SECTION **EM**

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CONTENTS

Precautions

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

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

WARNING

- **To avoid rendering the SRS inoperative, which could increase the risk of personal injury or death in the event of a collision which would result in airbag inflation, all maintenance must be performed by an authorized Renault Samsung dealer.**
- **Before servicing the SRS, turn ignition switch OFF, and disconnect both battery cables. Then wait at least 3 minutes. (This is to discharge all the remaining electricity in the airbag sensor unit's auxiliary power circuit.)**
- **Do not use air impact or electrical tools when installing/removing the components.**
- **Do not use any electrical test equipments such as circuit tester when inspecting the SRS airbag and pretensioner seatbelt circuit while installed unless instructed to in this Service Manual. (The weak current in the tester can cause the SRS airbag to operate.)**
- **Do not insert any foreign materials such as a screwdriver in the airbag module and pretensioner seatbelt connector in order to prevent unintended operation due to static electricity.**
- **Improper maintenance, including incorrect removal and installation of the SRS, can lead to personal injury caused by unintentional activation of the system.**
- **Do not leave SRS airbag unit and pre-tensioner seat belt related components in the place where the temperature is above 80°C.**
- **Be careful not to drop or jar the SRS airbag unit and related components.**
- **Do not re-use the inflated SRS airbag unit and pre-tensioner seat belt assembly.**

Precautions for Drain Engine Coolant

- Drain engine coolant when engine is cooled.

Precautions for Disconnecting Fuel Piping

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

Precautions for Removal and Disassembly

- When instructed to use special service tools, use 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 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 bolts and nuts, 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

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

Precautions for Assembly and Installation

- Use torque wrench to tighten nuts and bolts to specification.
- When tightening bolts and nuts, as a basic rule, equally tighten in several different steps starting with the ones in center, then ones on inside and outside diagonally in this order. If the order of tightening is specified, do exactly as specified.
- Replace with new gasket, packing, oil seal or O-ring.
- Thoroughly wash, clean, and air-blow each part. Carefully check 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.
- Use the following procedure to check for fuel leaks.
  a. Turn ignition switch "ON" (with engine stopped), then check connections for leaks by applying fuel pressure to fuel piping.
  b. Start engine, rev it up and make sure there are no fuel leaks at the fuel system connections.
- After repairing, start engine and increase engine speed to check engine coolant, fuel, engine oil, and exhaust gases for leakage.

Parts Requiring Angle Tightening

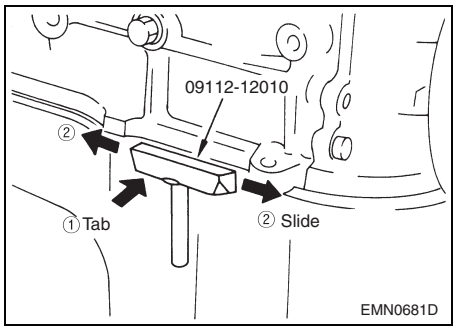
- Use angle wrench for the final tightening of the following engine parts:
  - Crankshaft pulley bolt (Note)
  - Cylinder head bolts
  - Main bearing cap fixing bolts
  - Connecting rod cap nuts (VQ23DE)
  - Connecting rod cap bolts (VQ35DE)

⚠ CAUTION No angle wrench is required as bolt flange is provided with notches for angle tightening.

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

Precautions for Liquid Gasket

REMOVAL OF LIQUID GASKET SEALING



- After removing mounting nuts and bolts, separate the mating surface using seal cutter (09112-12010) and remove old liquid gasket sealing.

⚠ WARNING

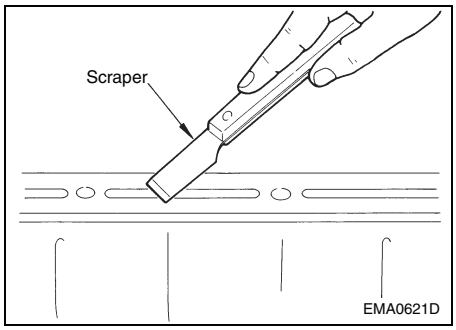
Be careful not to damage the mating surfaces.

- In areas where seal cutter is difficult to use, use plastic hammer to lightly tap the parts to remove it.

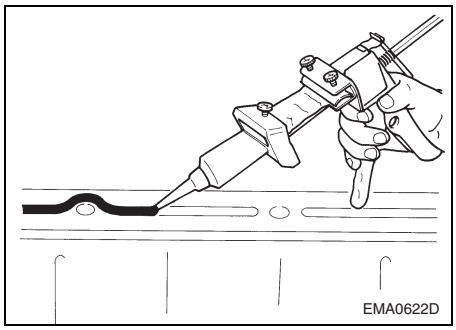
⚠ CAUTION

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

LIQUID GASKET APPLICATION PROCEDURE



1. Using scraper, remove old liquid gasket adhering to the gasket application surface and the mating surface.
   - Remove liquid gasket completely from the groove of the gasket application surface, mounting bolts, and bolt holes.
2. Wipe the liquid gasket application surface and the mating surface with white gasoline (lighting and heating use) to remove adhering moisture, grease and foreign materials.
3. Attach liquid gasket tube to tube presser. Use Genuine Liquid Gasket or equivalent.



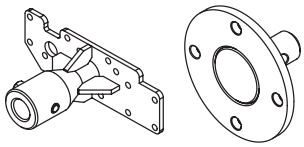
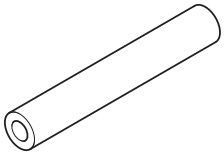
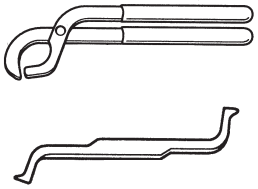
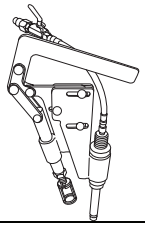
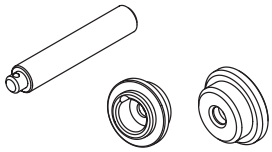
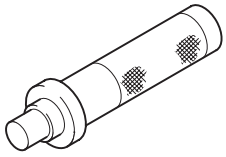
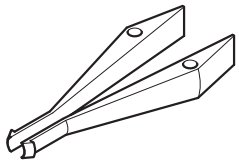
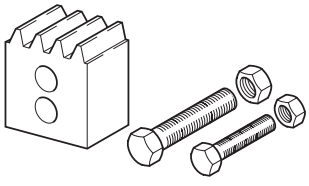
4. Apply liquid gasket without breaks to the specified location with the specified dimensions.
   - If there is a groove for the liquid gasket application, apply liquid gasket to the groove.
   - As for the bolt holes, normally apply liquid gasket inside the holes. Occasionally, it should be applied outside the holes. Make sure to read the text of this manual.
   - Within 5 minutes of liquid gasket application, install the mating component.
   - If liquid gasket protrudes, wipe it off immediately.
   - After 30 minutes or more have passed from the installation, fill engine oil and engine coolant.

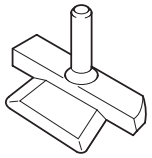
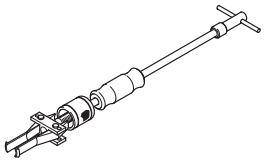
⚠ CAUTION

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

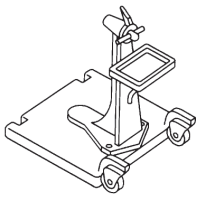
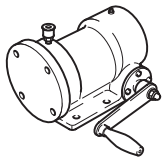
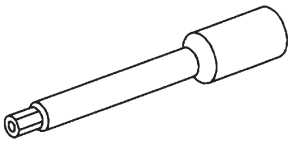
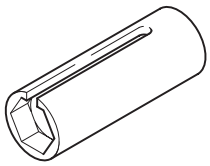
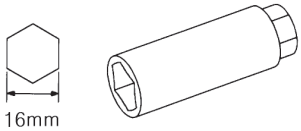
Preparation

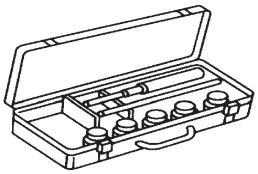
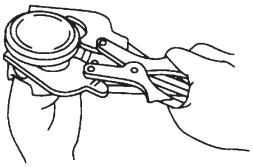
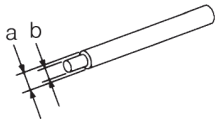
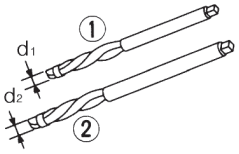
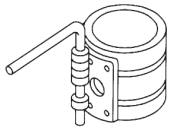
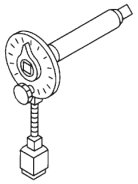
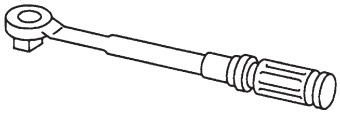
Special Service Tools

Tool Name	Description
09100-120S0 Engine sub-attachment set 	Disassembling and repairing engine
09122-12010 Valve oil seal drift 	Installing valve oil seal
Lifter stopper set ⓐ 09122-21010 Lifter stopper ⓐ ⓑ 09122-21020 Lifter stopper ⓑ 	Replacing valve shims
09122-121S0 Valve spring compressor set 	Compressing valve spring
09115-120S0 Front oil seal drift set • 09115-21010 Extension bar • 09115-21020 (SR) Front oil seal drift • 09115-21030 (VQ) Front oil seal drift 	Assembling front cover oil seal
09134-12030 Drift B 	Assembling pilot converter
09134-12010 Pilot converter puller 	Removing pilot converter
09134-12021 Ring gear brake 	Fixing drive plate when turning crankshaft

Tool Name	Description
09112-12010 Seal cutter 	Removing oil pan
09361-11090 Puller E 	Removing front cover oil seal

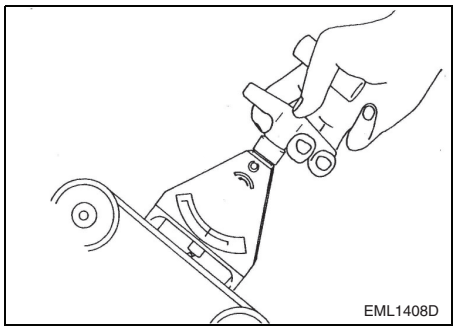
Commercial Service Tools

Tool Name	Description
Engine stand 	Disassembling and repairing engine
Stand gear housing 	Disassembling and repairing engine
Cylinder head bolt wrench 	Loosening and tightening cylinder head bolt
Heated oxygen sensor wrench 	Removing and installing heated oxygen sensor
Spark plug wrench 	Removing and installing spark plug

