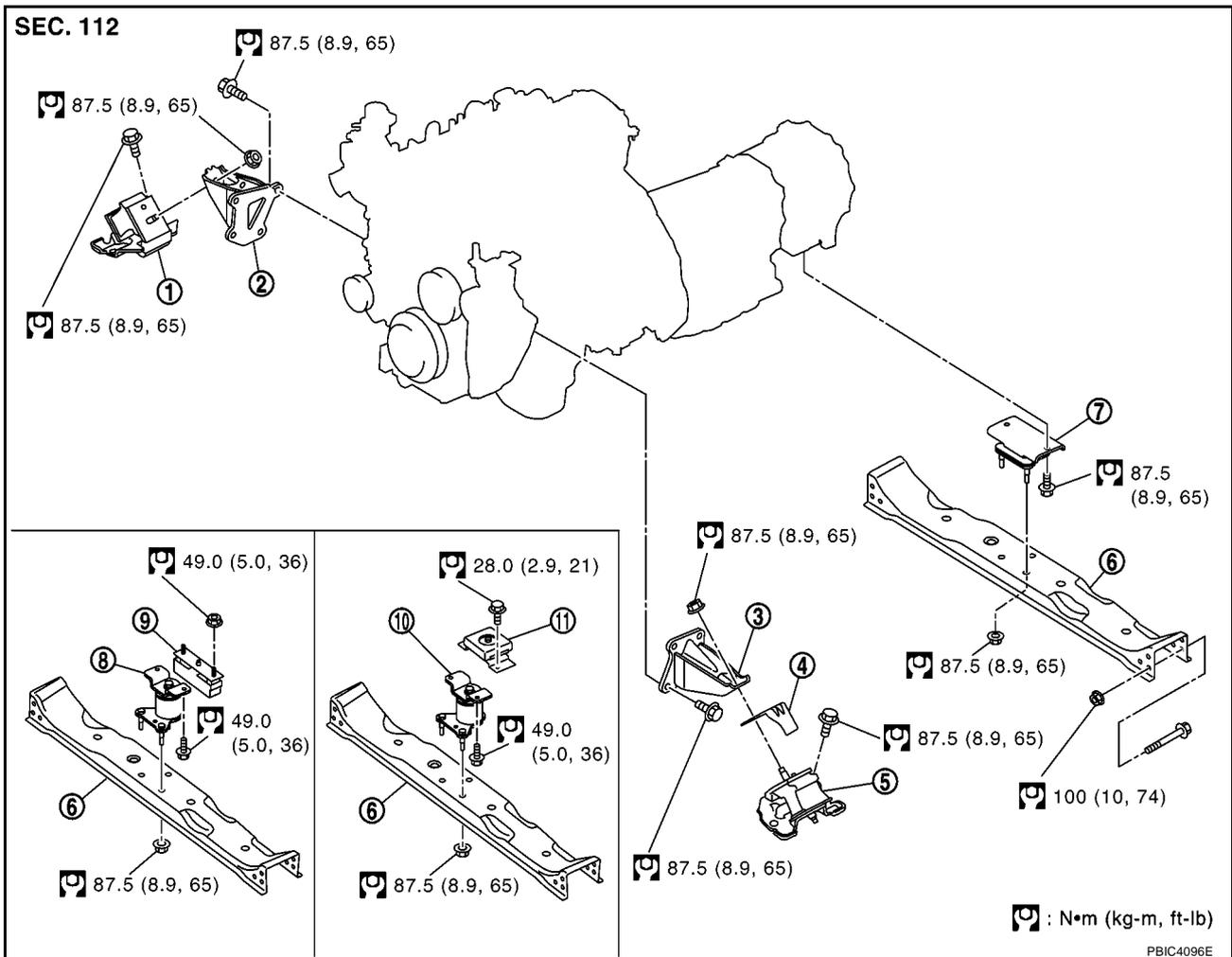
ENGINE ASSEMBLY

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ENGINE ASSEMBLY

Components

EBS01EV6



- | | | |
|--|---|---|
| 1. RH engine mounting insulator | 2. RH engine mounting bracket | 3. LH engine mounting bracket |
| 4. Heat insulator | 5. LH engine mounting insulator | 6. Transmission cross member |
| 7. Engine mounting insulator (rear)
(4WD models) | 8. Engine mounting insulator (rear)
(2WD M/T models) | 9. Dynamic damper (2WD M/T mod-
els) |
| 10. Engine mounting insulator (rear)
(2WD A/T models) | 11. Dynamic damper (2WD A/T models) | |

Removal and Installation

EBS01E6D

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.

ENGINE ASSEMBLY

- For supporting points for lifting and jacking point at rear axle, refer to [GI-52, "Pantograph Jack, Garage Jack and Safety Stand"](#) .

REMOVAL

Description of work

Remove transmission assembly from vehicle downward. Then hoist the engine from vehicle upward.

Preparation

1. Disconnect battery cable from negative terminal. Refer to [SC-5, "BATTERY"](#) .
2. Drain engine coolant from radiator drain plug. Refer to [CO-7, "Changing Engine Coolant"](#) .
3. Remove the following parts.
 - Engine undercover front, engine undercover middle, engine undercover rear; Refer to [EI-15, "FRONT BUMPER"](#) .
 - Hood assembly; Refer to [BL-12, "HOOD"](#) .
 - Engine cover; Refer to [EM-20, "INTAKE MANIFOLD"](#) .
 - Drive belts; Refer to [EM-12, "DRIVE BELTS"](#) .
 - Cooling fan, fan coupling and water pump pulley; Refer to [CO-19, "COOLING FAN"](#) .
 - Air duct and air cleaner case; Refer to [EM-15, "AIR CLEANER AND AIR DUCT"](#) .
 - Air inlet tube and air inlet hose; Refer to [EM-18, "CHARGE AIR COOLER"](#) .
 - Alternator; Refer to [SC-23, "Removal and Installation"](#) .
 - Radiator, radiator shroud (upper and lower) and cooling fan assembly; Refer to [CO-11, "RADIATOR"](#) and [CO-19, "COOLING FAN"](#) .
4. Disconnect engine room harness from the engine side and set it aside for easier work.
5. Disconnect all the body-side vacuum hoses and air hoses at engine side.

Engine room RH

1. Disconnect fuel feed hose and return hose, and plug it to prevent fuel from draining. Refer to [EM-44, "INJECTION TUBE AND FUEL INJECTOR"](#) .
2. Remove fuel filter. Refer to [FL-4, "FUEL FILTER"](#) .
3. Disconnect heater hose, and install plug it to prevent engine coolant from draining. Refer to [CO-23, "THERMOSTAT AND WATER PIPING"](#) .

Engine room LH

1. Remove A/C compressor with piping connected from engine. Temporarily secure it on body with a rope to avoid putting load on it. Refer to [ATC-142, "Removal and Installation for Compressor"](#) (automatic A/C models) or [MTC-122, "Removal and Installation for Compressor"](#) (manual A/C models).

Vehicle underbody

1. Remove exhaust front tube. Refer to [EX-3, "Removal and Installation"](#) .
2. Remove front propeller shaft (4WD models) and rear propeller shaft. Refer to [PR-3, "FRONT PROPELLER SHAFT"](#) (4WD models) and [PR-7, "REAR PROPELLER SHAFT"](#) .
3. Remove clutch operating cylinder from transmission, and move it aside (M/T models). Refer to [MT-16, "TRANSMISSION ASSEMBLY"](#) and [CL-11, "OPERATING CYLINDER"](#) .
4. Disconnect power steering fluid piping at a point between body and engine. Refer to [PS-30, "HYDRAULIC LINE"](#) .
5. Remove starter motor. Refer to [SC-31, "Removal and Installation"](#) .
6. Remove transmission assembly. Refer to [MT-16, "TRANSMISSION ASSEMBLY"](#) (M/T models) or [AT-247, "TRANSMISSION ASSEMBLY"](#) (A/T models).

ENGINE ASSEMBLY

Removal

1. Install engine slingers into front right of cylinder head (A) and rear left of cylinder head (B).

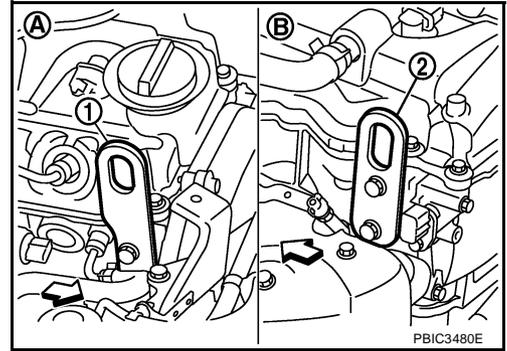
1 : Engine slinger (front)

2 : Engine slinger (rear)

↶ : Engine front

Engine slinger bolts:

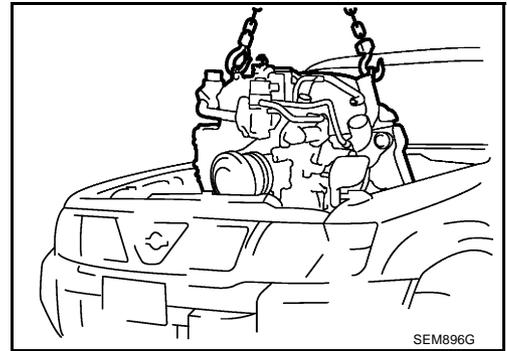
: 28.0 N-m (2.9 kg-m, 21 ft-lb)



2. Lift with hoist and secure engine in position.
3. Loosen LH and RH engine mounting insulator mounting nuts.
4. Remove engine.

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.



INSTALLATION

Install in the reverse order of removal.

- Do not allow engine 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 figure of components. Refer to [EM-106, "ENGINE ASSEMBLY"](#) .
- Make sure that each mounting insulator is seated properly, and tighten mounting bolts and nuts.
- Insert vacuum hose to vacuum gallery until vacuum hose comes in contact with the stopper when a stopper is provided at vacuum gallery.
- Insert vacuum hose up to 15 mm (0. 59 in) when a stopper is not provided at vacuum gallery.

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-14, "RECOMMENDED FLUIDS AND LUBRICANTS"](#) .
- Use procedure below to check for fuel leakage.
 - Before starting engine, 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.

ENGINE ASSEMBLY

Summary of the inspection items:

Item	Before starting engine	Engine running	After engine stopped
Engine coolant	Level	Leakage	Level
Engine oil	Level	Leakage	Level (*2)
Other oils and fluid (*1)	Level	Leakage	Level
Fuel	Leakage	Leakage	Leakage
Exhaust gases	—	Leakage	—

*1: Transmission/transaxle/AT fluid, power steering fluid, brake fluid, etc.

*2: Check engine oil level 10 minutes after engine stopped.

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CYLINDER BLOCK

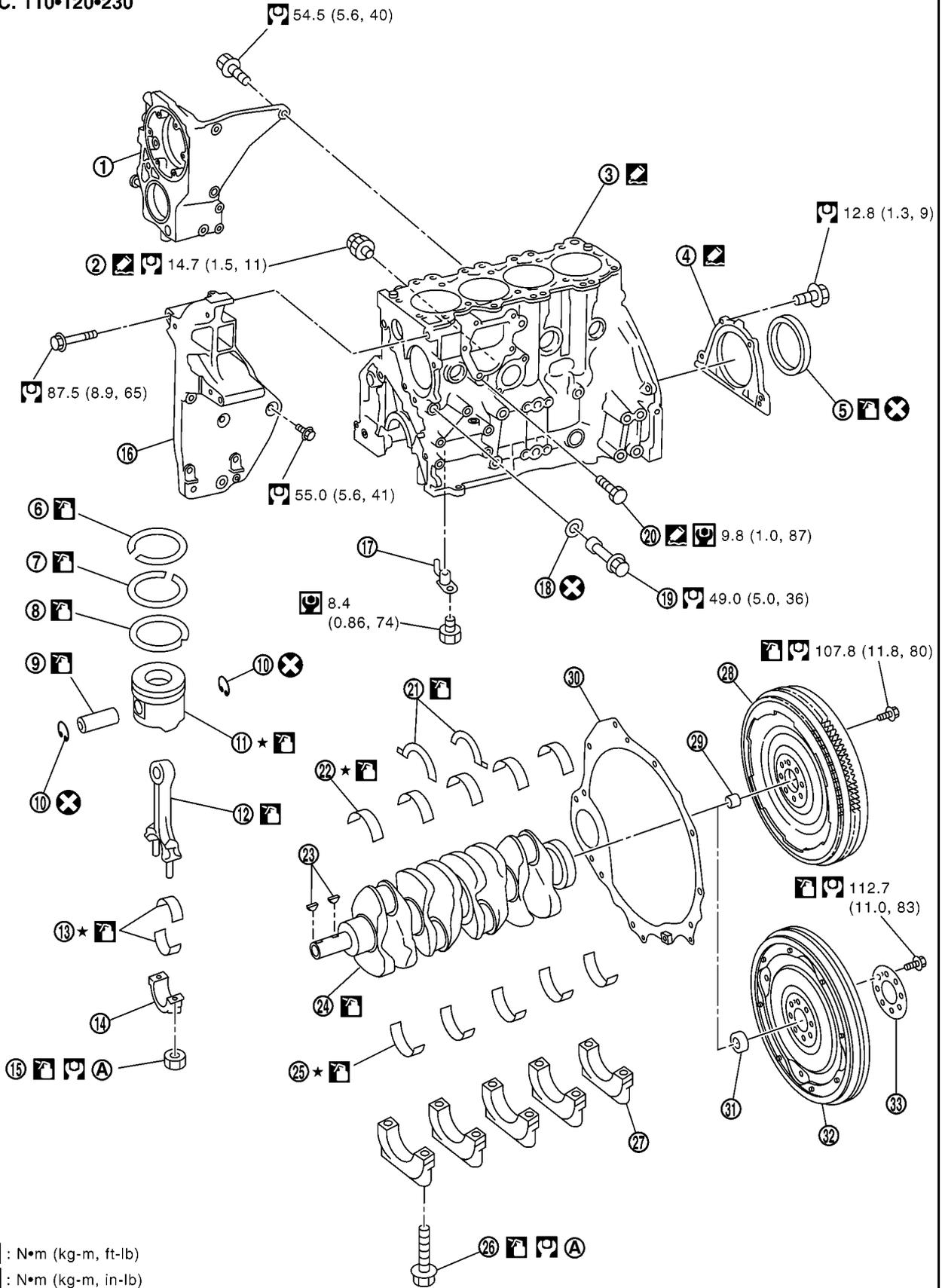
CYLINDER BLOCK

PFP:11010

Components

EBS01F54

SEC. 110•120•230



☐ : N•m (kg-m, ft-lb)
 ☐A : N•m (kg-m, in-lb)

PBIC3481E

CYLINDER BLOCK

- | | | |
|----------------------------------|--------------------------------|--------------------------------------|
| 1. Fuel pump bracket | 2. Oil pressure switch | 3. Cylinder block |
| 4. Rear oil seal retainer | 5. Rear oil seal | 6. Top ring |
| 7. Second ring | 8. Oil ring | 9. Piston pin |
| 10. Snap ring | 11. Piston | 12. Connecting rod |
| 13. Connecting rod bearing | 14. Connecting rod cap | 15. Connecting rod nut |
| 16. A/C compressor bracket | 17. Oil jet | 18. Copper washer |
| 19. Oil jet relief valve | 20. Drain plug | 21. Thrust bearing |
| 22. Main bearing upper | 23. Key | 24. Crankshaft |
| 25. Main bearing lower | 26. Main bearing cap bolt | 27. Main bearing cap |
| 28. Flywheel (M/T models) | 29. Pilot bushing (M/T models) | 30. Rear plate |
| 31. Pilot converter (A/T models) | 32. Drive plate (A/T models) | 33. Reinforcement plate (A/T models) |
- A. Refer to [EM-114](#).

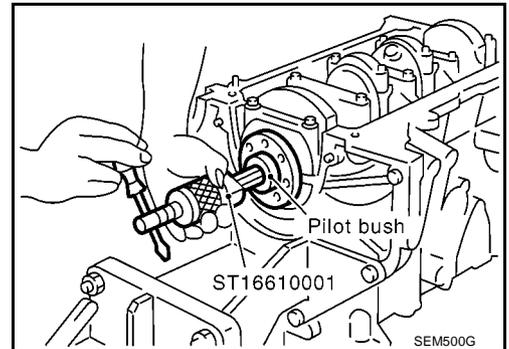
- Refer to [GI-10, "Components"](#) for symbol marks in the figure.

Disassembly and Assembly

DISASSEMBLY

EBS01E6E

- Remove engine from the vehicle. Refer to [EM-106, "ENGINE ASSEMBLY"](#).
- Remove clutch cover and disk. (M/T models) Refer to [CL-17, "CLUTCH DISC, CLUTCH COVER AND FLYWHEEL"](#).
- If they need to be replaced, replace pilot bush (M/T models) or pilot converter (A/T models).
 - Using the pilot bushing puller [SST], remove the pilot bush (M/T models) or pilot converter (A/T models) from rear end of crankshaft.

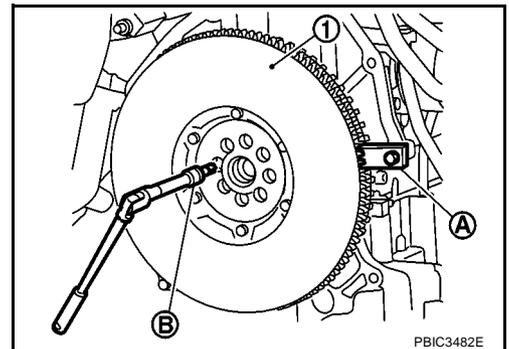


- Install engine to engine stand as follows.
 - Remove flywheel (M/T models) or drive plate (A/T models).
 - Secure ring gear with the ring gear stopper (A) [SST], then loosen mounting bolts with TORX socket (B) (commercial service tool) and remove them. As an alternative method hold crankshaft pulley with the pulley holder (commercial service tool) to remove flywheel (M/T models) or drive plate (A/T models).

1 : Flywheel (M/T models) or drive plate (A/T models)

A : KV10105630

B : TORX bit (size: T55)(M/T models) or TORX socket (size: E20)(A/T models)



CAUTION:

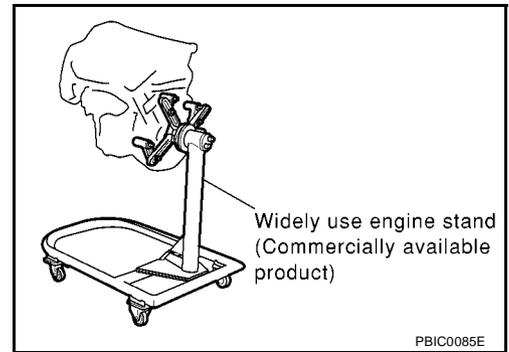
- Do not disassemble flywheel (M/T models) or drive plate (A/T models).
- Do not place flywheel (M/T models) or drive plate (A/T models) with signal plate facing down.
- When handling signal plate, take care not to damage or scratch it.
- Handle signal plate in a manner that prevents it from becoming magnetized.

CYLINDER BLOCK

- b. Hoist engine and install it to the engine stand (commercial service tool).

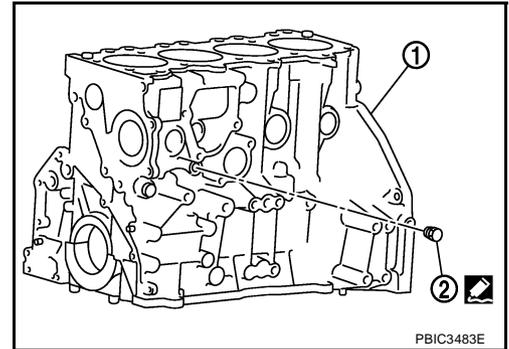
NOTE:

The figure shows an example of general-purpose engine stand that can hold mating surface of transmission with drive plate and rear plate removed.



5. Drain engine oil and engine coolant from inside engine. Refer to [LU-6, "Changing Engine Oil"](#) .
6. Drain engine coolant by removing drain plug from inside of engine.

- 1 : Cylinder block
2 : Drain plug



7. Remove the following parts and related parts. (Only major parts are listed.)
- Intake manifold (Refer to [EM-20, "INTAKE MANIFOLD"](#) .)
 - Turbocharger (Refer to [EM-28, "TURBO CHARGER"](#) .)
 - Exhaust manifold (Refer to [EM-34, "EXHAUST MANIFOLD"](#) .)
 - Rocker cover (Refer to [EM-56, "ROCKER COVER"](#) .)
 - Fuel injector (Refer to [EM-44, "INJECTION TUBE AND FUEL INJECTOR"](#) .)
 - Oil pan and oil strainer (Refer to [EM-36, "OIL PAN AND OIL STRAINER"](#) .)
 - Water pump (Refer to [CO-21, "WATER PUMP"](#) .)
 - Thermostat and water piping (Refer to [CO-23, "THERMOSTAT AND WATER PIPING"](#) .)
 - Secondary timing chain (Refer to [EM-73, "SECONDARY TIMING CHAIN"](#) .)
 - Primary timing chain (Refer to [EM-79, "PRIMARY TIMING CHAIN"](#) .)
 - Fuel pump (Refer to [EM-49, "FUEL PUMP"](#) .)
 - Vacuum pump (Refer to [EM-42, "VACUUM PUMP"](#) .)
 - Camshaft (Refer to [EM-59, "CAMSHAFT"](#) .)
 - Cylinder head (Refer to [EM-92, "CYLINDER HEAD"](#) .)
 - Oil cooler (Refer to [LU-11, "OIL COOLER"](#) .)
 - Accessory, accessory bracket and mount brackets
8. Remove fuel pump bracket.
9. Remove rear oil seal retainer.
- Insert a flat-bladed screwdriver between main bearing cap and rear oil seal retainer to remove retainer.
10. Remove rear oil seal from rear oil seal retainer. Refer to [EM-70, "OIL SEAL"](#) .
- Punch out with a flat-bladed screwdriver.

CAUTION:

Be careful not to damage rear oil seal retainer.

CYLINDER BLOCK

11. Remove piston and connecting rod assembly.

- Before removing piston and connecting rod assembly, check connecting rod side clearance. Refer to [EM-125, "CONNECTING ROD SIDE CLEARANCE"](#).

- a. Move crankshaft pin to be removed to approximately BDC.
- b. Remove connecting rod caps.
- c. Using the grip of a hammer, press the piston and connecting rod assembly out to cylinder head side.

CAUTION:

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

- When removing piston and connecting rod assembly, prevent the big end of connecting rod from interfering with oil jet.

12. Remove connecting rod bearings from connecting rods and caps.

- Keep them by cylinder to avoid confusion.

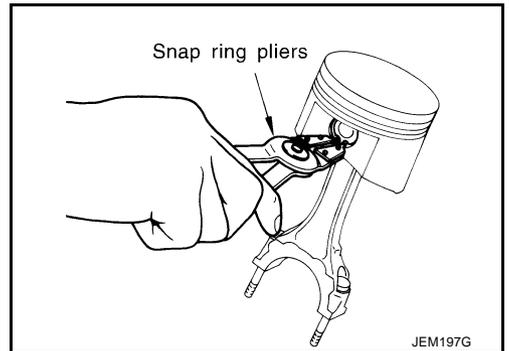
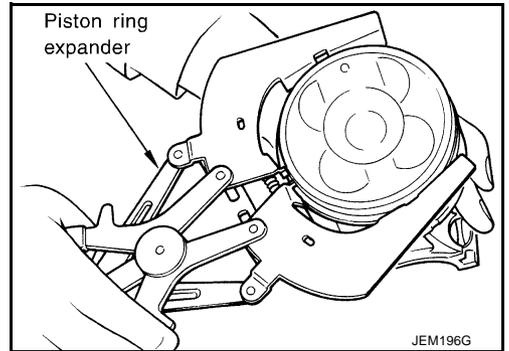
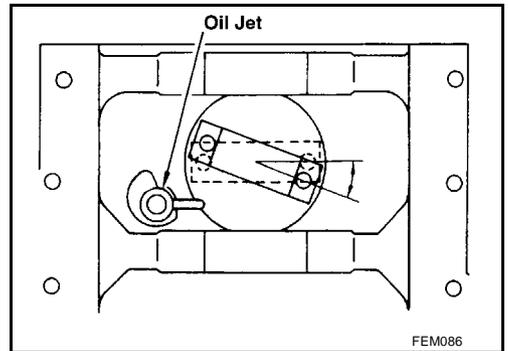
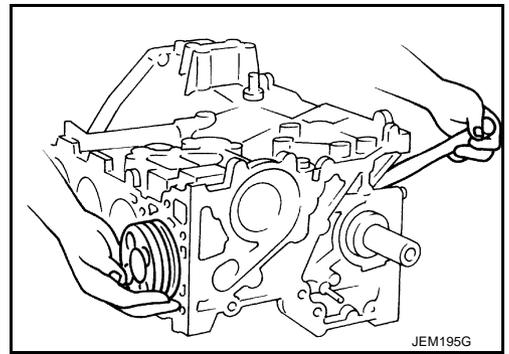
13. Remove piston rings from pistons using the piston ring expander (commercial service tool).

CAUTION:

- When removing, prevent pistons from being damaged.
- Do not expand piston rings excessively. This may damage piston rings.

14. Remove pistons from connecting rods.

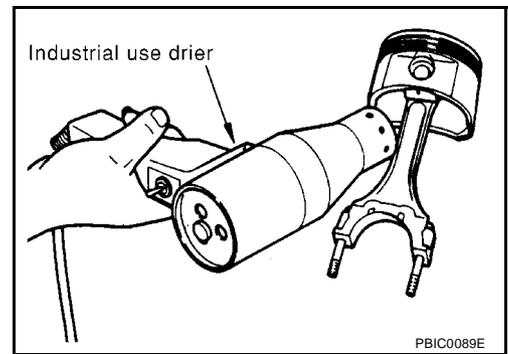
- a. Using the snap ring pliers, remove snap rings.



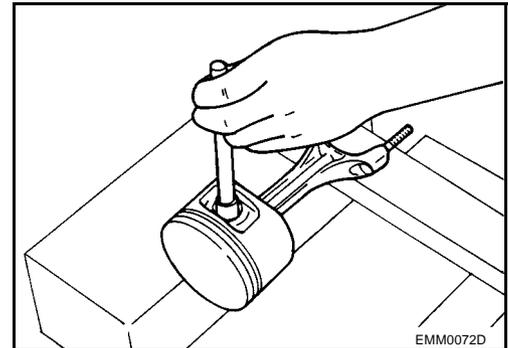
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CYLINDER BLOCK

- b. Using the industrial use dryer, heat pistons up to 60 to 70°C (140 to 158°F).

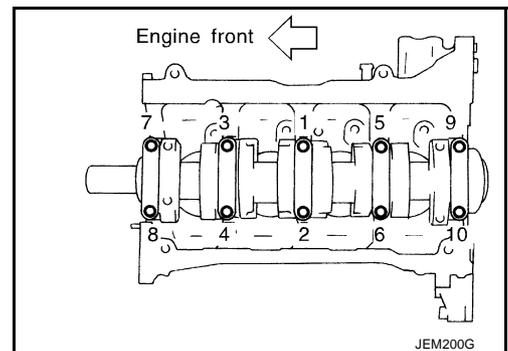


- c. Using rod with outer diameter of 26 mm (1.02 in), press piston pins out.



15. Remove main bearing cap bolts.

- With a TORX socket (size: E14, commercial service tool), loosen main bearing cap bolts in several stages in the reverse order of that shown in the figure and remove them.
- Before loosening main bearing cap bolts, measure crankshaft end play. Refer to [EM-124. "CRANKSHAFT END PLAY"](#).



16. Remove main bearing caps.

- Using main bearing cap bolts, remove by rocking bearing cap back and forth.

17. Remove crankshaft.

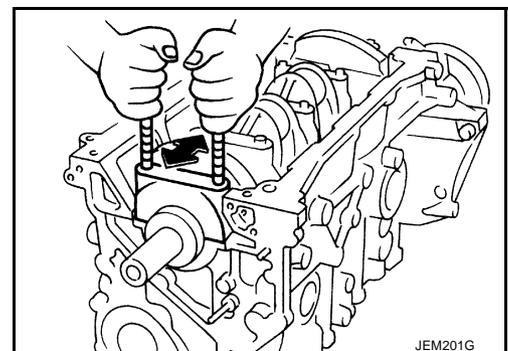
18. Remove main bearings and thrust bearings from cylinder block and main bearing caps.

CAUTION:

Check the correct installation locations of removed parts. Store them so they do not get mixed up.

19. Remove oil jet.

20. Remove oil jet relief valve.



ASSEMBLY

1. Blow air sufficiently to inside engine coolant passage, engine oil passage, crankcase and cylinder bore to remove foreign matter.

CAUTION:

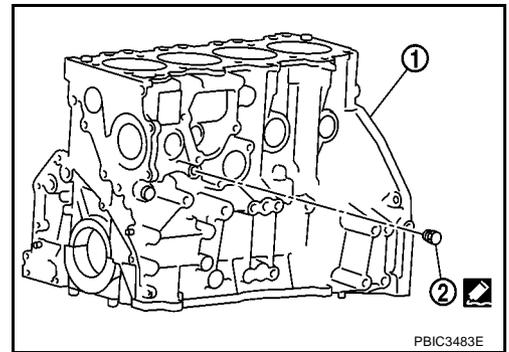
Use a goggles to protect your eye.

CYLINDER BLOCK

2. Install drain plug to cylinder block.

- 1 : Cylinder block
- 2 : Drain plug

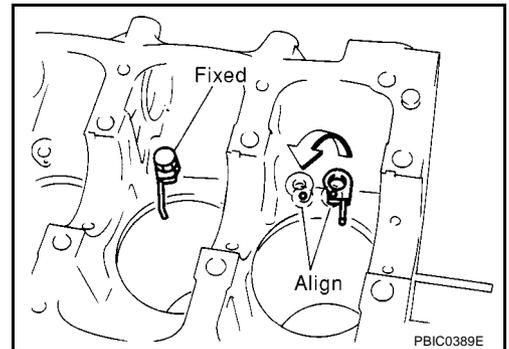
- Apply liquid gasket to drain plug.
Use Genuine Liquid Gasket or equivalent



3. Install oil jet relief valve.

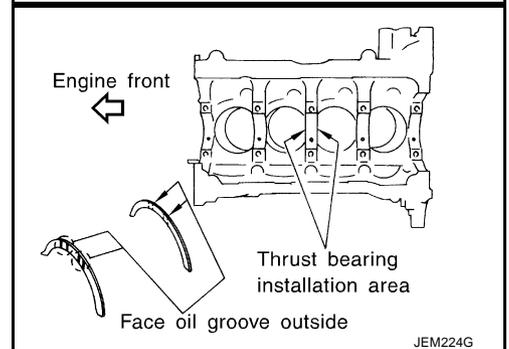
4. Install oil jet.

- Align knock pin on back of oil jet with hole on block when installing oil jet.