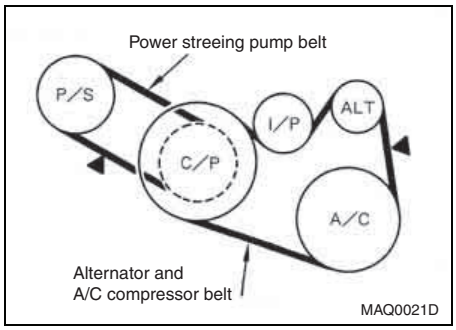
Tool Name		Description
Valve seat cutter set		Finishing valve seat dimensions
Piston ring expander		Removing and installing piston ring
Valve guide drift		Removing and installing valve guide **Intake & Exhaust** a = 9.5 mm dia. b = 5.5 mm dia.
Valve guide reamer		Reaming valve guide ① or hole for over-size valve guide ② **Intake & Exhaust** d_1 = 6.0 mm dia. d_2 = 10.2 mm dia.
Piston ring compressor		Installing piston assembly into cylinder bore
Angle wrench		Tightening bolts for bearing cap, cylinder head, etc. in angle
Torque wrench		Tightening torque for bolts and nuts

Drive Belts

Checking Drive Belts



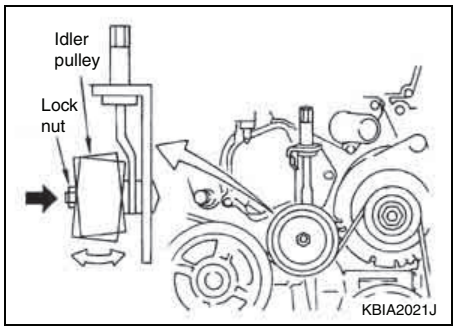
- Inspection should be done only when engine is cold or over 30 minutes after engine is stopped.
- Visually inspect belts for cracks, fraying and wear and.



- Measure the belt tension at " ▼ " positions with a tension meter.
- Refer to tension meter operating manual.
- When measuring deflection, apply 98 N (10 kg, 22 lb) 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.**



Portion	Belt Type	Tension [N (kg)]			Belt Deflection (mm) [when pushing it with 98.1 N (10 kg, 22 lb)]		
		New Belt	After Adjustment	Limit	New Belt	After Adjustment	Limit
Alternator and A/C compressor belt	Poly V-belt (6 pitches)	838 ~ 926 (85.5 ~ 94.5)	730 ~ 818 (74.5 ~ 83.5)	294 (30)	3.7 ~ 4.1	4.2 ~ 4.6	7
Power steering oil pump belt	Poly V-belt (4 pitches)	603 ~ 691 (61.5 ~ 70.5)	495 ~ 583 (50.5 ~ 59.5)	196 (20)	6.5 ~ 7.2	7.3 ~ 8.0	11

Tension Adjustment

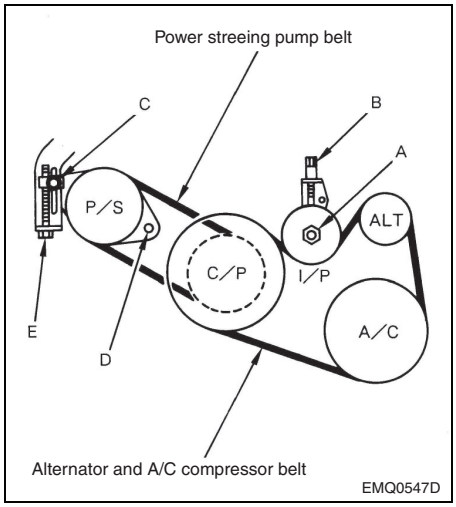
- Adjust belt tension at the portions below:

Portion	Belt tightening method for adjustment
Alternator and A/C compressor belt	Adjusting bolt on idler pulley
Power steering oil pump belt	Adjusting bolt on power steering oil pump

CAUTION

- **When belt is replaced with a new one, adjust it to value for "New belt" to accommodate for insufficient adaptability with pulley grooves.**
- **When deflection of belt being used exceeds ìLimitî, adjust it to value for "After adjustment".**
- **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.**
- **When installing belt, make sure that it is correctly engaged with pulley groove.**
- **Keep engine oil, working fluid and engine coolant away from belt.**
- **Do not twist or bend belt excessively.**

ALTERNATOR AND A/C COMPRESSOR BELT



1. Remove splash guard (RH).
2. Loosen idler pulley lock nut (A).
3. Adjust tension by turning adjusting bolt (B).
   - For specified belt tension, refer to "Checking Drive Belts".
4. Tighten lock nut (A).

   Tightening torque : 34.8 N·m (3.5 kgf-m)

5. Tighten adjusting bolt (B).

   Tightening torque : 5.4 N·m (0.55 kgf-m)

POWER STEERING OIL PUMP BELT

1. Remove splash guard (RH).
2. Loosen adjuster lock bolt (C).
3. Loosen power steering oil pump mounting bolt (D).
   - Bolt head (D) is engine rear side.
4. Adjust tension by turning adjusting bolt (E).
   - For specified belt tension, refer to "Checking Drive Belts".
5. Tighten adjuster lock bolt (C).

   Tightening torque : 28.0 N·m (2.9 kgf-m)

6. Tighten power steering oil pump mounting bolt (D).

Tightening torque : 43.2 N·m (4.4 kgf-m)

Removal and Installation

REMOVAL

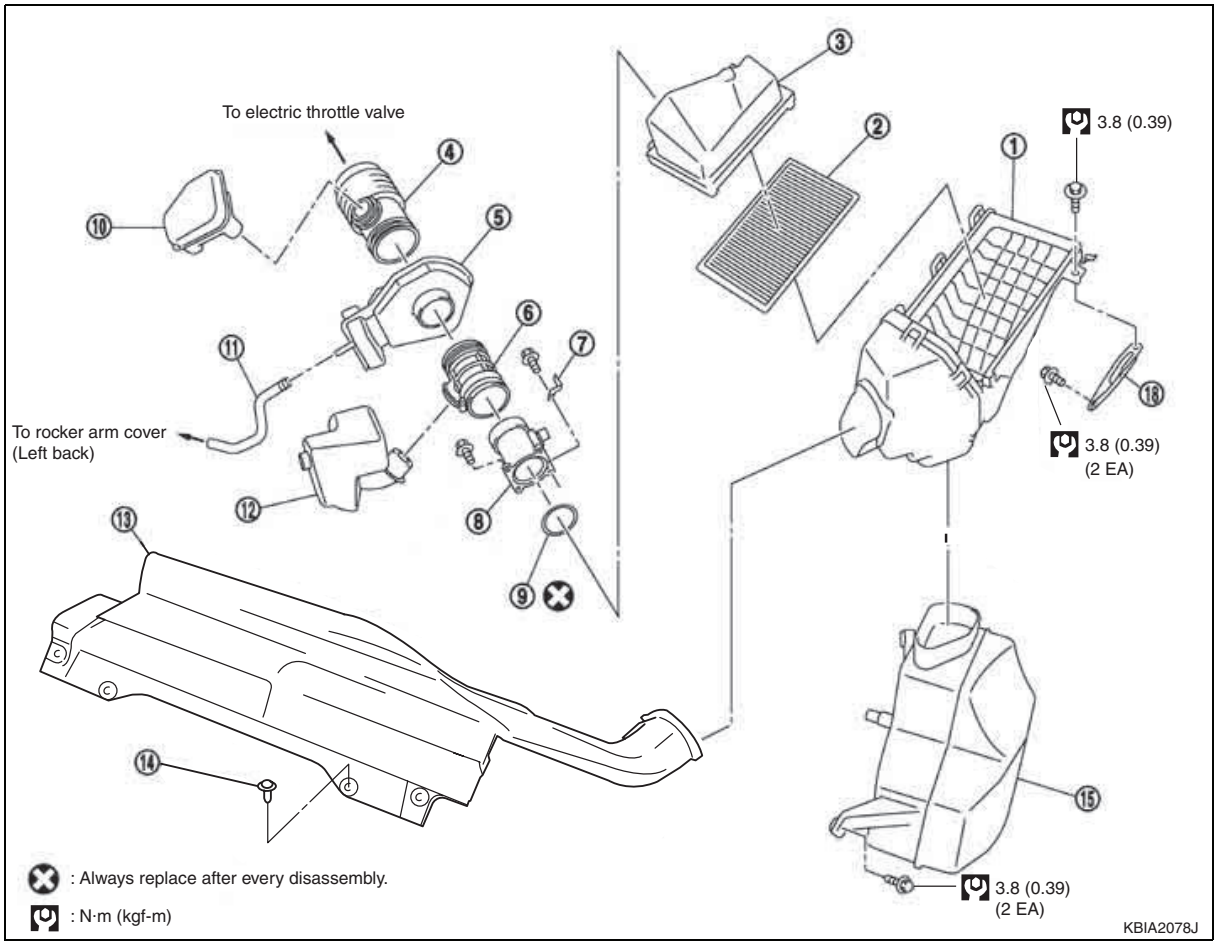
1. Remove splash guard (RH).
2. Fully loosen each belt by following the guidelines in Tension Adjustment. Remove alternator, A/C compressor belt, and then power steering oil pump belt.

INSTALLATION

1. Install each belt to pulley in the reverse order of removal.
2. Adjust belt tension. Refer to "Tension Adjustment".
3. Make sure again that tension of each belt is within the standard.

Air Cleaner and Air Duct

Components



1. Air cleaner case (lower)
2. Air cleaner filter
3. Air cleaner case (upper)
4. Air duct
5. Resonator
6. Air duct
7. Harness bracket
8. Mass air flow sensor
9. O-ring
10. Resonator
11. Blow-by hose
12. Resonator
13. Air duct (inlet)
14. Clips (4)
15. Resonator
16. Bracket

Removal

1. Disconnect harness connector from mass air flow sensor.
2. Remove mounting clips and air duct (inlet).
3. Disconnect each connection and remove air cleaner case, mass air flow sensor assembly, air duct and resonator assembly.
   - Add mating marks as necessary for easier installation.
4. Remove mass air flow sensor from air cleaner case (upper).