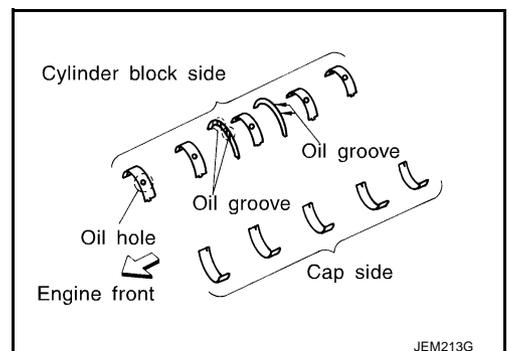
5. Install main bearings and thrust bearings.

- a. Remove contamination, dust and engine oil from bearing mounting positions on cylinder block and main bearing caps.
- b. Install thrust bearings on both sides of No. 3 housing on cylinder block.
 - Install thrust bearings with oil groove facing to crankshaft arm (outside).



c. Being careful with the direction, install main bearings.

- Install main bearings with the oil holes and grooves onto the cylinder block side, and those without oil holes and grooves onto the main cap side.
- While installing bearings, apply engine oil to bearing surfaces (inside). Do not apply engine oil to rear surfaces, but clean them completely.
- Align stopper notches on bearings to install them.
- Make sure that the oil holes on the cylinder block body are mated with the oil hole positions on the bearings.



6. Install crankshaft to cylinder block.

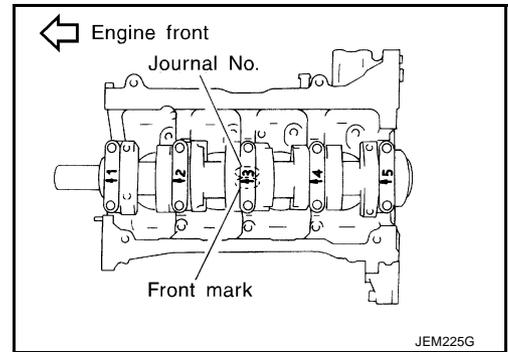
- Make sure crankshaft rotates smoothly by hand.

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CYLINDER BLOCK

7. Install main bearing caps.

- Identify main bearing caps by the punched mark. Install correctly matching the journal No. on the bearing cap and the journal with the front mark facing forward.
- Main bearing caps are commonly processed with the cylinder block. Therefore, caps and cylinder block should be replaced as a set.



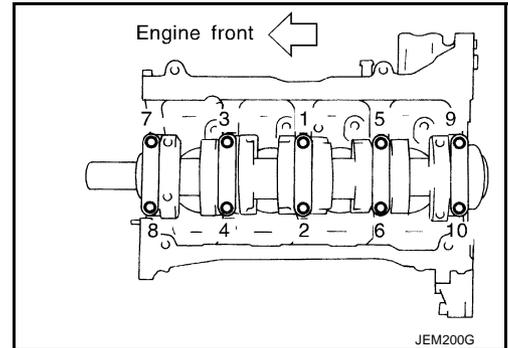
8. Check the main bearing cap bolts for deformation. Refer to [EM-133, "MAIN BEARING CAP BOLT DEFORMATION"](#).

9. With the TORX socket (size: E14, commercial service tool), tighten the main bearing cap bolts according to the following procedure:

- Apply engine oil to the threaded part and seat surface of each bolt.
- Tighten all bolts in numerical order shown in the figure.

 : 27.0 N·m (2.8 kg-m, 20 ft-lb)

c. Put alignment marks (with paint) on each bolt and the main bearing cap, all in the same direction. (When using a protractor)



d. Then, tighten 90 degrees. (angle tightening)

CAUTION:

Always use either the angle wrench [SST] or protractor during angular tightening. Avoid tightening based on visual checks alone.

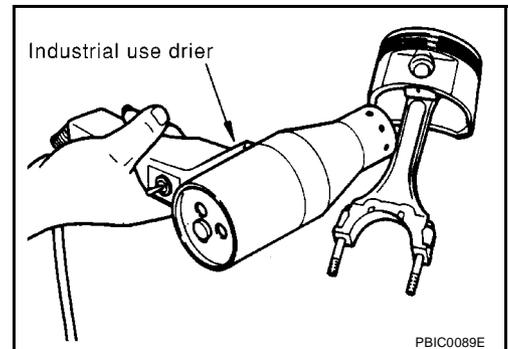
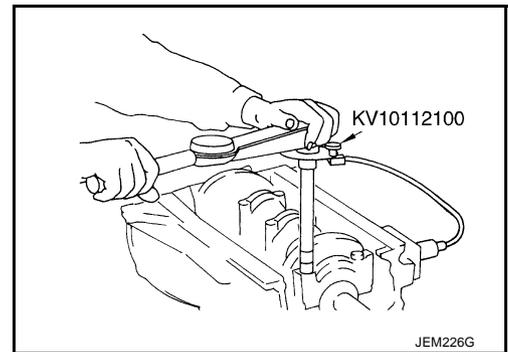
- After tightening bolts to specified torque, make sure that crankshaft rotates smoothly.
- Check crankshaft end play. Refer to [EM-124, "CRANKSHAFT END PLAY"](#).

10. Check the outer diameter of connecting rod bolts. Refer to [EM-133, "CONNECTING ROD BOLT DEFORMATION"](#).

11. Install piston to connecting rod.

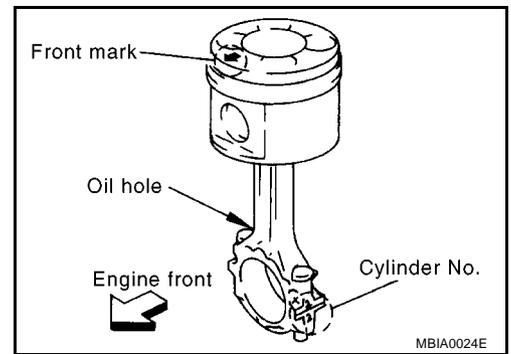
- Using the snap ring pliers, install snap rings to groove on piston rear side.
 - Fit snap ring correctly into grooves.
- Install pistons to connecting rods.

- Using the industrial use dryer, heat pistons up to approx. 60 to 70°C (140 to 158°F) until piston pin can be pressed down by finger touch. Then insert piston pin into piston and connecting rod from front side of piston toward rear.



CYLINDER BLOCK

- Assemble piston and connecting rod with front mark of piston head and cylinder No. stamped on connecting rod being positioned as shown in the figure.
- c. Install snap ring to front side of piston.
- Refer to above step a for precaution on snap ring installation.
 - After installation, check connecting rods for smooth movement.



12. Use the piston ring expander (commercial service tool) to install piston rings.

CAUTION:

When installing, prevent piston from being damaged.

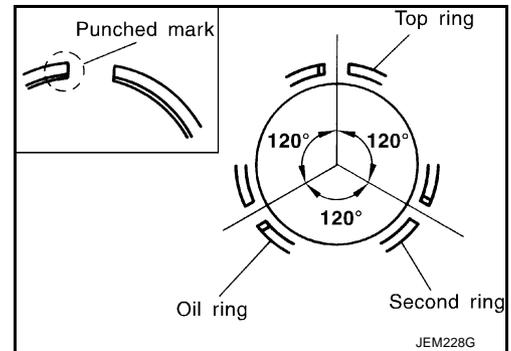
- Install top ring and second ring with punched mark surfaces facing upward.

Punched mark:

Top ring : RTOP

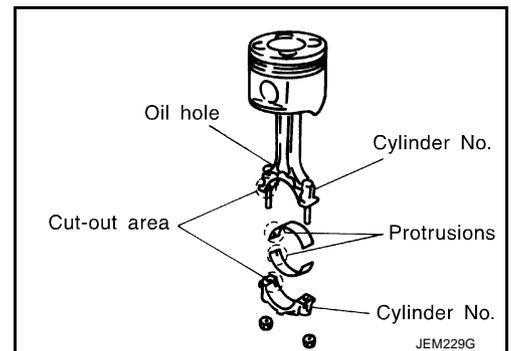
Second ring : R2ND

- Install rings so that three closed gap position 120 degrees apart one another.
- Closed gaps do not need to face in a specific directions, as long as each are positioned 120 degrees apart.



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

- While installing connecting rod bearing, apply engine oil to bearing surfaces (inside). Do not apply engine oil to rear surfaces, but clean them completely.
- Align protrusions on connecting rod bearings with connecting rod cut-outs to install connecting rod bearings.

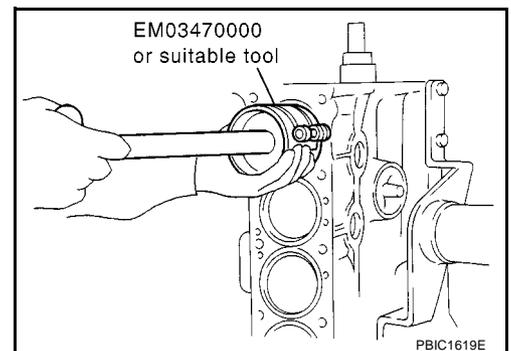


14. Install piston and connecting rod assembly to crankshaft.

- Move crankshaft pin to be assembled to BDC.
- Align cylinder position with cylinder No. on connecting rod to install piston and connecting rod assembly.
- Using the piston ring compressor [SST] or suitable tool, install piston and connecting rod assembly with front mark on piston head facing toward the front side of engine.

CAUTION:

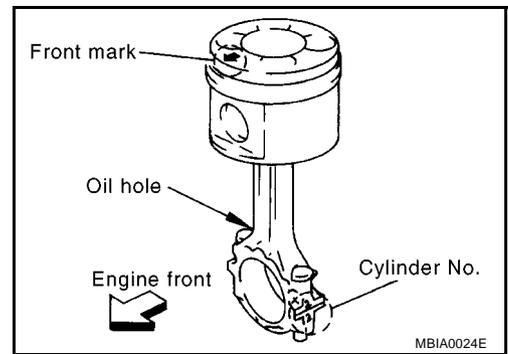
When installing piston and connecting rod assembly, prevent the big end of connecting rod from interfering with oil jet.



CYLINDER BLOCK

15. Install connecting rod caps and mounting nuts.

- Align cylinder No. stamped on connecting rod with that on cap to install connecting rod cap.
- Make sure that the front mark on connecting rod cap faces towards the front of the engine.



16. Tighten connecting rod nuts according to the following procedure:

a. Apply engine oil on bolt threads and seat surface of nuts.

b. Tighten bolts.

 : 29.4 N·m (3.0 kg-m, 22 ft-lb)

c. Loosen completely.

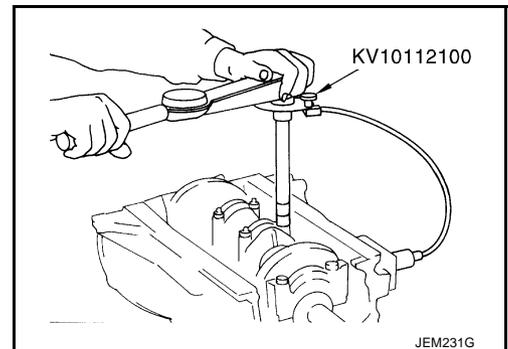
 : 0 N·m (0 kg-m, 0 in-lb)

d. Tighten bolts.

 : 19.6 N·m (2.0 kg-m, 14 ft-lb)

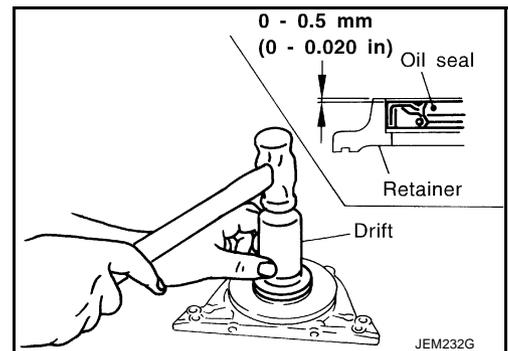
e. Tighten 120 degrees. (angle tightening)

- **Always use either the angle wrench [SST] or protractor during angular tightening. Avoid tightening based on visual checks alone.**
- After tightening nuts, make sure that crankshaft rotates smoothly.
- Check connecting rod side clearance. Refer to [EM-125](#). "[CONNECTING ROD SIDE CLEARANCE](#)".



17. Press fit rear oil seal into rear oil seal retainer.

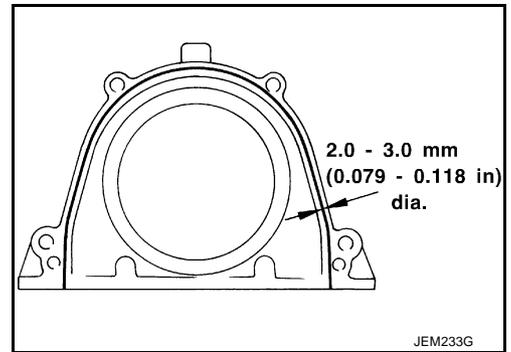
- Using the drift [105 mm (4.13 in) dia.], press fit so that the dimension is as specified in the figure.
- Avoid inclined fitting. Force fit perpendicularly.



CYLINDER BLOCK

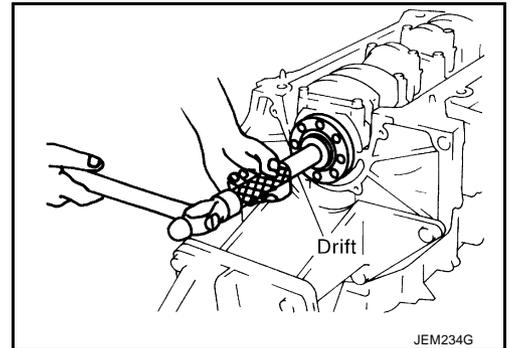
18. Install rear oil seal retainer to cylinder block.

- Apply new engine oil to the oil and dust seal lips.
- Apply liquid gasket to rear oil seal retainer using the tube presser [SST: WS39930000] as shown in the figure.
Use Genuine Liquid Gasket or equivalent.



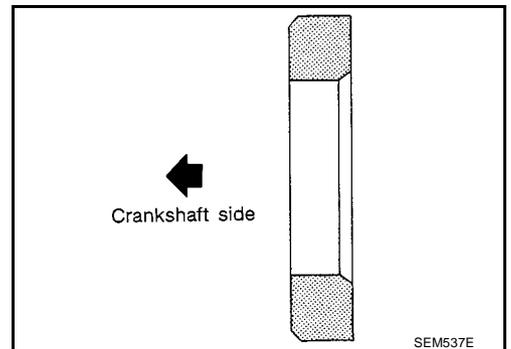
19. Press fit pilot bushing into crankshaft (M/T models).

- Using the drift with outer diameter of 19 mm (0.75 in), press fit pilot bushing until it stops.



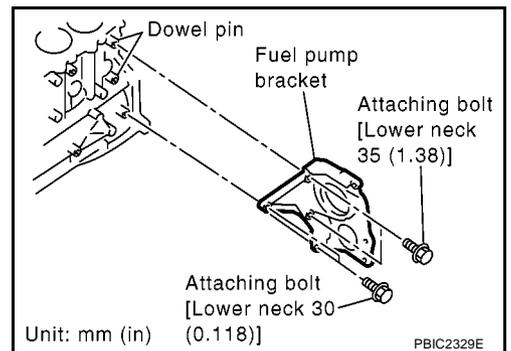
20. Press fit pilot converter into crankshaft (A/T models).

- Using the drift with outer diameter of 33 mm (1.30 in), press fit pilot converter until it stops.
- Press fit pilot converter with its chamfer facing crankshaft as shown in the figure.



21. Install fuel pump bracket.

- Align the bracket with the dowel pins on cylinder block to install.
- The two bolts used for dowel pins have a longer shanks than the other two.



22. Install parts to engine in the reverse order of disassembly.

23. Remove engine from engine stand in the reverse order of assembly.

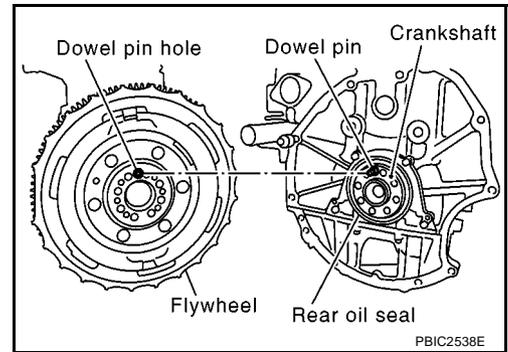
24. Install flywheel (M/T models).

CYLINDER BLOCK

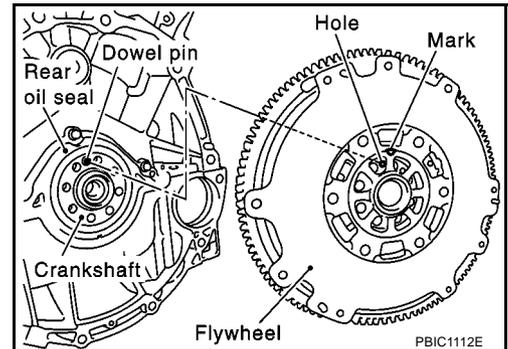
- When installing flywheel to crankshaft, be sure to correctly align crankshaft side dowel pin and flywheel side dowel pin hole.

CAUTION:

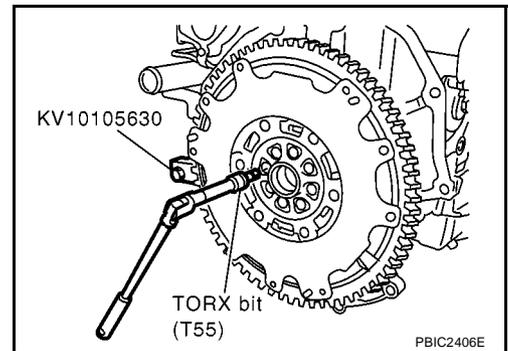
If these are not aligned correctly, engine runs roughly and “MI” turns on.



- There is a mating mark on the clutch cover side of flywheel. Refer it during installation.



- Holding ring gear with ring gear stopper [SST], tighten securing bolts with TORX socket (size: T55, commercial service tool).
- Tighten bolts uniformly in a crisscross manner.



- If these are not aligned correctly, engine runs roughly and “MI” turns on.

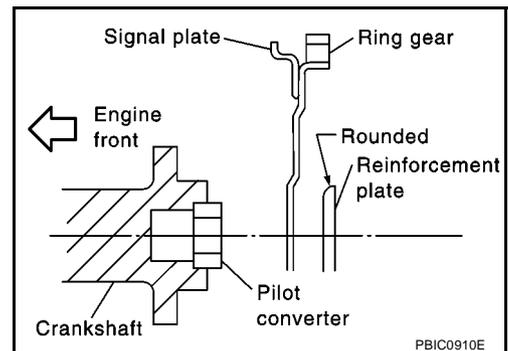
25. Install drive plate (A/T models).

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

CAUTION:

If these are not aligned correctly, engine runs roughly and “MI” turns on.

- Install drive plate and reinforcement plate as shown in the figure.
- Holding ring gear with ring gear stopper [SST: KV10105630], tighten securing bolts with TORX socket (size: E20) (commercial service tool).
- Tighten bolts uniformly in a crisscross manner.



26. Install in the reverse order of removal.

CYLINDER BLOCK

How to Select Piston and Bearing

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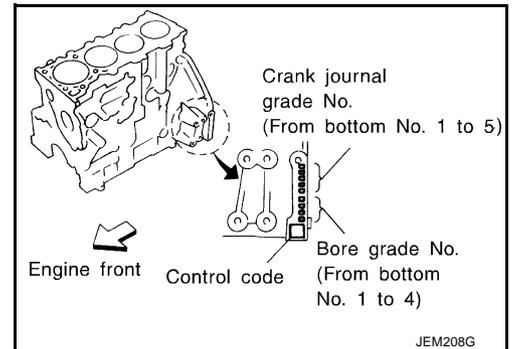
Selection points	Selection parts	Selection items	Selection methods
Between cylinder block to crankshaft	Main bearing	Main bearing grade (bearing thickness)	Determined by match of cylinder block bearing housing grade (inner diameter of housing) and crankshaft journal grade (outer diameter of journal)
Between crankshaft to 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.
Between cylinder block to piston	Piston and piston pin assembly The piston is available together with piston pin 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.

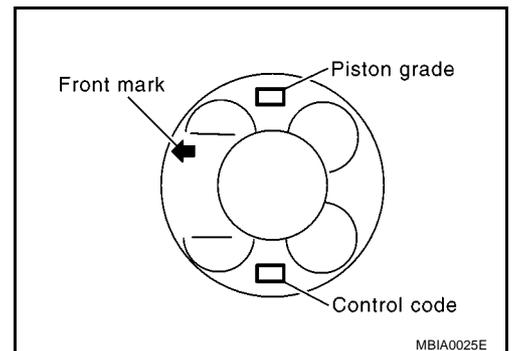
HOW TO SELECT PISTON

When Using New Cylinder Block

1. Identify the cylinder bore grade (No. 1, 2, or 3) on LH surface at the rear of cylinder block.
2. Select piston of the same grade.
 - The part No. of piston is specified together with piston pin as an assembly.



When Re-using an Old Cylinder Block



1. Measure cylinder bore inner diameter. Refer to [EM-129, "Cylinder Bore Inner Diameter"](#).
2. Referring to "Cylinder bore inner diameter" in "Piston Selection Table", determine the bore grade.
3. Select piston of the same grade.

Piston Selection Table

Unit: mm (in)

Grade (punched)	1	2	3

CYLINDER BLOCK

Cylinder bore inner diameter	89.000 - 89.010 (3.5039 - 3.5043)	89.010 - 89.020 (3.5043 - 3.5047)	89.020 - 89.030 (3.5047 - 3.5051)
Piston outer diameter	88.928 - 88.942 (3.5011 - 3.5016)	88.938 - 88.952 (3.5015 - 3.5020)	88.948 - 88.962 (3.5019 - 3.5024)

NOTE:

Piston is available together with piston pin as an assembly.

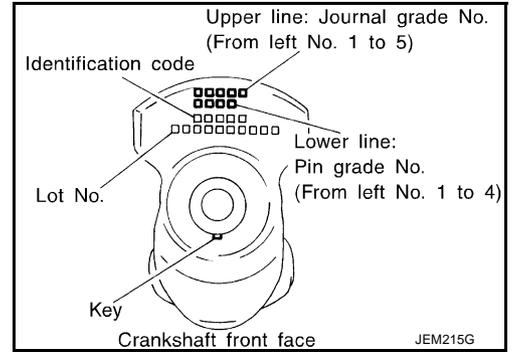
HOW TO SELECT CONNECTING ROD BEARING

When Using New Crankshaft and Connecting Rod

1. Identify the pin diameter grade (No. 0, 1, or 2) on front surface of crankshaft.
2. Select connecting rod bearings of the same grade.

NOTE:

There is no grading for the inner diameter of the big end of the connecting rod.



When Re-using the Removed Crankshaft and Connecting Rod

1. Measure the inner diameter of the big end of connecting rod and make sure it is within the specified range. Refer to [EM-127, "CONNECTING ROD BIG END INNER DIAMETER"](#).
2. Measure the outer diameter of the crankshaft pin. Refer to [EM-130, "CRANKSHAFT PIN JOURNAL DIAMETER"](#).
3. Determine the crankshaft pin grade by comparing the measurement with the values under the column "Crankshaft pin outer diameter" in "Selection Table of connecting Rod Bearing".
4. Choose bearings of the same grade.

Selection Table of connecting Rod Bearing

Unit: mm (in)

Connecting rod big end inner diameter	55.000 - 55.013 (2.1654 - 2.1659)
---------------------------------------	-----------------------------------

Unit: mm (in)

Crankshaft pin outer diameter	Grade (Mark)	Dimension (Bearing thickness range)	Bearing grade No.	Color
51.968 - 51.974 (2.0460 - 2.0462)	0	1.492 - 1.496 (0.0587 - 0.0589)	STD 0	Black
51.961 - 51.968 (2.0457 - 2.0460)	1	1.496 - 1.500 (0.0589 - 0.0591)	STD 1	Brown
51.954 - 51.961 (2.0454 - 2.0457)	2	1.500 - 1.504 (0.0591 - 0.0592)	STD 2	Green

Under Size Bearing Usage

- If bearing clearance is out of the specifications for connecting rod bearings in standard size, use under size bearings.
- When using under size bearings, measure bearing inner diameter with bearing installed, and grind crankshaft pins to adjust clearance to specification.

Connecting Rod Bearing Under Size List

Unit: mm (in)

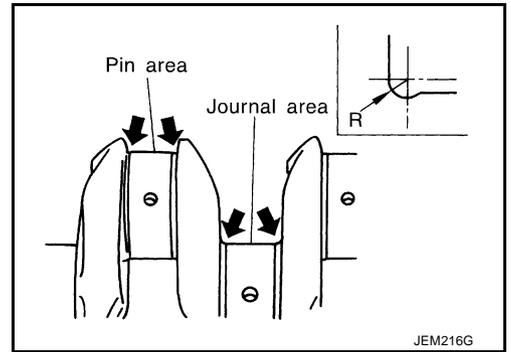
Size	Thickness
US 0.08 (0.0031)	1.536 - 1.540 (0.0605 - 0.0606)
US 0.12 (0.0047)	1.556 - 1.560 (0.0613 - 0.0614)
US 0.25 (0.0098)	1.621 - 1.625 (0.0638 - 0.0640)

CYLINDER BLOCK

CAUTION:

When grinding the crankshaft pin to use an under size bearing, avoid damaging the fillet R.

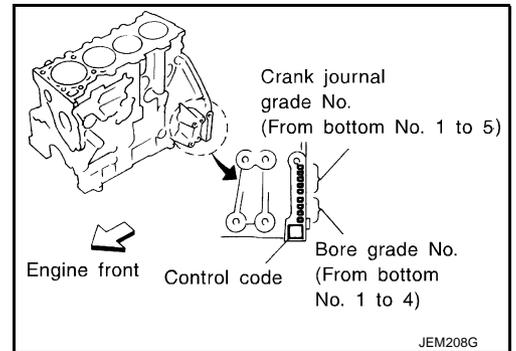
Standard dimension R : 1.5 - 1.7 mm (0.0591 - 0.0669 in)



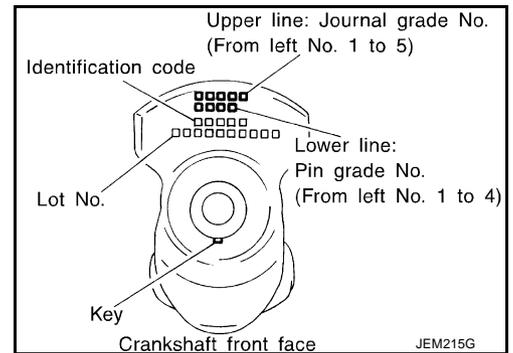
HOW TO SELECT MAIN BEARING

When Using New Cylinder Block and Crankshaft

1. Identify the crank journal grade (No. 0, 1, or 2) on LH surface at the rear of the cylinder block, and locate the applicable grade on the "Grade" row in the "Main Bearing Grade Table".



2. Identify the journal grade (No. 0, 1, or 2) on the front surface of crankshaft, and locate the applicable grade under the "Grade" column in the "Main Bearing Grade Table".



3. The main bearing to be used (STD 0 to STD 4) can be located in the cell where the row and column cross.

When Re-using Removed Cylinder Block and Crankshaft

1. Measure the inner diameter of cylinder block main bearing housing. Refer to [EM-128, "MAIN BEARING HOUSING INNER DIAMETER"](#).
2. Locate the applicable cell where the measurement falls, on "Inner diameter of Cylinder block main bearing housing" row in the "Main Bearing Grade Table".
3. Measure the outer diameter of crankshaft journal. Refer to [EM-130, "CRANKSHAFT MAIN JOURNAL DIAMETER"](#).
4. Locate the applicable cell where the measurement falls, under "Crankshaft journal outer diameter" column in the "Main Bearing Grade Table".
5. The main bearing to be used (STD 0 to STD 4) can be located in the cell where the row and column cross.

Main Bearing Grade Table

Unit: mm (in)

Inner diameter of Cylinder block main bearing housing		66.654 - 66.663 (2.6242 - 2.6245)	66.663 - 66.672 (2.6245 - 2.6249)	66.672 - 66.681 (2.6249 - 2.6252)
Crankshaft journal outer diameter	Grade (punched)	0	1	2

CYLINDER BLOCK

62.967 - 62.975 (2.4790 - 2.4793)	0	<ul style="list-style-type: none"> ● Bearing grade No. ● Bearing thickness ● Oil clearance ● Identification color 	STD 0 1.816 - 1.820 (0.0715 - 0.0717) 0.039 - 0.066 (0.0015 - 0.0026) Black	STD 1 1.820 - 1.824 (0.0717 - 0.0718) 0.039 - 0.066 (0.0015 - 0.0026) Brown	STD 2 1.824 - 1.828 (0.0718 - 0.0720) 0.039 - 0.066 (0.0015 - 0.0026) Green
62.959 - 62.967 (2.4787 - 2.6790)	1	<ul style="list-style-type: none"> ● Bearing grade No. ● Bearing thickness ● Oil clearance ● Identification color 	STD 1 1.820 - 1.824 (0.0717 - 0.0718) 0.039 - 0.066 (0.0015 - 0.0026) Brown	STD 2 1.824 - 1.828 (0.0718 - 0.0720) 0.039 - 0.066 (0.0015 - 0.0026) Green	STD 3 1.828 - 1.832 (0.0720 - 0.0721) 0.039 - 0.066 (0.0015 - 0.0026) Yellow
62.951 - 62.959 (2.4784 - 2.4787)	2	<ul style="list-style-type: none"> ● Bearing grade No. ● Bearing thickness ● Oil clearance ● Identification color 	STD 2 1.824 - 1.828 (0.0718 - 0.0720) 0.039 - 0.066 (0.0015 - 0.0026) Green	STD 3 1.828 - 1.832 (0.0720 - 0.0721) 0.039 - 0.066 (0.0015 - 0.0026) Yellow	STD 4 1.832 - 1.836 (0.0721 - 0.0723) 0.039 - 0.066 (0.0015 - 0.0026) Blue

Under Size Bearing Usage

- If bearing clearance is out of the specifications for main bearings in standard size, use under size bearings.
- When using under size bearings, measure bearing inner diameter with bearing installed, and grind crankshaft journals to adjust clearance to the specification.

Main Bearing Under Size List

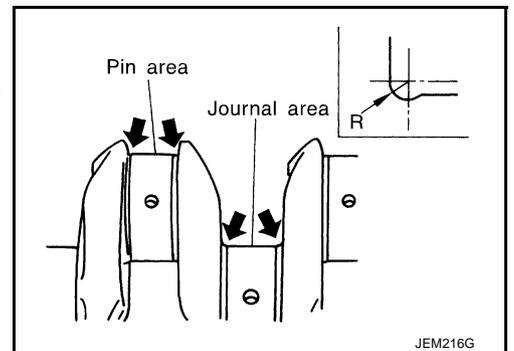
Unit: mm (in)

Size	Thickness
US 0.25(0.0098)	1.949 - 1.953 (0.0767 - 0.0769)

CAUTION:

When grinding crank journals to use under size bearings, keep corners radius of fillet R. (All journals)

Standard dimension R : 1.5 - 1.7 mm (0.0591 - 0.0669 in)



Inspection After Disassembly CRANKSHAFT END PLAY

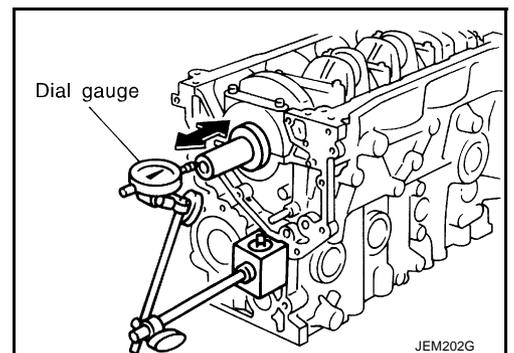
EBS01E6G

- Using dial gauge, measure crankshaft travel amount by moving the crankshaft forward or backward.