CAUTION

Handle mass air flow sensor with following cares.

- **Do not shock it.**
- **Do not disassemble it. (Disassembly prohibited parts)**
- **Do not touch its sensor.**

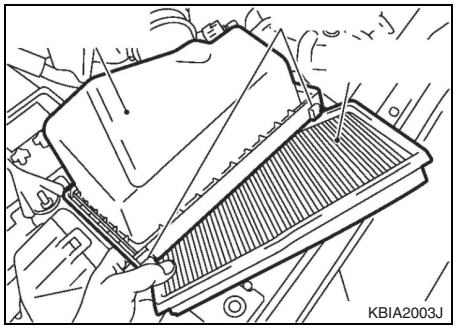
5. Remove resonator, removing left side fender protector (front).

Installation

Note the following, and install in the reverse order of removal.
- Align marks. Attach each joint. Screw clamps firmly.

Changing Air Cleaner Filter

Change Interval: Every 20,000 km



REMOVAL

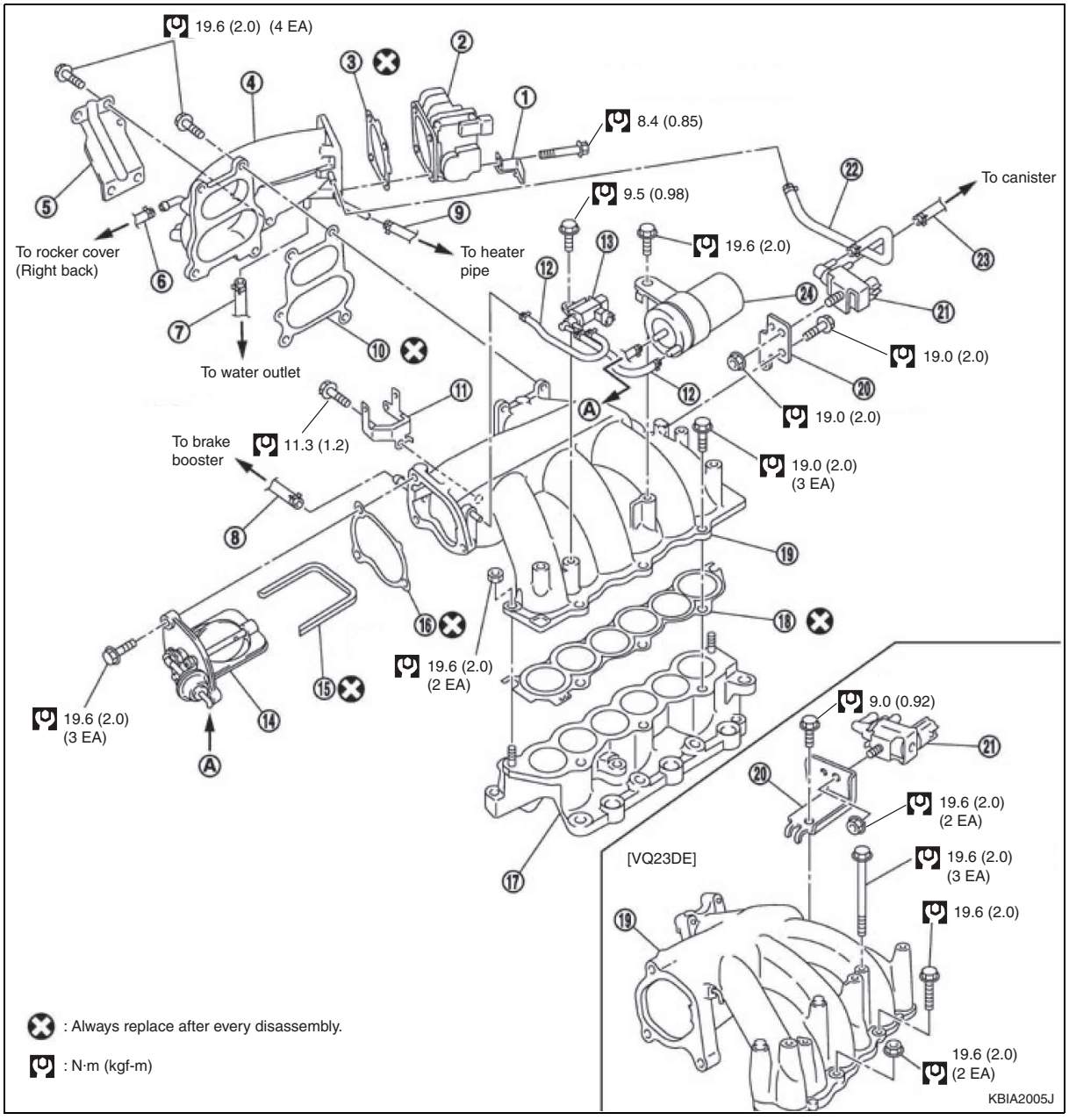
- Unhook air cleaner case clips (2) and lift up air cleaner case (upper). Remove air cleaner filter.

INSTALLATION

- Install in the reverse order of removal.

Intake Manifold Collector

Components



REFERENCE

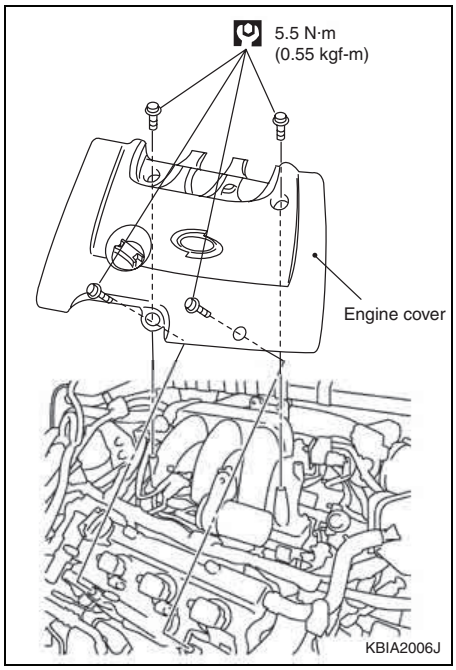
- **The figure illustrates VQ35DE as an example. Each part form of VQ23DE is different from VQ35DE for difference of port diameter and so forth.**
- **Only portions which structures (components) differ are illustrated.**

1. Bracket
2. Electric throttle control actuator
3. Gasket
4. Intake manifold collector (upper)
5. Intake manifold collector support
6. Blow-by hose
7. Heater hose
8. Vacuum hose
9. Water hose
10. Gasket
11. Bracket
12. Vacuum hose
13. Variable intake air control solenoid
14. Variable intake air control solenoid valve
15. Gasket
16. Gasket
17. Intake manifold
18. Gasket
19. Intake manifold collector (lower)
20. Bracket
21. EVAP canister purge volume control solenoid valve
22. Vacuum hose
23. Vacuum hose
24. Vacuum tank

Removal

REFERENCE

It shows VQ35DE as an example unless the figure includes specification.



1. Remove engine cover.

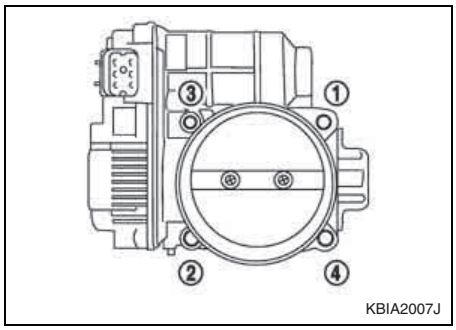
CAUTION

Be careful not to damage or scratch engine cover.

2. Remove air cleaner case (upper) with mass air flow sensor and air duct assembly. Refer to "AIR CLEANER AND AIR DUCT".
3. Remove radiator drain plug and drain engine coolant. or when water hoses are disconnected, attach hose clamp to prevent engine coolant leakage. Refer to "Changing Engine Coolant".

CAUTION

Perform this step when engine is cold.



4. Disconnect harness connector and vacuum hose from EVAP canister purge volume control solenoid valve.
5. Remove electric throttle control actuator as follows:
   a. Disconnect harness connector.
   b. Loosen mounting bolts in reverse order as shown in the figure.

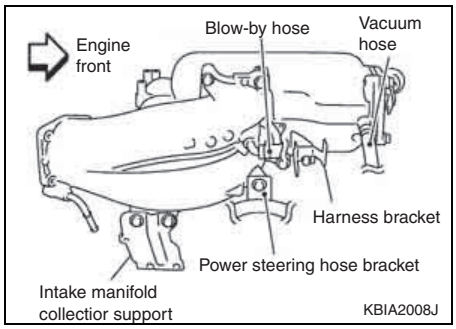
CAUTION

- **Handle carefully to avoid any shock to electric throttle control actuator.**
- **Do not disassemble and adjust. (disassembly and adjustment prohibited parts)**

REFERENCE

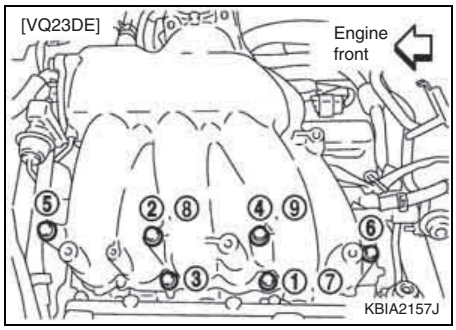
Mounting bolts: Hexagon socket head bolt (size: 5 mm)

6. Disconnect water hoses from intake manifold collector (upper).
   - When engine coolant is not drained from radiator drain plug, attach plug or hose clamp to water hoses to prevent engine coolant leakage.



7. Remove the following parts from right side of intake manifold collector (upper, lower) as shown in the figure:
   - Vacuum hose
   - Blow-by hose
   - Power steering hose bracket
   - Intake manifold collector support
   - Harness bracket

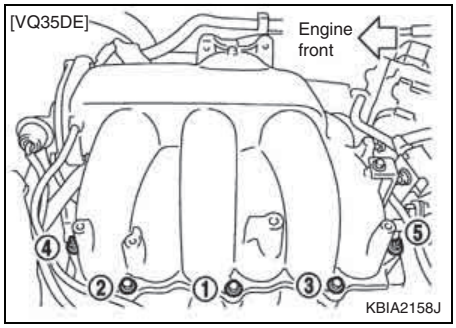
8. Remove variable intake air control solenoid and vacuum tank from intake manifold collector (lower).
   - Add mating marks as necessary for easier installation.

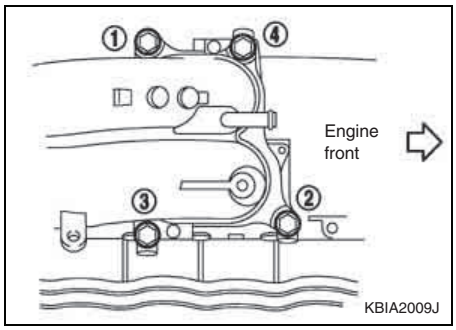


9. Remove intake manifold collectors (upper and lower)assembly.
   - Loosen mounting bolts and nuts in reverse order as shown in the figure to remove intake manifold collectors (upper and lower)assembly and gasket.

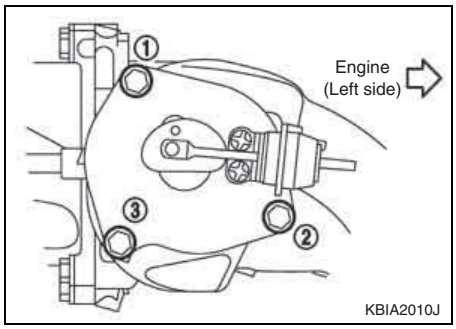
⚠ CAUTION

Disregard the numerical order No. 7 to 9 in removal. (VQ23DE)





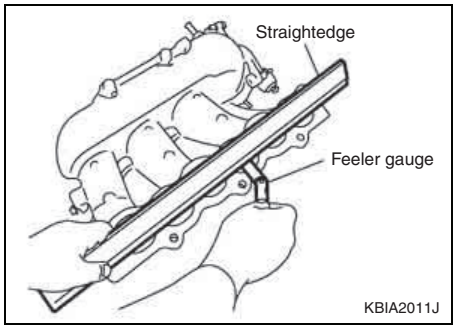
10. Remove intake manifold collector (upper) from intake manifold collector (lower).
    - Loosen mounting bolts in reverse order as shown in the figure.



11. Remove variable intake air control solenoid valve from intake manifold collector (lower).
    - Loosen mounting bolts in reverse order as shown in the figure.

Inspection after Removal

SURFACE DISTORTION



- Check the surface distortion of intake manifold collector (lower) with straightedge and feeler gauge.

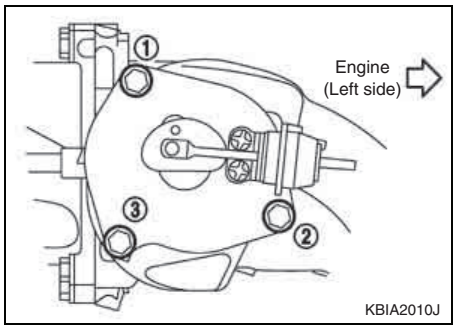
  Limit: 0.1 mm

- If it exceeds the limit, replace intake manifold collector (lower).

Installation

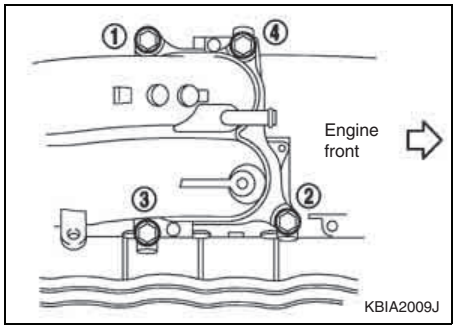
Note the following, and install in the reverse order of removal.

VARIABLE INTAKE AIR CONTROL SOLENOID VALVE



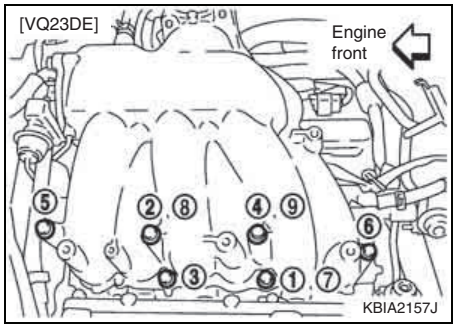
Tighten mounting bolts in numerical order as shown in the figure.

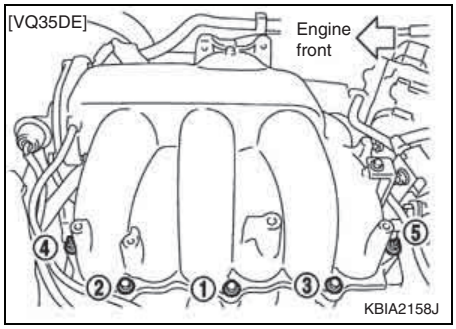
INTAKE MANIFOLD COLLECTOR (UPPER)



- Tighten mounting bolts in numerical order as shown in the figure.

INTAKE MANIFOLD COLLECTOR (LOWER)

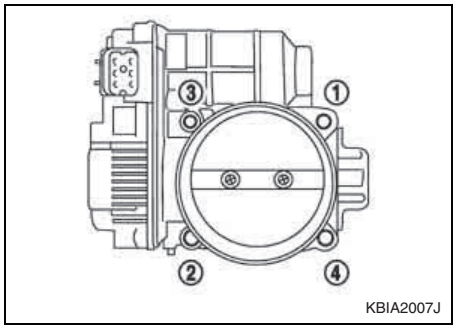




- Tighten mounting nuts and bolts in numerical order as shown in the figure.

REFERENCE

Tighten mounting bolts No. 1, 2 and 4 in two steps. The numerical order No. 7, 8 and 9 shown second step. (VQ23DE)

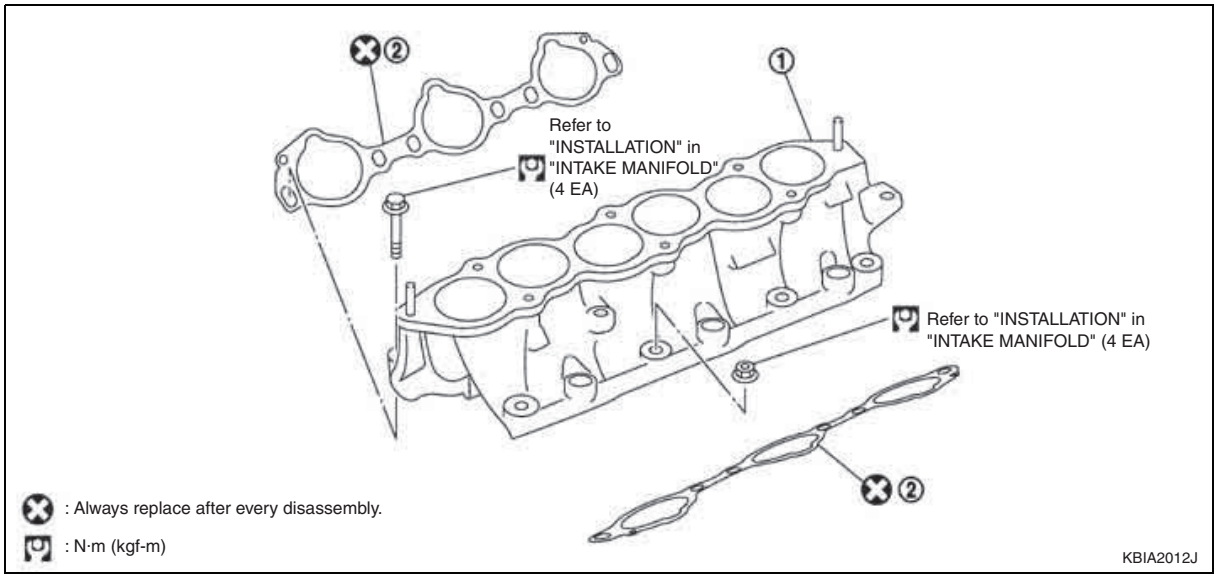


ELECTRIC THROTTLE CONTROL ACTUATOR

- Tighten mounting bolts in numerical order as shown in the figure.
- Perform the "Throttle Valve Closed Position Learning" when harness connector of electric throttle control actuator is disconnected. Refer to "Throttle Valve Closed PositionLearning" and "Quick TAS Learning".
- Perform the "Throttle Valve Closed PositionLearning" and "Quick TAS Learning" when electric throttle control actuator is replaced. Refer to "Throttle Valve Closed PositionLearning" and "Quick TAS Learning".

Intake Manifold

Components



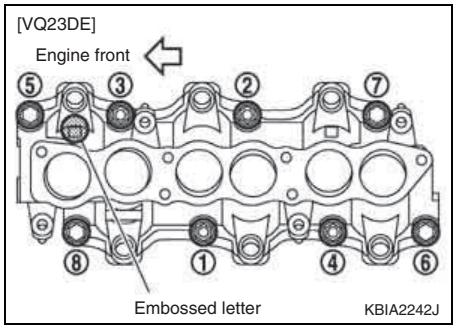
1. Intake manifold
2. Gasket

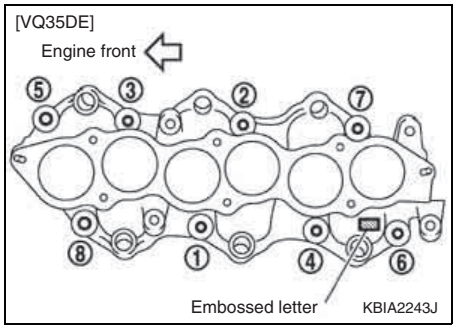
REFERENCE

Figure is shown as an example VQ35DE. VQ23DE has a different port shape, bolt hole for intake manifold collector (lower) installation and stud bolt position.