Standard : 0.10 - 0.25 mm (0.0039 - 0.0098 in)

Limit : 0.30 mm (0.0118 in)

- If the value exceeds the limit, replace thrust bearings with new ones and measure again.
If the measurement exceeds the limit again, replace crankshaft with a new one.



CYLINDER BLOCK

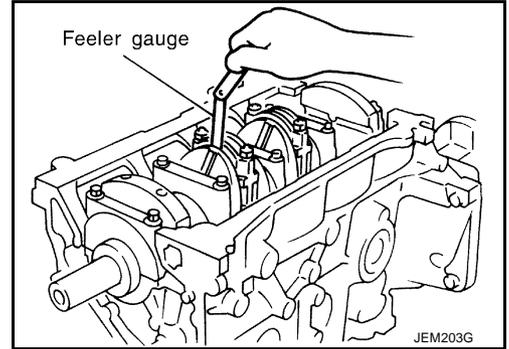
CONNECTING ROD SIDE CLEARANCE

- Using feeler gauge, measure side clearance between connecting rod and crankshaft arm.

Standard : 0.20 - 0.35 (0.0079 - 0.0138 in)

Limit : 0.40 mm (0.0157 in)

- If measured value exceeds the limit, replace connecting rod and repeat measurement.
If measured value still exceeds the limit, replace crankshaft.

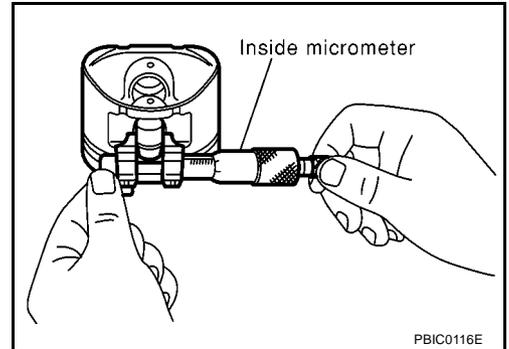


PISTON TO PISTON PIN CLEARANCE

Piston Pin Bore Diameter

Using inside micrometer, measure piston pin bore diameter.

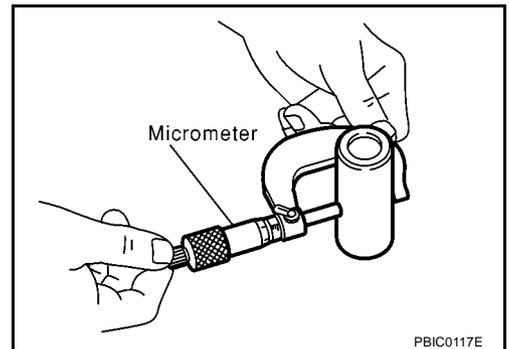
Standard : 28.003 - 28.009 mm (1.1025 - 1.1027 in)



Piston Pin Outer Diameter

Using micrometer, measure piston pin outer diameter.

Standard : 27.995 - 28.000 mm (1.1022 - 1.1024 in)



Calculation of Piston to Piston Pin Clearance

(Piston pin clearance) = (Piston pin bore diameter) – (Piston pin outer diameter)

Standard : 0.003 - 0.014 mm (0.0001 - 0.0006 in)

- If out of the standard, replace piston/piston pin assembly.

NOTE:

Piston is available together with piston pin as assembly.

A
EM
C
D
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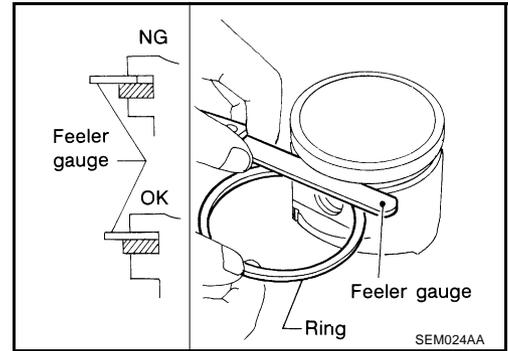
CYLINDER BLOCK

PISTON RING SIDE CLEARANCE

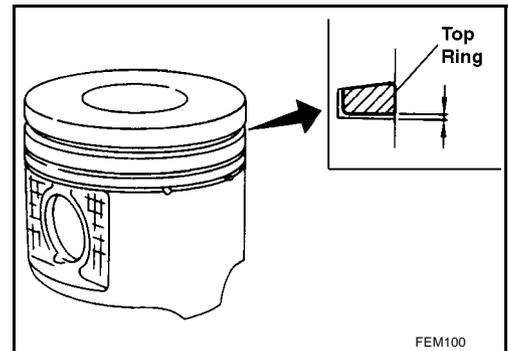
- Using feeler gauge, measure the side clearance between piston ring and piston ring groove.

Unit: mm (in)

Item	Standard	Limit
Top ring	0.050 - 0.090 (0.0020 - 0.0035)	0.2 (0.008)
2nd ring	0.050 - 0.090 (0.0020 - 0.0035)	0.1 (0.004)
Oil ring	0.030 - 0.070 (0.0012 - 0.0028)	—



- Align top ring and external surface of piston. Measure lower side clearance of top ring with top ring pressed onto upper side of ring groove.
- If side clearance exceeds the limit, replace piston ring.
- Check clearance again. If side clearance still exceeds the limit, replace piston.

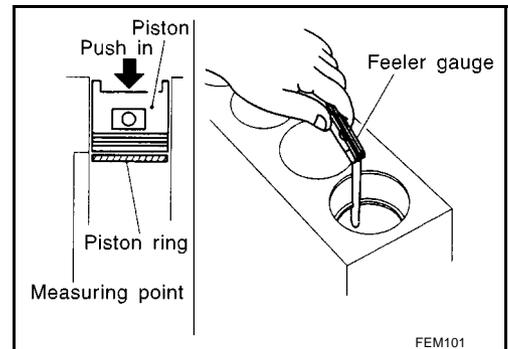


PISTON RING END GAP

- Make sure that cylinder bore diameter is within the specifications. Refer to [EM-129, "PISTON TO CYLINDER BORE CLEARANCE"](#).
- 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 feeler gauge.

Unit: mm (in)

Item	Standard	Limit
Top ring	0.21 - 0.28 (0.0083 - 0.0110)	1.0 (0.039)
2nd ring	0.32 - 0.47 (0.0126 - 0.0185)	
Oil ring	0.30 - 0.55 (0.0118 - 0.0217)	

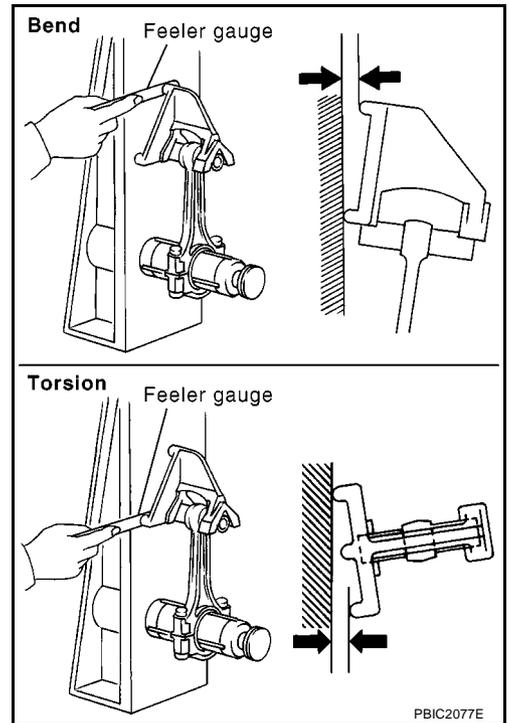


- If out of the limit, replace piston ring. If gap still exceeds the limit even with a new ring, re-bore cylinder and use oversized piston and piston ring. Refer to [EM-129, "PISTON TO CYLINDER BORE CLEARANCE"](#).

CYLINDER BLOCK

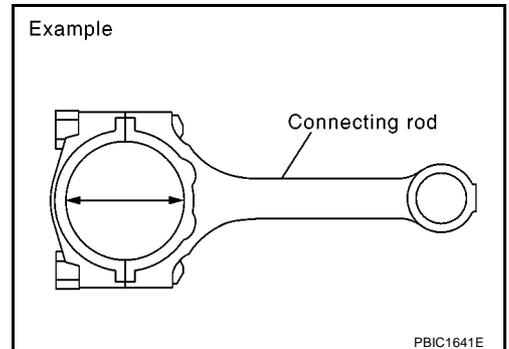
CONNECTING ROD BEND AND TORSION

- Use connecting rod aligner to check bend and torsion.
 - Bend limit : 0.12 mm (0.0047 in)/100 mm (3.94 in)**
 - Torsion limit : 0.12 mm (0.0047 in)/100 mm (3.94 in)**
- If it exceeds the limit, replace connecting rod assembly.



CONNECTING ROD BIG END INNER DIAMETER

- Install connecting rod caps without connecting rod bearings and tighten connecting rod nuts to the specified torque. Refer to [EM-114, "ASSEMBLY"](#).
- Using inside micrometer, measure connecting rod big end inner diameter.
 - Standard : 55.000 - 55.013 mm (2.1654 - 2.1659 in)**
- If out of the standard, replace connecting rod.

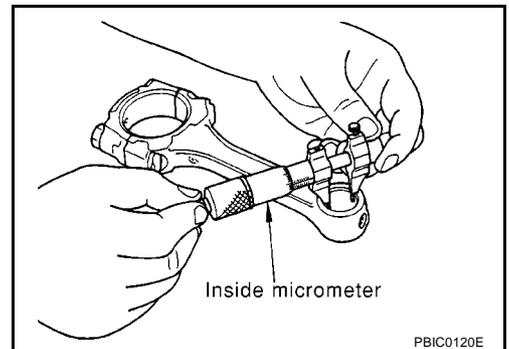


CONNECTING ROD BUSHING OIL CLEARANCE

Connecting Rod Bushing Inner Diameter

Use inside micrometer to measure bushing inner diameter.

Standard : 28.026 - 28.038 mm (1.1034 - 1.1039 in)

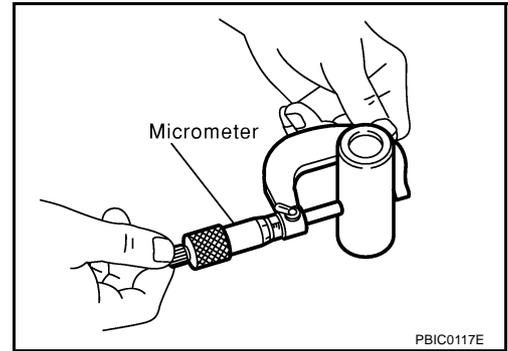


CYLINDER BLOCK

Piston Pin Outer Diameter

Use micrometer to measure piston pin outer diameter.

Standard : 27.995 - 28.000 mm (1.1022 - 1.1024 in)



Calculation of Connecting Rod Bushing Clearance

(Connecting rod bushing clearance) = (Connecting rod bushing inner diameter) – (Piston pin outer diameter)

Standard : 0.026 - 0.043 mm (0.0010 - 0.0017 in)

Limit : 0.057 mm (0.0022 in)

- If it exceeds the limit, replace connecting rod and/or piston and piston pin assembly. Refer to [EM-122, "HOW TO SELECT CONNECTING ROD BEARING"](#) and/or [EM-121, "HOW TO SELECT PISTON"](#).

CYLINDER BLOCK TOP SURFACE DISTORTION

- Using scraper, remove gasket installed onto cylinder block surface. Remove contamination such as engine oil, scale, and carbon.

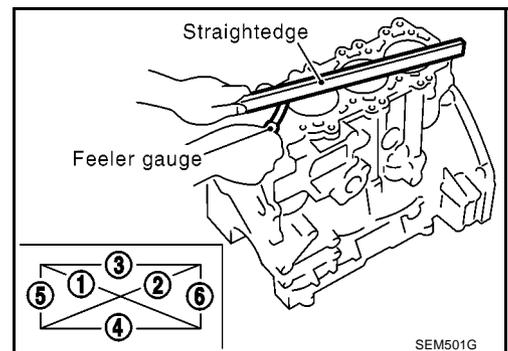
CAUTION:

Keep broken pieces of gasket clear of engine oil and engine coolant passages.

- Use straightedge and feeler gauge to check block upper surface for six distortion.

Limit : 0.1 mm (0.004 in)

- If it exceeds the limit, replace cylinder block.



MAIN BEARING HOUSING INNER DIAMETER

- Without installing main bearings, install main bearing caps, and tighten bolts to the specified torque. Refer to [EM-114, "ASSEMBLY"EM-114, "ASSEMBLY"](#).

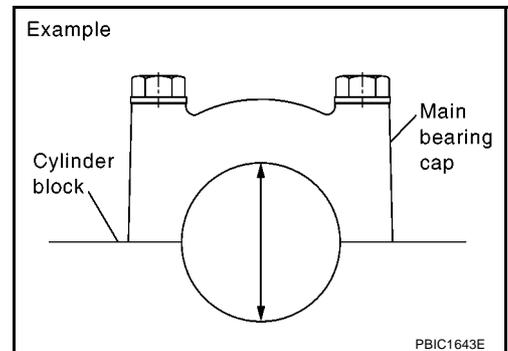
- Measure the inner diameter of main bearing housing with a bore gauge.

Standard : 66.654 - 66.681 mm (2.6242 - 2.6252 in)

- If the measurement is out of the standard, replace cylinder block and main bearing caps.

NOTE:

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



CYLINDER BLOCK

PISTON TO CYLINDER BORE CLEARANCE

Cylinder Bore Inner Diameter

- Using bore gauge, measure cylinder inner diameters at six positions; top, middle, and bottom (A, B, C) in 2 directions (X, Y).

Cylinder bore inner diameter

: 89.000 – 89.030 mm (3.5039 – 3.5051 in)

Wear limit

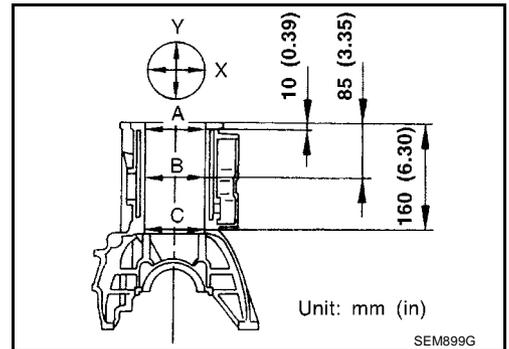
: 0.07 mm (0.028 in)

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

: 0.015 mm (0.0006 in)

Taper limit (Difference between A and C)

: 0.010 mm (0.0004 in)



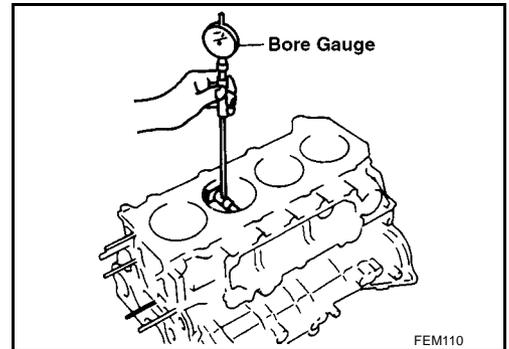
- If the measured value exceeds the limit, or if there are scratches and/or seizure on the cylinder inner wall, hone or bore the inner wall.
- Oversize piston is provided. When using oversize piston, hone the cylinder so that the clearance between piston and cylinder satisfies the standard.