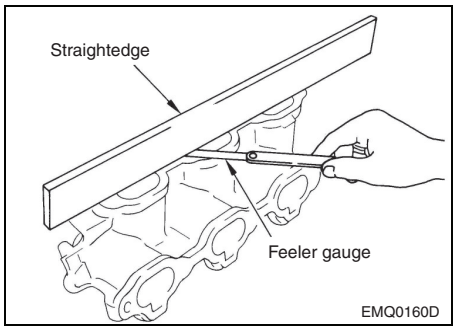
Removal

1. Release fuel pressure. Refer to "FUEL PRESSURE RELEASE".
2. Remove intake manifold collectors (upper and lower). Refer to "INTAKE MANIFOLD COLLECTOR".
3. Remove fuel tube and fuel injector assembly. Refer to "FUEL INJECTOR AND FUEL TUBE".
4. Loosen mounting nuts and bolts in reverse order as shown inthe figure to remove intake manifold.





Inspection after Removal



SURFACE DISTORTION

- Check the surface distortion of the intake manifold mating surfaces with straightedge and feeler gauge.

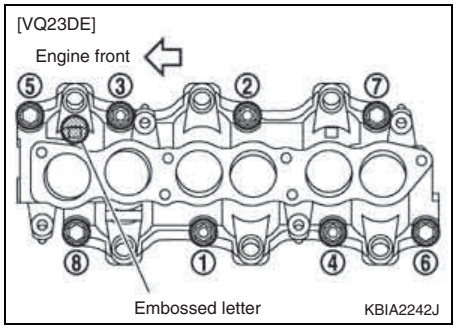
  Limit: 0.1 mm

- If it exceeds the limit, replace intake manifold.

Installation

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

INTAKE MANIFOLD

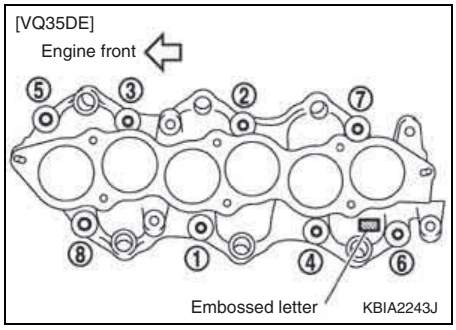


- If stud bolts were removed, install them and tighten to the specified torque below.

  Tightening torque : 10.8 N·m (1.1 kgf-m)

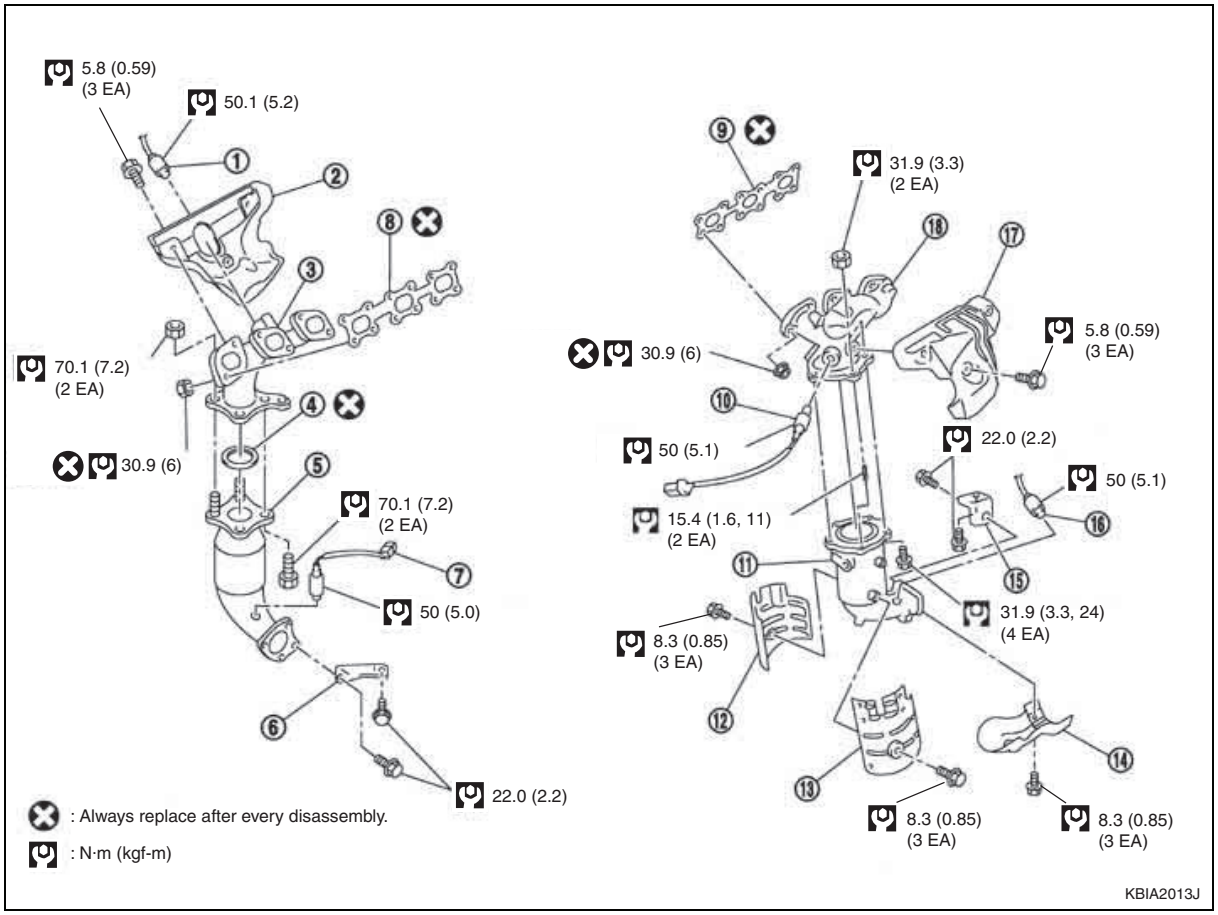
- Position the direction of embossed letter (LH) at the edge as shown in the figure, and install intake manifold.
- Tighten all mounting nuts and bolts to the specified torque in three or more steps in numerical order shown in the figure.

  1st step : 17.4 N·m (0.75 kgf-m)
  2nd step : 129.0 N·m (3.0 kgf-m)
  3rd step and after : 129.0 N·m (3.0 kgf-m)



Exhaust Manifold and Three Way Catalyst

Components



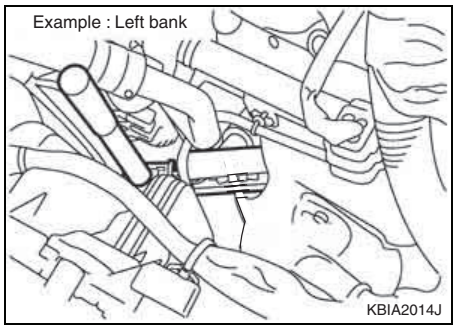
1. Heated oxygen sensor 1 (right bank)
2. Exhaust manifold cover
3. Exhaust manifold (right bank)
4. Ring gasket
5. Three way catalyst (right bank)
6. Three way catalyst support
7. Heated oxygen sensor 2 (right bank)
8. Gasket
9. Gasket
10. Heated oxygen sensor 1 (left bank)
11. Three way catalyst (left bank)
12. Three way catalyst cover
13. Three way catalyst cover
14. Three way catalyst cover
15. Three way catalyst support
16. Heated Heated oxygen sensor 2 (left bank)
17. Exhaust manifold cover
18. Exhaust manifold (left bank)

Removal

1. Remove following parts:
   - Engine cover; Refer to "INTAKE MANIFOLD COLLECTOR".
   - Air cleaner cases (upper and lower) with mass air flow sensor and air duct assembly; Refer to "AIR CLEANER AND AIR DUCT".
   - Undercover
   - Radiator and radiator cooling fan assembly; Refer to "RADIATOR".
   - Exhaust front tube; Refer to "EXHAUST SYSTEM".
2. Remove front engine mounting insulator and rear engine mounting insulator. Refer to "Removal and Installation" in "ENGINE ASSEMBLY" section.

CAUTION

- **Support oil pan (lower) bottom with transmission jack.**
- **Engine mounting insulators are installed on electronically controlled type. Make sure that the harness connector is disconnected.**
- **Be careful not to damage engine mounting insulator.**



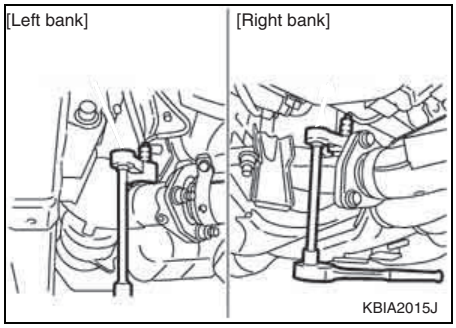
3. Remove heated oxygen sensor 1 from exhaust manifold with heated oxygen sensor wrench.

CAUTION

Be careful not to damage heated oxygen sensor 1.

REFERENCE

- **Figure is shown as an example of left bank.**
- **For right bank, insert the tool from engine rear to remove heated oxygen sensor 1.**

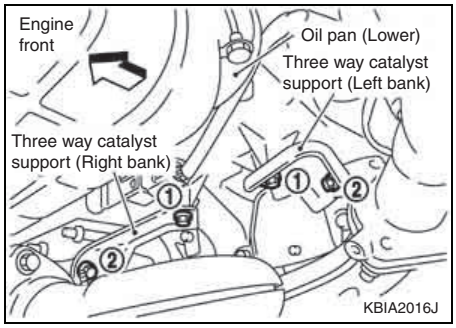


4. Remove heated oxygen sensor 2 from three way catalyst with heated oxygen sensor wrench.

CAUTION

Be careful not to damage heated oxygen sensor 2.

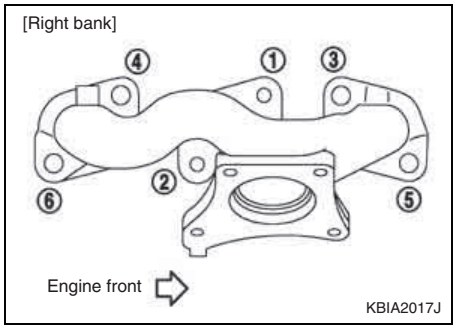
5. Remove exhaust manifold covers (right and left banks) and three way catalyst covers.



6. Remove mounting bolts in reverse order as shown in the figure to remove three way catalyst supports (right and left banks).
7. Remove three way catalysts (right and left banks).