CAUTION:

If oversize piston is used, use it for all cylinders with oversize piston rings.

Oversize (OS) : 0.25 mm (0.0098 in)

: 0.50 mm (0.0197 in)



Piston Outer Diameter

Use micrometer to measure piston outer diameter.

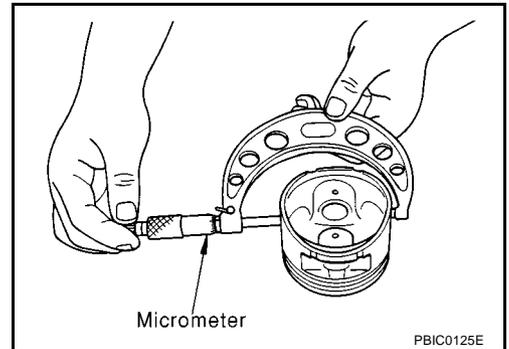
Piston outer diameter

Measurement position : 11.0 mm (0.43 in)
Distance from the bottom

Standard : 88.928 – 88.962 mm
(3.5011 – 3.5024 in)

0.25 (0.0098) O/S : 89.188 – 89.202
(3.5113 – 3.5119 in)

0.50 (0.0197) O/S : 89.438 – 89.452
(3.5212 – 3.5217 in)



Calculation of Piston to Cylinder Bore Clearance

- Calculate using piston outer diameter and cylinder bore inner diameter (direction X, position B).
(Clearance) = (Cylinder bore inner diameter) – (Piston outer diameter)

Specifications at room temperature [20°C (68°F)]:

Standard : 0.058 - 0.082 mm (0.0023 - 0.0032 in)

- If it exceeds the limit, replace piston and piston pin assembly. Refer to [EM-121, "HOW TO SELECT PISTON"](#).

Reboring Cylinder Bore

- Determine the cylinder bore size by adding piston-to-cylinder bore clearance to piston diameter.

Rebore size calculation:

$$D = A + B - C$$

Where,

D: Bored diameter

CYLINDER BLOCK

A: Piston outer diameter as measured

B: Piston-to-cylinder bore clearance

C: Honing allowance 0.02 mm (0.0008 in)

2. Install main bearing caps and tighten bolts to the specified torque. Refer to [EM-114, "ASSEMBLY"](#) . This will prevent distortion of cylinder bores.
3. Cut cylinder bore.

NOTE:

- 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 at a time.

4. Hone cylinders to obtain the specified piston-to-cylinder bore clearance.

5. Measure finished cylinder bore for the out-of-round and taper.

NOTE:

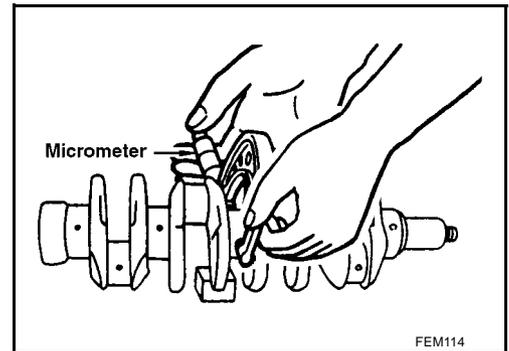
- Measurement should be done after cylinder bore cools down.

CRANKSHAFT MAIN JOURNAL DIAMETER

- Use micrometer to measure crankshaft main journal diameter.

Standard : 62.951 - 62.975 mm (2.4784 - 2.4793 in)

- If out of the standard, measure the main bearing oil clearance. then use the undersize bearing. Refer to [EM-132, "MAIN BEARING OIL CLEARANCE"](#) .

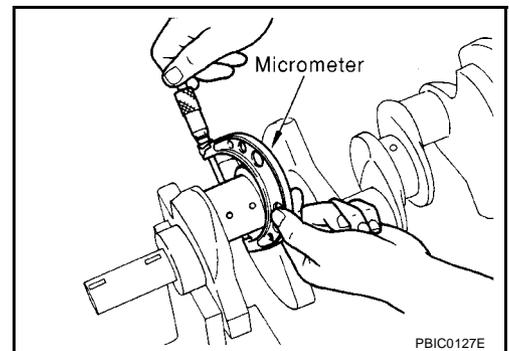


CRANKSHAFT PIN JOURNAL DIAMETER

- Use micrometer to measure crankshaft pin journal diameter.

Standard : 51.954 - 51.974 mm (2.0454 - 2.0462 in)

- If out of the standard, measure the connecting rod bearing oil clearance. then use the undersize bearing. Refer to [EM-131, "CONNECTING ROD BEARING OIL CLEARANCE"](#) .



CRANKSHAFT OUT-OF-ROUND AND TAPER

- Using micrometer, measure each journal and pin at four points shown in the figure.
- Out-of-round value is indicated by difference in dimensions between directions X and Y at points A and B.
- Taper value is indicated by difference in dimensions between points A and B in directions X and Y.

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

Standard : 0.003 mm (0.0001 in)

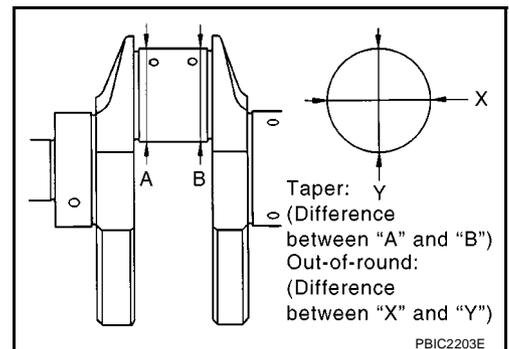
Limit : 0.005 mm (0.0002 in)

Taper: (Difference between A and B)

Standard : 0.003 mm (0.0001 in)

Limit : 0.005 mm (0.0002 in)

- If the measured value exceeds the limit, correct or replace crankshaft.

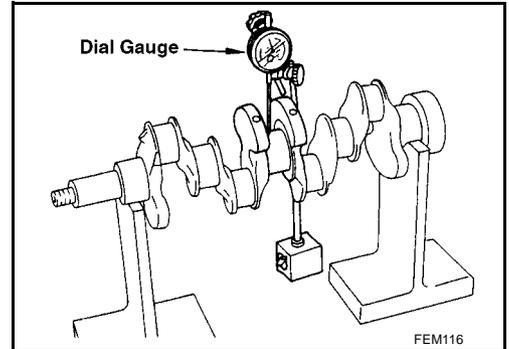


CYLINDER BLOCK

- If corrected, measure the bearing oil clearance of the corrected journal and/or pin. Then select the main bearing or connecting rod bearing. Refer to [EM-132, "MAIN BEARING OIL CLEARANCE"](#) and/or [EM-131, "CONNECTING ROD BEARING OIL CLEARANCE"](#).

CRANKSHAFT RUNOUT

- Place V-block onto surface plate to support journals at both ends of crankshaft.
 - Position dial gauge vertically onto No. 3 journal.
 - Rotate crankshaft to read needle movement on dial gauge. (Total indicator reading)
- Standard : 0.05 mm (0.0020 in)**
Limit : 0.10 mm (0.0039 in)
- If it exceeds the limit, replace crankshaft.



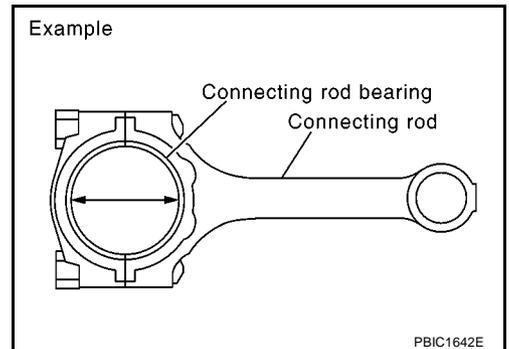
CONNECTING ROD BEARING OIL CLEARANCE

Method by Measurement

- Install connecting rod bearings to connecting rod and cap, and tighten connecting nuts to the specified torque. Refer to [EM-114, "ASSEMBLY"](#). Use inside micrometer to measure connecting rod bearing inner diameter. (Bearing clearance) = (Connecting rod bearing inner diameter) – (Crankshaft pin outer diameter)

Standard : 0.039 - 0.070 mm (0.0015 - 0.0028 in)

- If clearance exceeds the standard, select proper connecting rod bearing according to connecting rod big end diameter and crankshaft pin outer diameter to obtain specified bearing oil clearance. Refer to [EM-122, "HOW TO SELECT CONNECTING ROD BEARING"](#).



Method of Using Plastigage

- Remove contamination such as engine oil, dust completely from crankshaft pins and each bearing surface.
- Cut plastigage slightly shorter than bearing width, place it in crankshaft direction, avoiding oil holes.
- Install connecting rod bearings to caps, and tighten connecting rod nuts to the specified torque.

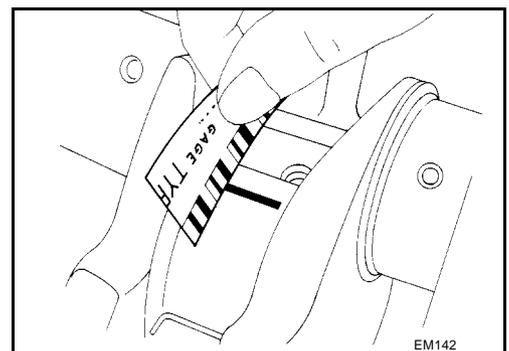
CAUTION:

Do not rotate crankshaft.

- Remove connecting rod caps and bearings, and measure plastigage width using scale on plastigage bag.

NOTE:

If out of specification, take same action mentioned in "Method by Measurement".



CYLINDER BLOCK

MAIN BEARING OIL CLEARANCE

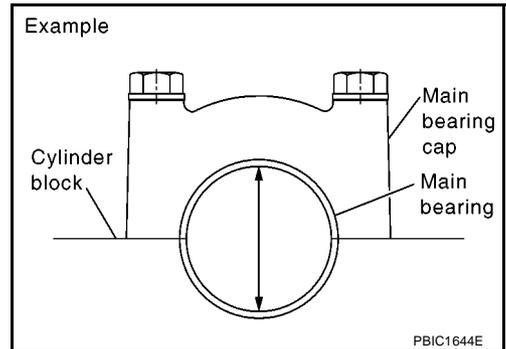
Method by Measurement

- Install main bearings to cylinder block and bearing cap, and tighten the bolts to the specified torque. Refer to [EM-114, "ASSEMBLY"](#). Then, measure the inner diameter of main bearings.

(Bearing clearance) = (Bearing inner diameter) – (Crankshaft journal outer diameter)

Standard : 0.047 - 0.077 mm (0.0019 - 0.0030 in)

- If out of the standard, check main bearing housing inner diameter and crankshaft journal outer diameter, and select appropriate main bearing to adjust clearance to specifications. Refer to [EM-123, "HOW TO SELECT MAIN BEARING"](#).



Method of Using Plastigage

- Remove contamination such as engine oil and dust completely from crankshaft journals and each bearing surface.
- Cut plastigage slightly shorter than bearing width. Place it in crankshaft turning direction, avoiding oil holes.
- Install main bearings and bearing cap and tighten to the specified torque. Refer to [EM-114, "ASSEMBLY"](#) for the tightening procedure.

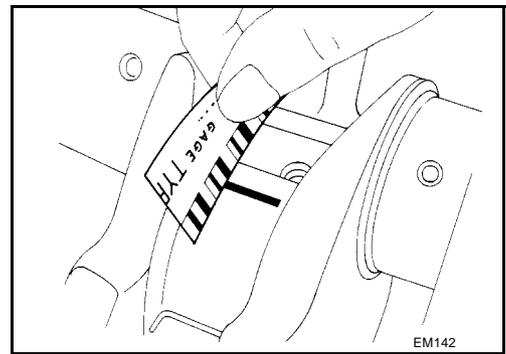
CAUTION:

Do not rotate crankshaft.

- Remove main bearings and bearing caps, and measure plastigage width using scale on plastigage bag.

NOTE:

If out of specification, take same action mentioned in "Method by Measurement".

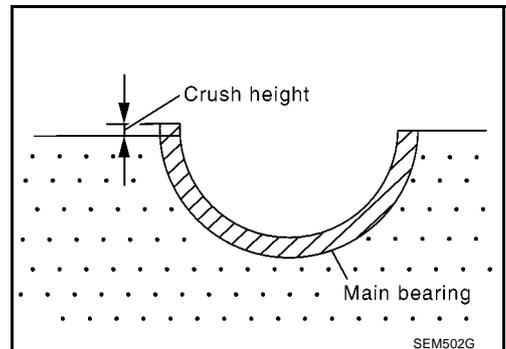


CRUSH HEIGHT OF MAIN BEARING

- When bearing cap is removed after being tightened to the specified torque with main bearings installed, the tip end of bearing must protrude. Refer to [EM-114, "ASSEMBLY"](#).

Standard : There must be crush height.

- If out of the standard, replace main bearings.

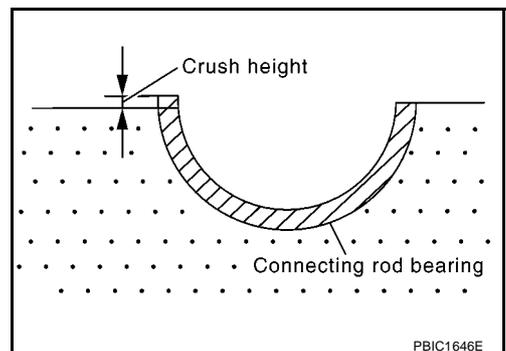


CRUSH HEIGHT OF CONNECTING ROD BEARING

- 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-114, "ASSEMBLY"](#).

Standard : There must be crush height.

- If out of the standard, replace connecting rod bearings.



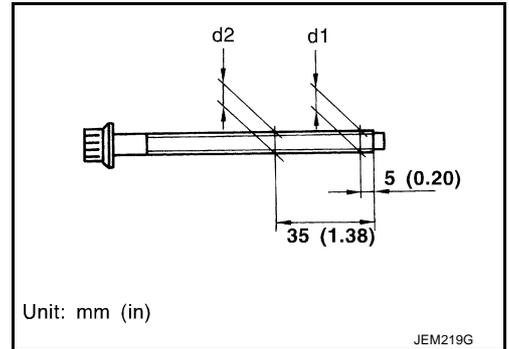
CYLINDER BLOCK

MAIN BEARING CAP BOLT DEFORMATION

- Measure the outer diameter of threaded area, d1 and d2, at the points specified in the figure.
- When the necked point is identified at a point other than where specified, measure at the point as d2.
- Calculate the difference between d1 and d2.

Limit : 0.13 mm (0.0051 in)

- If it exceeds the limit, replace main bearing cap bolt.



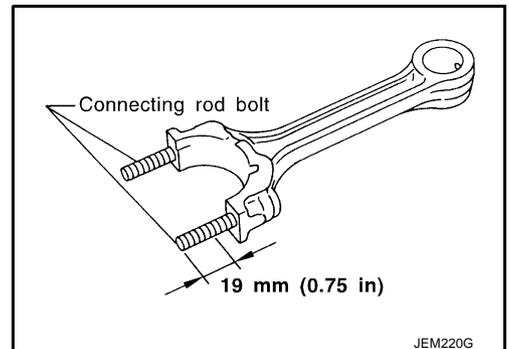
CONNECTING ROD BOLT DEFORMATION

- Install nuts to connecting rod bolts. Make sure that the nut can be screwed smoothly on bolt threads by hand to the last thread on the bolt.
- If the nut does not screw in smoothly, measure the outer diameter of the bolt thread at the point specified in the figure.
- If a necked point is identified, measure at that point.