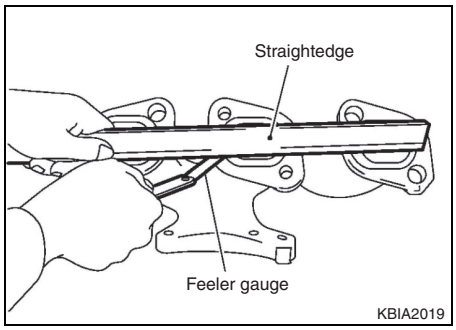
CAUTION

Handle carefully to avoid any shock to three way catalyst.



8. Loosen mounting nuts in reverse order as shown in the figure to remove exhaust manifolds (right and left banks).

Inspection after Removal



SURFACE DISTORTION

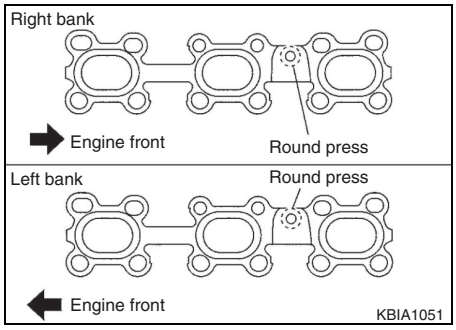
- Check the surface distortion of the exhaust manifold mating surfaces with straightedge and feeler gauge.

  Limit: 0.3 mm

- If it exceeds the limit, replace exhaust manifold.

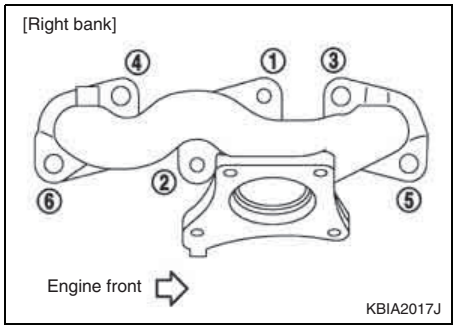
Installation

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



EXHAUST MANIFOLD GASKET

- Install in the direction indicated below. (same procedures in both banks)

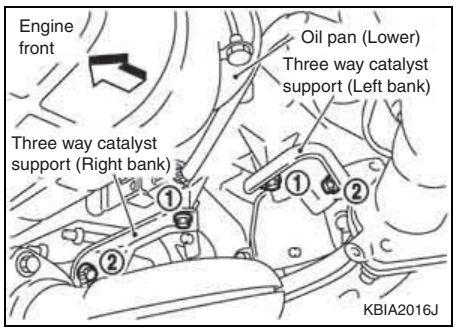


EXHAUST MANIFOLD

- If stud bolts were removed, install them and tighten to the specified torque below.

  Tightening torque : 15.4 N·m (1.6 kgf-m)

- Tighten mounting nuts in numerical order as shown in the figure and install exhaust manifold.

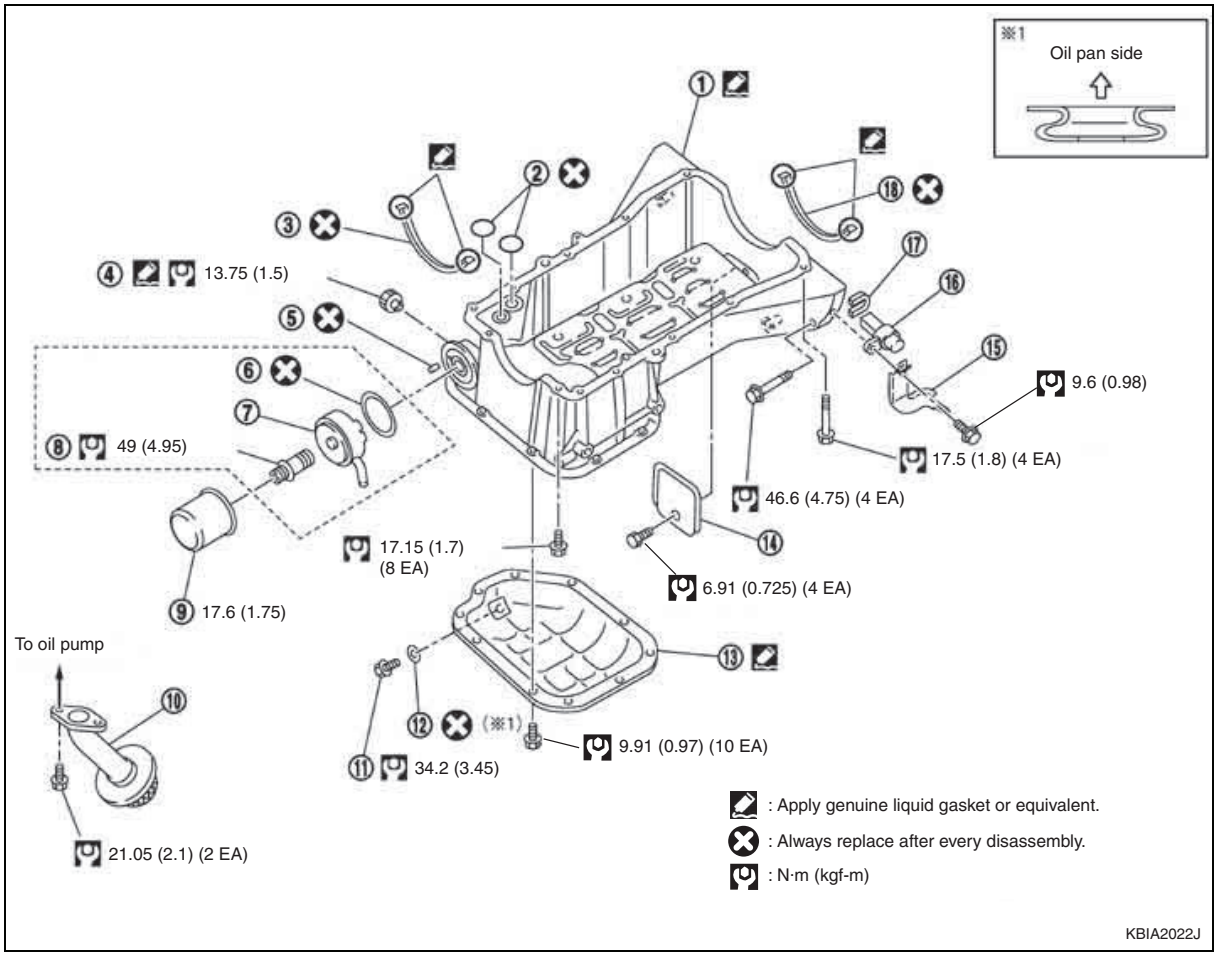


THREE WAY CATALYST SUPPORTS

- Temporarily tighten three way catalyst support mounting bolts. Tighten three way catalyst support mounting bolts to specified torque in numerical order as shown in the figure.

Oil Pan and Oil Strainer

Components



1. Oil pan (upper)
2. O-ring
3. Oil pan gasket
4. Oil pressure switch
5. Plug (VQ23DE)
   Relief valve (VQ35DE)
6. O-ring
7. Oil cooler
8. Connector bolt
9. Oil filter
10. Oil strainer
11. Drain plug
12. Drain plug washer
13. Oil pan (lower)
14. Rear plate cover
15. Harness bracket
16. Crankshaft position sensor (POS)
17. Seal rubber
18. Oil pan gasket

Removal

CAUTION

Perform this step when engine is cold.

REFERENCE

When removing oil pan (lower) or oil strainer only, take step 2 then step 10.

1. Remove following parts:
   - Engine cover; Refer to "INTAKE MANIFOLD COLLECTOR".
   - Undercover
   - Splash guard (RH, LH)
   - Exhaust front tube (Refer to "EXHAUST SYSTEM".)
   - Drive belts (Refer to "DRIVE BELTS".)

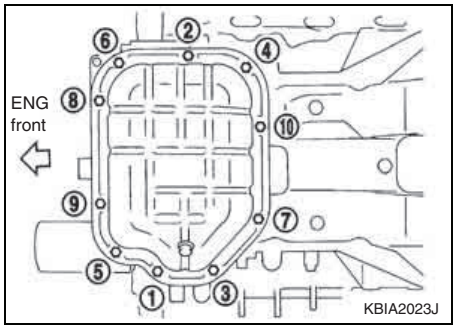
2. Drain engine oil. Refer to "Changing Engine Oil".
3. Drain engine coolant. Refer to "Changing Engine Coolant".
4. Remove alternator. (Refer to "Charging System".
5. Remove A/C compressor with piping connected, and temporarily secure it to aside. Refer to "Cooler Cycle".
6. Remove three way catalysts (right and left banks) from exhaust manifolds (right and left banks). Refer to "EXHAUST MANIFOLD AND THREE WAY CATALYST".
7. Remove oil pressure switch. Refer to "Engine Oil", "OIL PRESSURE CHECK".

8. Remove crankshaft position sensor (POS).

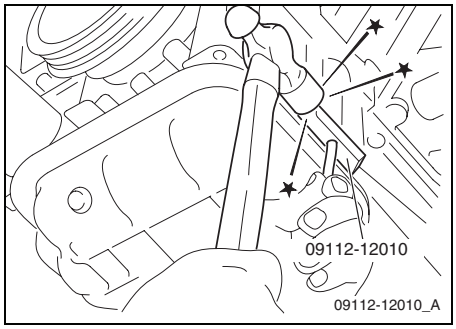
CAUTION

- **Handle carefully to avoid dropping and shocks.**
- **Do not disassemble. (Disassembly prohibited parts)**

9. Remove oil filter. Refer to "OIL FILTER".
10. Remove oil cooler and water pipes. Refer to "OIL COOLER (VQ35DE)".



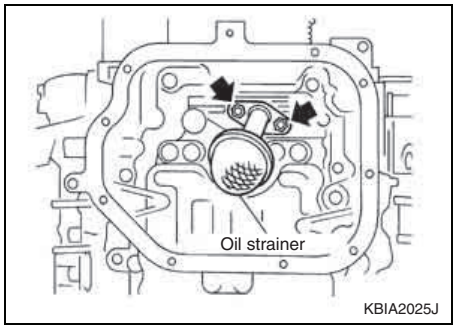
11. Remove oil pan (lower) as follows:
    a. Loosen mounting bolts in reverse order as shown in the figure.



    b. Insert seal cutter (09112-12010) between oil pan (lower) and oil pan (upper). Slide it by tapping on the side of the tool with hammer. Remove oil pan (lower)

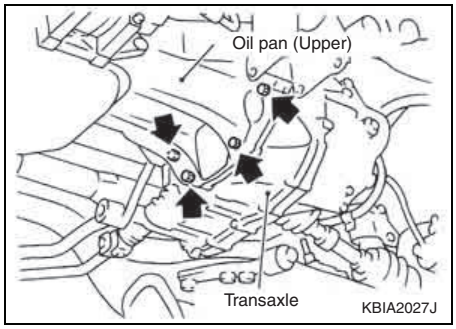
CAUTION

Be careful not to damage the mating surfaces.

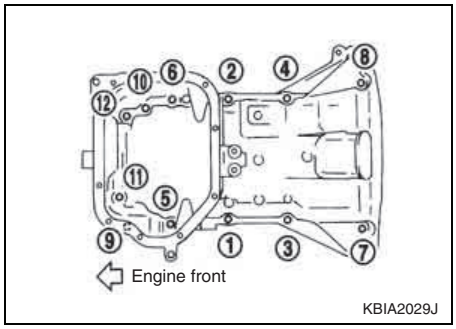


12. Remove oil strainer.

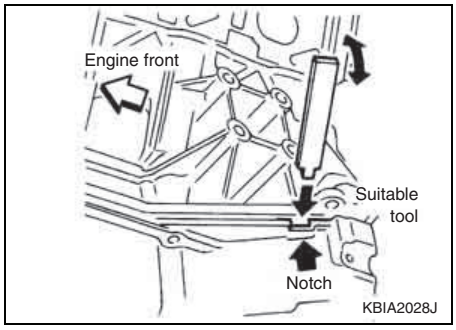
13. Remove oil pan (upper) as follows:
a. Remove transaxle joint bolts which pierce oil pan (upper).



b. Loosen mounting bolts in reverse order as shown in the figure and remove them.



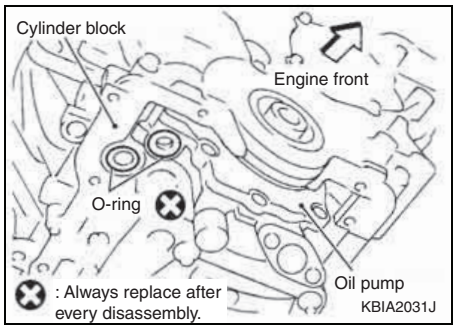
c. Insert suitable tool into the notch of oil pan (upper). Pry off oil pan (upper) by moving tool up and down to remove oil pan (upper).



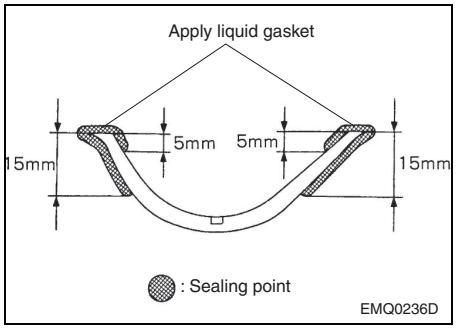
Inspection after Removal

- Check if any object is attached on oil strainer.
- Clean oil strainer if any object attached.

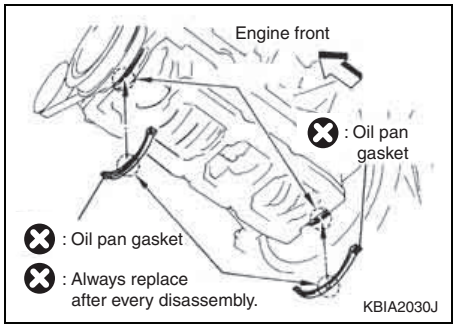
Installation



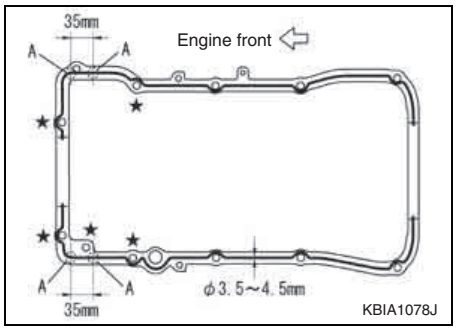
1. Install oil pan (upper) as follows:
   a. Install new O-rings (2) on the bottom of cylinder block and oil pump.



   b. Install oil pan gaskets.
      - Apply liquid gasket (Threebond 1217 F or equivalent) to new oil pan gaskets as shown in the figure. (Refer to "LIQUID GASKET APPLICATION PROCEDURE".)



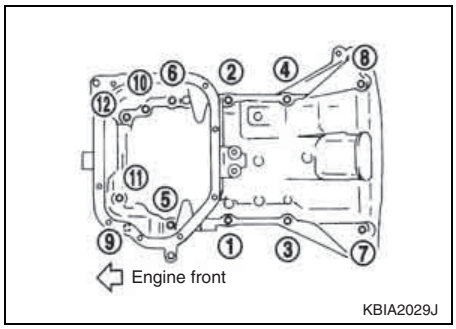
      - To install, align protrusion of oil pan gasket with notches of front timing chain case and rear oil seal retainer.
      - Install oil pan gasket with smaller arc to front timing chain case side.



   c. Apply a continuous bead of liquid gasket (Threebond H or equivalent) to cylinder block mating surface of oil pan (upper) as shown in the figure.

CAUTION

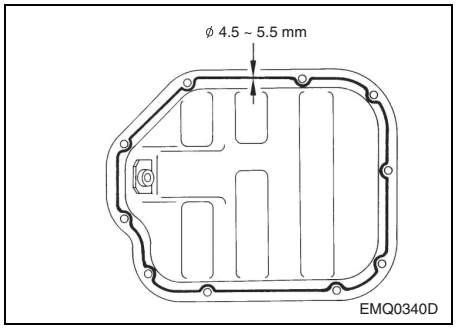
- **For bolt holes with marks (5 locations), apply liquid gasket outside the holes.**
- **Apply a bead of 4.5 to 5.5 mm diameter to area "A".**



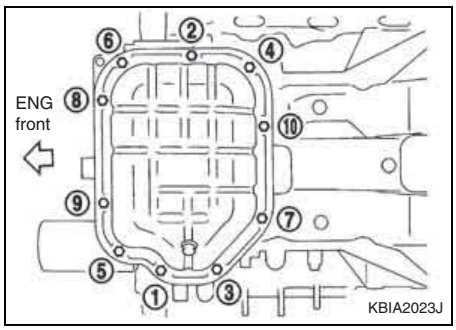
d. Tighten bolts in numerical order as shown in the figure.
   - Install avoiding misalignment of both oil pan gasket and O-rings.

e. Install transaxle joint bolts.

2. Install oil strainer to oil pump.



3. Install oil pan (lower) as follows:
   a. Apply a continuous bead of liquid gasket (Threebond 1217 H or equivalent) to oil pan (lower) as shown in the figure. Refer to "LIQUID GASKET APPLICATION PROCEDURE".



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

4. Install oil pan drain plug.
   (For installation direction of drain plug washer, refer to "Components", "Removal and Installation".)
5. Install in the reverse order of removal after this step.

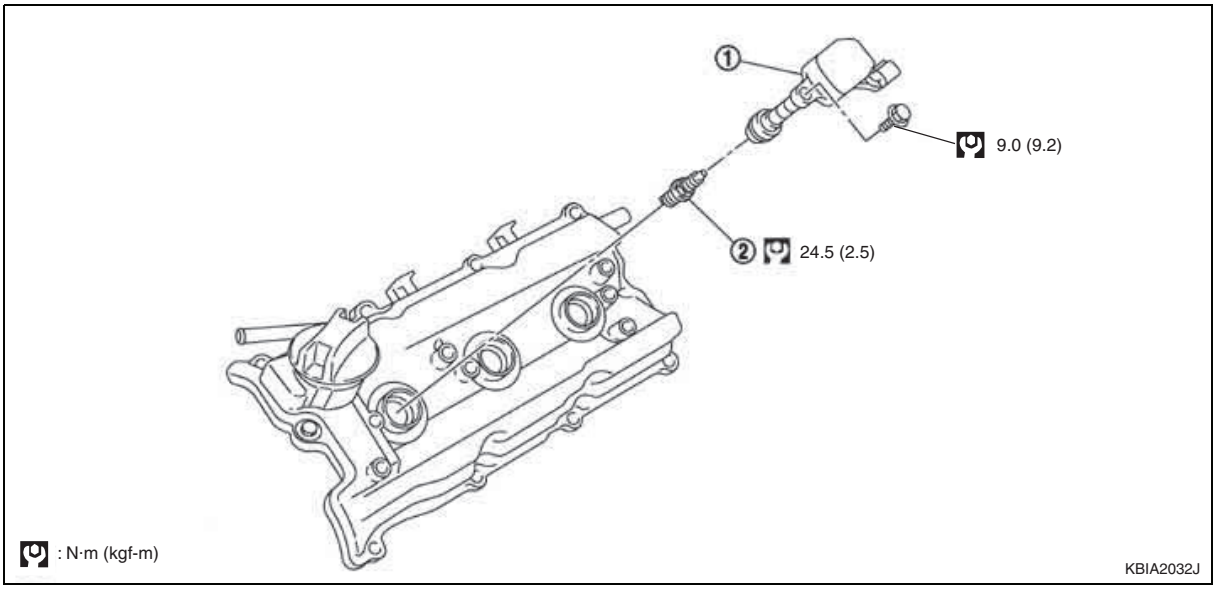
6. At least 30 minutes after oil pan is installed, pour engine oil.

Inspection after Installation

1. Check the engine oil level. Refer to "ENGINE OIL".
2. Start engine and make sure there is no leak of engine oil. Refer to "ENGINE OIL".
3. Stop engine and check the engine oil level again. Refer to "ENGINE OIL".

Ignition Coil

Components



1. Ignition coil
2. Spark plug

Removal

1. Remove engine cover. Refer to "INTAKE MANIFOLD COLLECTOR".
2. Remove intake manifold collectors (upper and lower). (At the right bank side, remove ignition coil) Refer to "INTAKE MANIFOLD COLLECTOR".
3. Move aside harness, harness bracket, and hoses located above ignition coil.
4. Disconnect harness connector from ignition coil.
5. Remove ignition coil.

CAUTION

Do not drop or shock it.