Standard : 8.90 - 9.00 mm (0.3504 - 0.3543 in) dia.

Limit : 8.75 mm (0.3445 in) dia.

- If it exceeds the limit, replace connecting rod bolts and nuts.

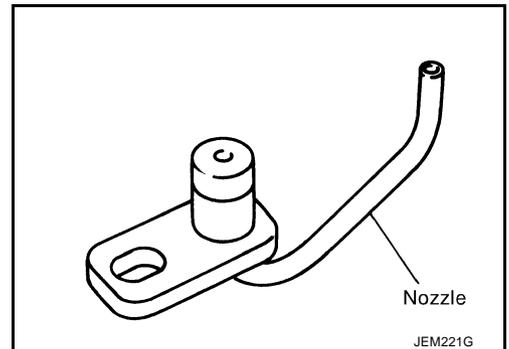


OIL JET

- Check nozzle for deformation and damage.
- Blow compressed air from nozzle, and check for clogs.

Standard : No deformation and no damage.

- If out of the standard, replace oil jet.



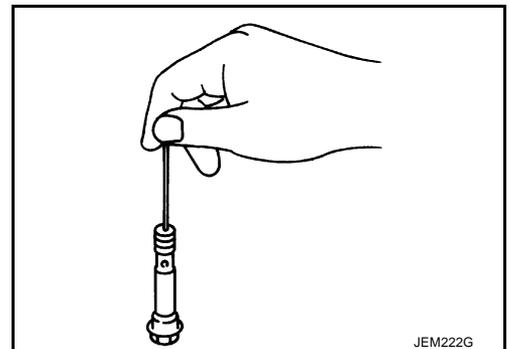
OIL JET RELIEF VALVE

- Using clean plastic stick, press check valve in oil jet relief valve. Make sure that valve moves smoothly with proper reaction force.

Standard:

Valve moves smoothly with proper reaction force.

- If out of the standard, replace oil jet relief valve.



CYLINDER BLOCK

FLYWHEEL DEFLECTION

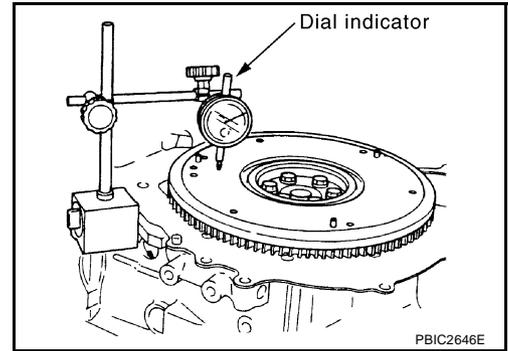
- Measure the deflection of flywheel contact surface to clutch with a dial indicator.
- Measure the deflection at 210 mm (8.27 in) dia.

Standard : 0.45 mm (0.0177 in) or less.

- If measured value is out of the standard, replace flywheel.

CAUTION:

When measuring, keep magnetic fields (such as dial indicator stand) away from signal plate of the rear end of crankshaft.



MOVEMENT AMOUNT OF FLYWHEEL

CAUTION:

Do not disassemble double mass flywheel.

Movement Amount of Thrust (Fore-and-Aft) Direction

- Measure the movement amount of thrust (fore-and-aft) direction when 100 N (10.2 kg, 22 lb) force is added at the portion of 125 mm (4.92 in) radius from the center of flywheel.

Standard : 1.3 mm (0.051 in) or less

- If measured value is out of the standard, replace flywheel.

Movement Amount in Radial (Rotation) Direction

Check the movement amount of radial (rotation) direction with the following procedure:

1. Install a bolt to clutch cover mounting hole, and place a torque wrench on the extended line of the flywheel center line.
 - Tighten bolt at a force of 9.8 N·m (1.0 kg·m, 87 in·lb) to keep it from loosening.
2. Put a mating mark on circumferences of the two flywheel masses without applying any load (Measurement standard points).
3. Apply a force of 9.8 N·m (1.0 kg·m, 87 in·lb) in each direction, and mark the movement amount on the mass on the transmission side.
4. Measure the dimensions of movement amounts "A" and "B" on circumference of the flywheel on the transmission side.

Standard: 32.0 mm (1.620 in) or less.

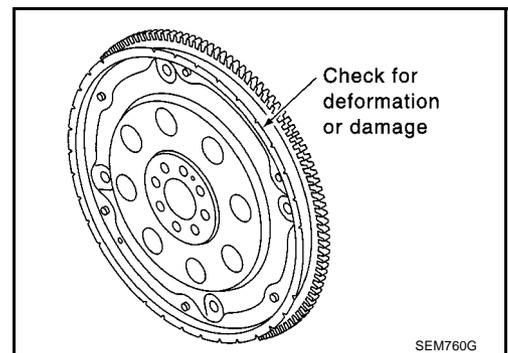
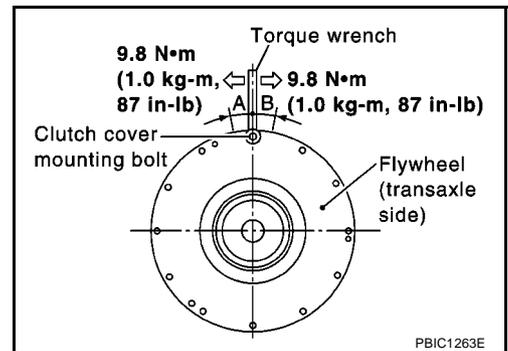
- If measured value is out of the standard, replace flywheel.

DRIVE PLATE

- Check drive plate and signal plate for deformation or cracks.

CAUTION:

- Do not disassemble drive plate.
- Do not place drive plate with signal plate facing down.
- When handling signal plate, take care not to damage or scratch it.
- Handle signal plate in a manner that prevents it from becoming magnetized.
- If anything is found, replace drive plate.



SERVICE DATA AND SPECIFICATIONS (SDS)

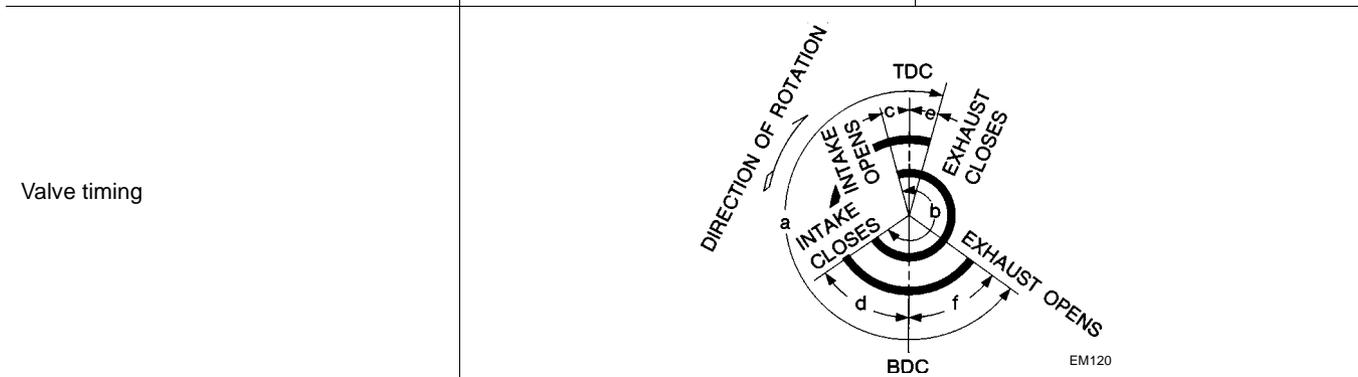
SERVICE DATA AND SPECIFICATIONS (SDS)

PPF:00030

Standard and Limit GENERAL SPECIFICATIONS

EBS01E6H

Cylinder arrangement		In-line 4
Displacement	Unit: cm ³ (cu in)	2,488 (151.82)
Bore and stroke	Unit: mm (in)	89.0 x 100 (3.504 x 3.937)
Valve arrangement		DOHC
Firing order		1-3-4-2
Number of piston rings	Compression	2
	Oil	1
Number of main bearings		5
Compression ratio		16.5
Compression pressure Unit: kPa (bar, kg/cm ² , psi)/200 rpm	Standard	3,100 (31, 31.6, 450)
	Minimum	2,500 (25, 25.5, 363)
	Differential limit between cylinders	490 (4.9, 5.0, 71)



Unit: degree

a	b	c	d	e	f
226	210	2	28	-2	48

INTAKE MANIFOLD AND EXHAUST MANIFOLD

Unit: mm (in)

Item	Limit	
Surface distortion	Intake manifold	0.1 (0.004)
	Exhaust manifold	0.3 (0.012)

DRIVE BELTS

Belt Deflection:

Applied belt	Belt deflection with 98 N (10 kg, 22 lb) force applied* mm (in)		
	New	Adjusted	Limit for re-adjusting
A/C compressor, alternator and water pump belt	2.9 - 3.4 (0.114 - 0.134)	3.9 - 4.4 (0.154 - 0.173)	8.5 (0.335)
Power steering oil pump belt	4.6 - 5.4 (0.181 - 0.213)	7.1 - 7.7 (0.280 - 0.303)	11.3 (0.445)

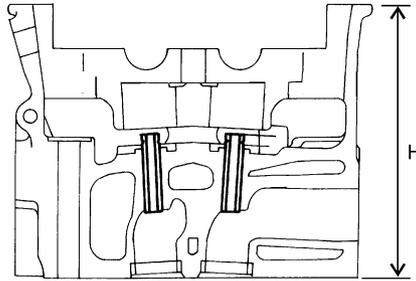
*: When engine is cold.

SERVICE DATA AND SPECIFICATIONS (SDS)

CYLINDER HEAD

Unit: mm (in)

Item	Standard	Limit
Cylinder head distortion	Less than 0.04 (0.0016)	0.1 (0.004)



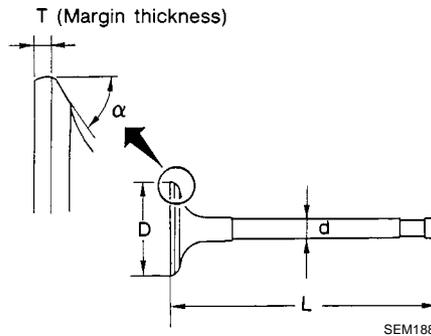
Nominal cylinder head height:
H = 153.9 - 154.1 mm (6.059 - 6.067 in)

JEM204G

VALVE

Valve Dimensions

Unit: mm (in)



SEM188

Valve head diameter "D"	Intake	28.0 - 28.3 (1.102 - 1.114)	
	Exhaust	26.0 - 26.3 (1.024 - 1.035)	
Valve length "L"	Intake	106.72 (4.2016)	
	Exhaust	106.36 (4.1874)	
Valve stem diameter "d"	Intake	5.965 - 5.980 (0.2348 - 0.2354)	
	Exhaust	5.945 - 5.960 (0.2341 - 0.2346)	
Valve seat angle "α"	Intake and exhaust	45 degrees 15' - 45 degrees 45'	
Valve margin "T"	Intake	1.60 (0.0630)	
	Exhaust	2WD models	1.80 (0.0709)
		4WD models	1.48 (0.0583)
Valve margin "T" limit		More than 1.0 (0.039)	
Valve stem end surface grinding limit		Less than 0.2 (0.008)	

Valve Clearance

Unit: mm (in)

Item	Cold	Hot* (Reference data)
Intake	0.24 - 0.32 (0.0094 - 0.0126)	0.274 - 0.386 (0.0108 - 0.0152)
Exhaust	0.26 - 0.34 (0.0102 - 0.0134)	0.308 - 0.432 (0.0121 - 0.0170)

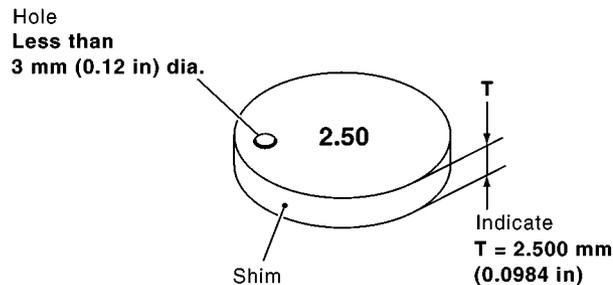
*: Approximately 80°C (176°F)

SERVICE DATA AND SPECIFICATIONS (SDS)

Available Shims

Stamped mark	Thickness mm (in)
2.10	2.10 (0.0827)
2.12	2.12 (0.0835)
2.14	2.14 (0.0843)
2.16	2.16 (0.0850)
2.18	2.18 (0.0858)
2.20	2.20 (0.0866)
2.22	2.22 (0.0874)
2.24	2.24 (0.0882)
2.26	2.26 (0.0890)
2.28	2.28 (0.0898)
2.30	2.30 (0.0906)
2.32	2.32 (0.0913)
2.34	2.34 (0.0921)
2.36	2.36 (0.0929)
2.38	2.38 (0.0937)
2.40	2.40 (0.0954)
2.42	2.42 (0.0953)
2.44	2.44 (0.0961)
2.46	2.46 (0.0969)
2.48	2.48 (0.0976)
2.50	2.50 (0.0984)
2.52	2.52 (0.0992)
2.54	2.54 (0.1000)
2.56	2.56 (0.1008)
2.58	2.58 (0.1016)
2.60	2.60 (0.1024)
2.62	2.62 (0.1031)
2.64	2.64 (0.1039)
2.66	2.66 (0.1047)
2.68	2.68 (0.1055)
2.70	2.70 (0.1063)
2.72	2.72 (0.1071)
2.74	2.74 (0.1079)

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



SEM512G

SERVICE DATA AND SPECIFICATIONS (SDS)

Valve Spring

Valve spring square	mm (in)	1.9 (0.075)
Free height	mm (in)	44.74 (1.761)
Pressure	N (kg, lb) at height mm (in)	184 - 208 (18.77 - 21.22, 41.4 - 46.8) at 32.82 (1.2921)
Height during valve open	mm (in)	24.82 (0.9772)
Load with valve open	N (kg, lb)	320 - 360 (32.65 - 36.73, 71.9 - 80.9)

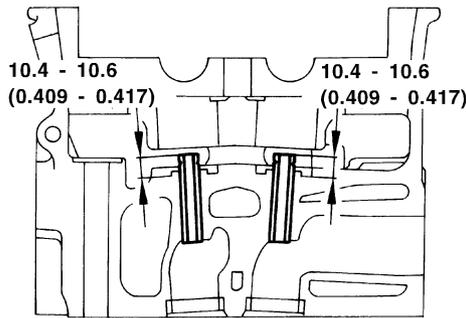
Valve Lifter

Unit: mm (in)

Item	Standard
Valve lifter outer diameter	29.960 - 29.975 (1.1795 - 1.1801)
Valve lifter bore diameter	30.000 - 30.021 (1.1811 - 1.1819)
Valve lifter clearance	0.025 - 0.061 (0.0010 - 0.0024)

Valve Guide

Unit: mm (in)



Unit: mm (in)

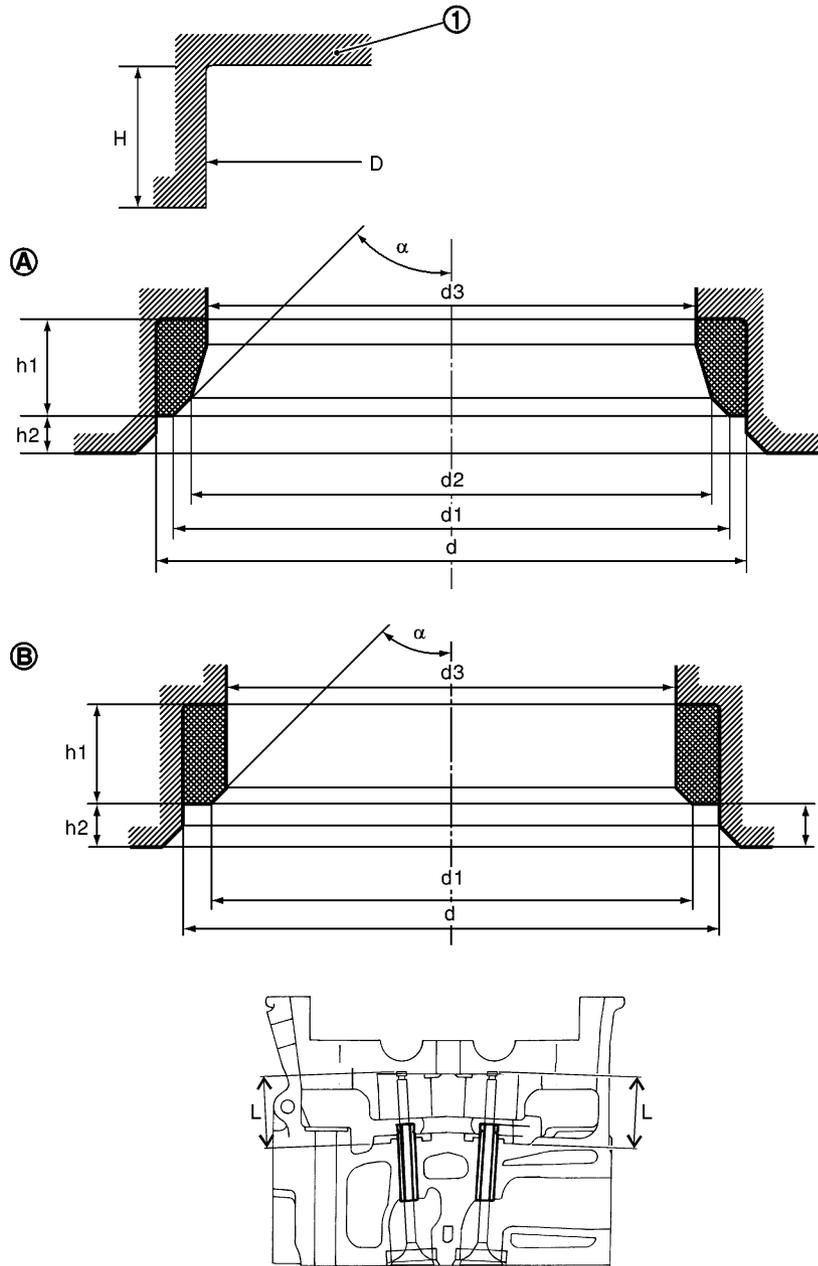
JEM156G

Item		Standard	Service
Valve guide	Outer diameter	10.023 - 10.034 (0.3946 - 0.3950)	10.223 - 10.234 (0.4025 - 0.4029)
Valve guide	Inner diameter (Finished size)	6.000 - 6.018 (0.2362 - 0.2369)	
Cylinder head valve guide hole diameter		9.975 - 9.996 (0.3927 - 0.3935)	10.175 - 10.196 (0.4006 - 0.4014)
Interference fit of valve guide		0.027 - 0.059 (0.0011 - 0.0023)	
Item		Standard	Limit
Valve guide clearance	Intake	0.020 - 0.053 (0.0008 - 0.0021)	0.08 (0.0031)
	Exhaust	0.040 - 0.073 (0.0016 - 0.0029)	0.10 (0.0039)
Projection length		10.4 - 10.6 (0.409 - 0.417)	

SERVICE DATA AND SPECIFICATIONS (SDS)

Valve Seat

Unit: mm (in)



PBIC4054E

JEM253G

Items		Standard	Oversize [0.5 (0.02)] (Service)
Cylinder head seat (1) recess diameter "D"	Intake	30.000 - 30.016 (1.1811 - 1.1817)	30.500 - 30.516 (1.2008 - 1.2014)
	Exhaust	29.000 - 29.016 (1.1417 - 1.1424)	29.500 - 29.516 (1.1614 - 1.1620)
Valve seat outer diameter "d"	Intake (A)	30.080 - 30.100 (1.1842 - 1.1850)	30.580 - 30.600 (1.2039 - 1.2047)
	Exhaust (B)	29.080 - 29.096 (1.1449 - 1.1455)	29.580 - 29.596 (1.1646 - 1.1652)
Valve seat interference fit	Intake (A)	0.064 - 0.100 (0.0025 - 0.0039)	
	Exhaust (B)	0.064 - 0.096 (0.0025 - 0.0038)	
Diameter "d1"	Intake (A)	27.15 - 27.65 (1.0689 - 1.0886)	26.05 - 26.55 (1.0256 - 1.0453)
	Exhaust (B)	24.95 - 25.45 (0.982 - 1.0020)	24.15 - 24.65 (0.9508 - 0.9705)

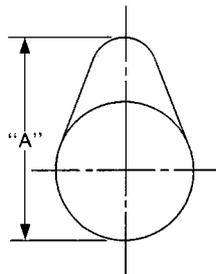
SERVICE DATA AND SPECIFICATIONS (SDS)

Diameter "d2"	Intake (A)	26.00 - 26.50 (1.0236 - 1.0433)	—
	Exhaust (B)	—	
Diameter "d3"	Intake (A)	25.3 - 25.7 (0.996 - 1.012)	
	Exhaust (B)	23.3 - 23.7 (0.917 - 0.933)	
Angle "α"	43°30' - 46°30'		
Height "h1"	Intake (A)	7.0 - 7.1 (0.276 - 0.280)	6.6 - 6.7 (0.260 - 0.264)
	Exhaust (B)	6.7 - 6.8 (0.264 - 0.268)	6.3 - 6.4 (0.248 - 0.252)
Height "h2"	Intake (A)	2.23 - 2.43 (0.0878 - 0.0957)	2.13 - 2.53 (0.0839 - 0.0996)
	Exhaust (B)	2.76 - 2.96 (0.1087 - 0.1165)	2.66 - 3.06 (0.1047 - 0.1205)
Depth "H"	Intake	8.83 - 9.13 (0.3476 - 0.3594)	
	Exhaust	9.06 - 9.36 (0.3567 - 0.3685)	
Projection (L)	Intake	36.53 - 36.98 (1.4382 - 1.4559)	
	Exhaust	36.53 - 37.01 (1.4382 - 1.4571)	

CAMSHAFT

Unit: mm (in)

Item	Standard	Limit
Camshaft journal oil clearance	0.045 - 0.086 (0.0018 - 0.0034)	
Camshaft bracket inner diameter	No.1	30.500 - 30.521 (1.2008 - 1.2016)
	No. 2, 3, 4, 5	24.000 - 24.021 (0.9449 - 0.9457)
Camshaft journal outer diameter	No. 1	30.435 - 30.455 (1.1982 - 1.1990)
	No. 2, 3, 4, 5	23.935 - 23.955 (0.9423 - 0.9431)
Camshaft runout [TIR*]	—	0.02 (0.0008)
Camshaft sprocket runout [TIR*]	—	0.15 (0.0059)
Camshaft end play	0.070 - 0.148 (0.0028 - 0.0058)	0.24 (0.0094)



SEM671

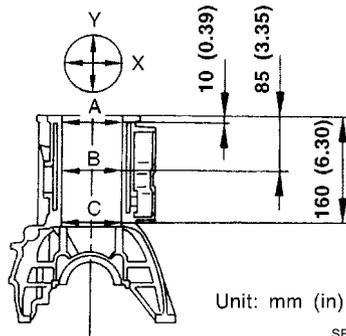
Cam height "A"	Intake	39.505 - 39.695 (1.5553 - 1.5628)
	Exhaust	39.905 - 40.095 (1.5711 - 1.5785)

*: Total indicator reading

SERVICE DATA AND SPECIFICATIONS (SDS)

CYLINDER BLOCK

Unit: mm (in)



Unit: mm (in)

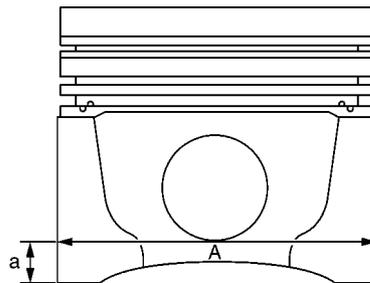
SEM899G

Top surface distortion		Standard		Less than 0.03 (0.0012)
		Limit		0.1 (0.004)
Cylinder bore	Inner diameter	Standard	Grade No. 1	89.000 - 89.010 (3.5039 - 3.5043)
			Grade No. 2	89.010 - 89.020 (3.5043 - 3.5047)
			Grade No. 3	89.020 - 89.030 (3.5047 - 3.5051)
		Wear limit		0.07 (0.0028)
Out-of-round (Difference between X and Y)		Limit		0.015 (0.0006)
Taper (Difference between A and C)		Limit		0.010 (0.0004)
Main bearing housing inner diameter (Without bearing)				66.654 - 66.681 (2.6242 - 2.6252)
Difference in inner diameter between cylinders	Limit		Less than 0.05 (0.0020)	

PISTON, PISTON RING AND PISTON PIN

Available Piston

Unit: mm (in)



MBIA0026E

Piston outer diameter "A"	Standard	Grade No. 1	88.928 - 88.942 (3.5011 - 3.5016)
		Grade No. 2	88.938 - 88.952 (3.5015 - 3.5020)
		Grade No. 3	88.948 - 88.962 (3.5019 - 3.5024)
		0.25 (0.0098) O/S (Service)	89.188 - 89.202 (3.5113 - 3.5119)
		0.50 (0.0197) O/S (Service)	89.438 - 89.452 (3.5212 - 3.5217)
"a" dimension			11.0 (0.43)

SERVICE DATA AND SPECIFICATIONS (SDS)

Piston pin bore diameter	28.003 - 28.009 (1.1025 - 1.1027)
Piston to cylinder bore clearance	0.058 - 0.082 (0.0023 - 0.0032)

SERVICE DATA AND SPECIFICATIONS (SDS)

Piston Ring

Unit: mm (in)

Item		Standard	Limit
Side clearance	Top	0.050 - 0.090 (0.0020 - 0.0035)	0.2 (0.008)
	2nd	0.050 - 0.090 (0.0020 - 0.0035)	0.1 (0.004)
	Oil ring	0.030 - 0.070 (0.0012 - 0.0028)	—
End gap	Top	0.21 - 0.28 (0.0083 - 0.0110)	1.0 (0.039)
	2nd	0.32 - 0.47 (0.0126 - 0.0185)	
	Oil ring	0.30 - 0.55 (0.0118 - 0.0217)	

Piston Pin

Unit: mm (in)

Piston pin outer diameter		27.995 - 28.000 (1.1022 - 1.1024)
Piston to piston pin clearance		0.003 - 0.014 (0.0001 - 0.0006)
Connecting rod bushing clearance	Standard	0.026 - 0.043 (0.0010 - 0.0017)
	Limit	0.057 (0.0022)

SERVICE DATA AND SPECIFICATIONS (SDS)

CONNECTING ROD

Unit: mm (in)

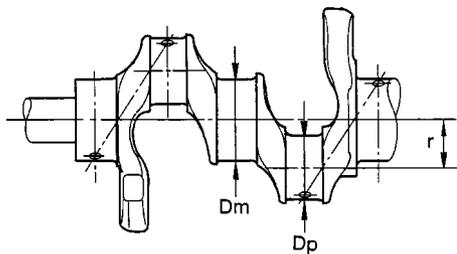
Center distance		154.5 (6.083)
Bend [per 100 (3.94)]	Limit	0.12 (0.0047)
Torsion [per 100 (3.94)]	Limit	0.12 (0.0047)
Connecting rod bushing inner diameter*		28.026 - 28.038 (1.1034 - 1.1039)
Connecting rod big end inner diameter*		55.000 - 55.013 (2.1654 - 2.1659)
Side clearance	Standard	0.20 - 0.35 (0.0079 - 0.0138)
	Limit	0.40 (0.0157)

*: After installing in connecting rod

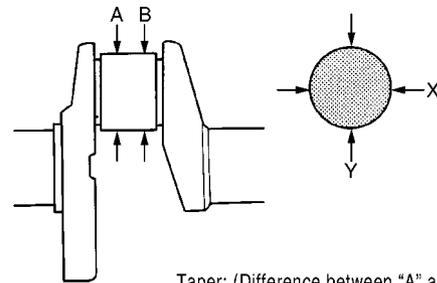
CRANKSHAFT

Unit: mm (in)

Main journal dia. "Dm"		62.951 - 62.975 (2.4784 - 2.4793)
Pin journal dia. "Dp"		51.954 - 51.974 (2.0454 - 2.0462)
Center distance "r"		49.97 - 50.03 (1.9673 - 1.9697)
Out-of-round (Difference between X and Y)	Standard	0.003 (0.0001)
	Limit	0.005 (0.0002)
Taper (Difference between A and B)	Standard	0.003 (0.0001)
	Limit	0.005 (0.0002)
Runout [TIR*]	Standard	0.05 (0.0020)
	Limit	0.10 (0.0039)
End play	Standard	0.10 - 0.25 (0.0039 - 0.0098)
	Limit	0.30 (0.0118)



SEM645



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

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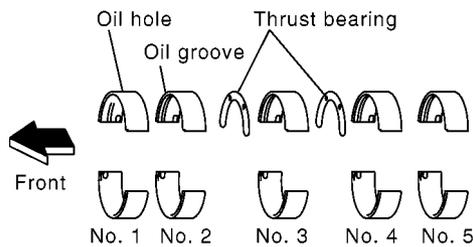
*: Total indicator reading

SERVICE DATA AND SPECIFICATIONS (SDS)

AVAILABLE MAIN BEARING

Main bearing

Unit: mm (in)



Grade number	Thickness "T"	Width "W"	Identification color
STD 0	1.816 - 1.820 (0.0715 - 0.0717)	19.9 - 20.1 (0.783 - 0.791)	Black
STD 1	1.820 - 1.824 (0.0717 - 0.0718)		Brown
STD 2	1.824 - 1.828 (0.0718 - 0.0720)		Green
STD 3	1.828 - 1.832 (0.0720 - 0.0721)		Yellow
STD 4	1.832 - 1.836 (0.0721 - 0.0723)		Blue

Undersize

Unit: mm (in)

Size	Thickness	Main journal diameter "Dm"
0.25 (0.0098)	1.949 - 1.953 (0.0767 - 0.0769)	Grind so that bearing clearance is the specified value.

AVAILABLE CONNECTING ROD BEARING

Connecting Rod Bearing

Unit: mm (in)

Grade number	Thickness "T"	Width "W"	Identification color (mark)
STD 0	1.492 - 1.496 (0.0587 - 0.0589)	22.9 - 23.1 (0.902 - 0.909)	Black
STD 1	1.496 - 1.500 (0.0589 - 0.0591)		Brown
STD 2	1.500 - 1.504 (0.0591 - 0.0592)		Green

Undersize

Unit: mm (in)

Size	Thickness	Crank pin journal diameter "Dp"
0.08 (0.0031)	1.536 - 1.540 (0.0605 - 0.0606)	Grind so that bearing clearance is the specified value.
0.12 (0.0047)	1.556 - 1.560 (0.0613 - 0.0614)	
0.25 (0.0098)	1.621 - 1.625 (0.0638 - 0.0640)	

MISCELLANEOUS COMPONENTS

Flywheel

Unit: mm (in)

Flywheel deflection [TIR]*	Standard	0.45 (0.0177) or less

*: Total indicator reading

SERVICE DATA AND SPECIFICATIONS (SDS)

Bearing Clearance

Unit: mm (in)

Main bearing oil clearance	Standard	0.047 - 0.077 (0.0019 - 0.0030)
Connecting rod bearing oil clearance	Standard	0.039 - 0.070 (0.0015 - 0.0028)