6. Remove spark plug using spark plug wrench (commercial service tool). Refer to SPARK PLUG (PLATINUM-TIPPED TYPE).

Installation

Install in the reverse order of removal.

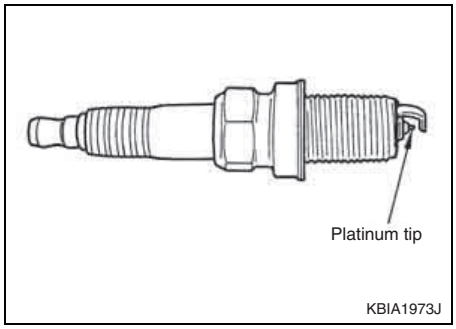
Spark Plug

Removal and Installation

REMOVAL

1. Remove ignition coil. Refer to "IGNITION COIL".
2. Remove spark plug using spark plug wrench (commercial service tool).

Inspection after Removal



Check electrode for damage and wear. Check insulator for damage.

CAUTION

- **Checking and adjusting plug gap is not required if it is platinum-tipped type.**
- **Do not insert a feeler gauge between electrode gap. Do not use wire brush for cleaning.**
- **If plug tip is covered with carbon, spark plug cleaner may be used. Cleaner air pressure: Less than 0.59 MPa (6 kg/cm^2), Cleaning time: Less than 20 seconds**

Installation

Install in the reverse order of removal.

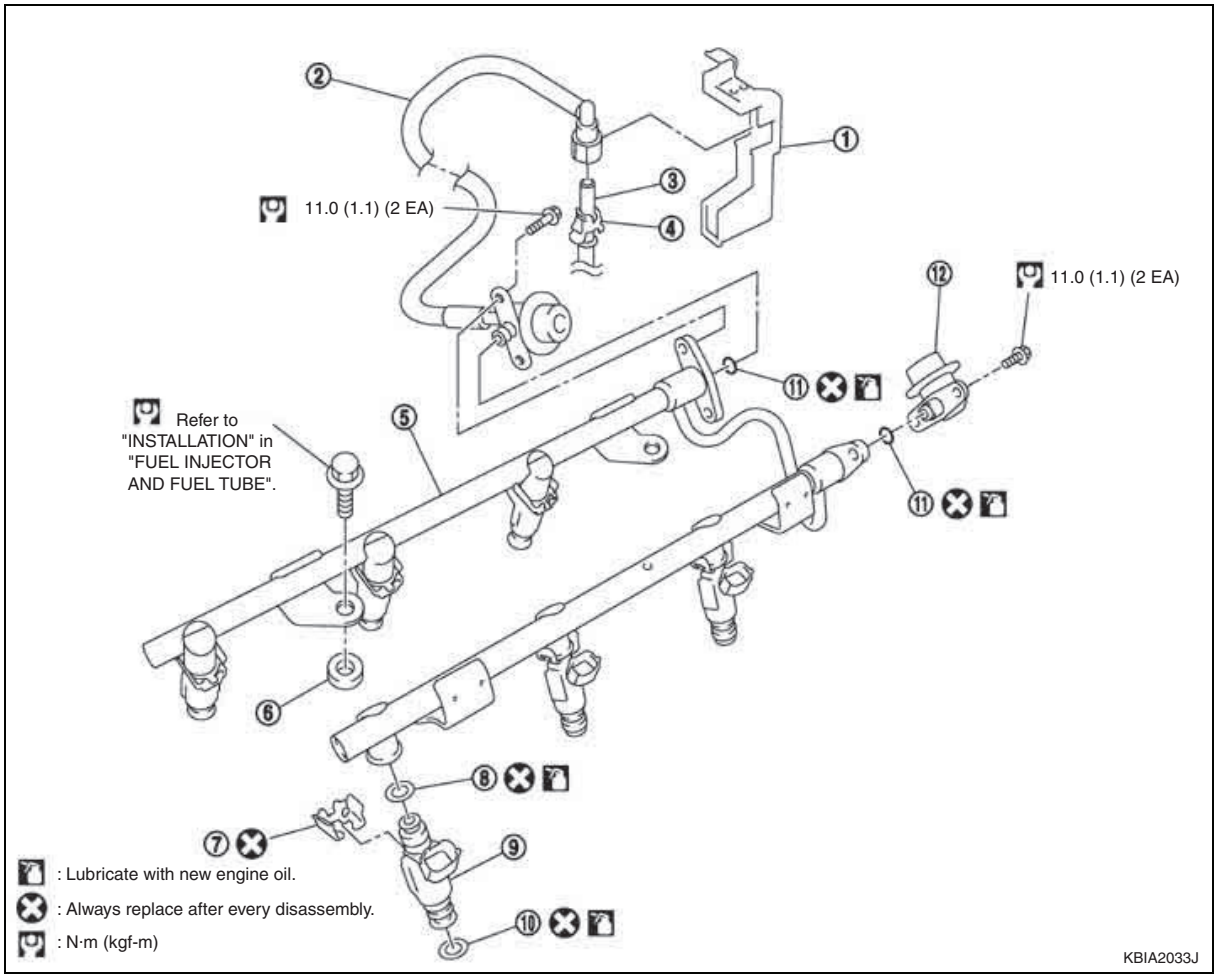
Tightening torque : 24.5 N·m (2.5 kgf-m)

Change Interval

Every 100,000 km (Platinum-tipped type)

Fuel Injector and Fuel Tube

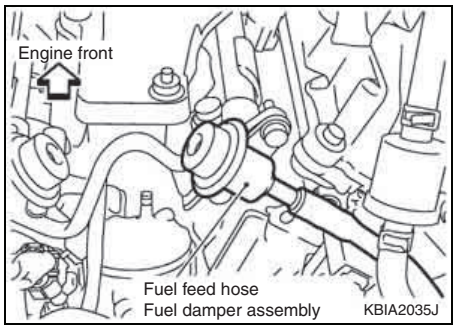
Components



1. Quick connector cap
2. Fuel feed hose (with damper)
3. Centralized under-floor piping
4. Retainer
5. Fuel tube
6. Insulator
7. Clip
8. O-ring (black)
9. Fuel injector
10. O-ring (green)
11. O-ring
12. Fuel damper

Removal

1. Remove engine cover. Refer to "INTAKE MANIFOLD COLLECTOR".
2. Release the fuel pressure. Refer to "FUEL PRESSURE RELEASE".
3. Remove air cleaner case, mass air flow sensor and air duct assembly. Refer to "AIR CLEANER AND AIR DUCT".
4. Remove intake manifold collectors (upper and lower). Refer to "INTAKE MANIFOLD COLLECTOR".



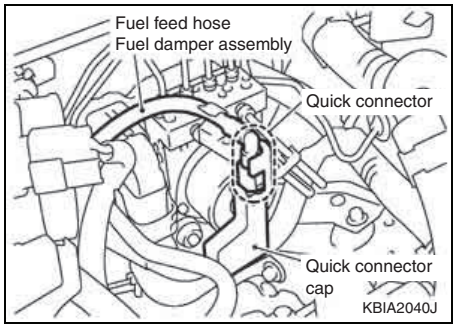
5. Remove fuel feed hose (with damper) from fuel tube.

CAUTION

- **While hose disconnected, plug it to prevent fuel from draining.**
- **Do not separate fuel damper and fuel feed hose.**

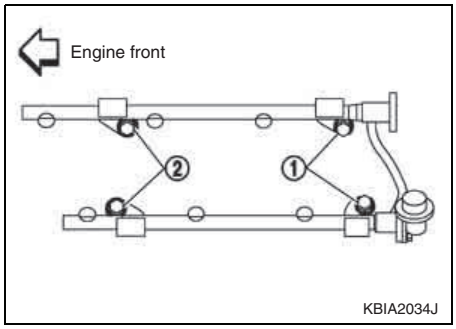
REFERENCE

No return lines.



6. When separating fuel feed hose (with damper) and centralized under-floor piping connection, disconnect quick connector as follows:
   a. Remove quick connector cap from quick connector.
   b. Remove quick connector. Refer to "Fuel gauge, fuel filter and fuel pump assembly".

7. Disconnect harness connector from fuel injector.



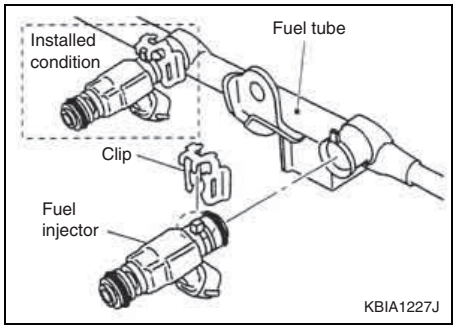
8. Loosen mounting bolts in reverse order as shown in the figure, and remove fuel tube and fuel injector assembly.

CAUTION

Do not tilt it, or remaining fuel in pipes may flow out from pipes.

REFERENCE

No orders between bolts with same unfastening number.



9. Remove fuel injector from fuel tube as follows:
   a. Open and remove clip.
   b. Remove fuel injector from fuel tube by pulling straight.

CAUTION

- **Be careful with remaining fuel that may go out from fuel tube.**
- **Be careful not to damage injector nozzle during removal.**
- **Do not bump or drop fuel injector.**
- **Do not disassemble fuel injector. (disassembly prohibited parts)**

10. Remove fuel damper from fuel tube.

Installation

1. Install fuel damper.
   - When handling new O-rings, be careful of the following caution:

⚠ CAUTION

- **Handle O-ring with bare hands. Do not wear gloves.**
- **Lubricate O-ring with new engine oil (low viscosity grade such as 5W-30).**
- **Do not clean O-ring with solvent.**
- **Make sure that O-ring and its mating part are free of foreign material.**
- **When installing O-ring, be careful not to scratch it with tool or fingernails. Also be careful not to twist or stretch O-ring. If O-ring was stretched while it was being attached, do not insert it quickly into fuel tube.**
- **Insert new O-ring straight into fuel damper. Do not decenter or twist it.**

   - Insert fuel damper straight into fuel tube.
   - Tighten mounting bolts evenly in turn.
   - After tightening mounting bolts, make sure that there is no gap between flange and fuel tube.

2. Install new O-rings to fuel injector paying attention to the following.

⚠ CAUTION

Upper and lower O-rings are different. Be careful not to confuse them.

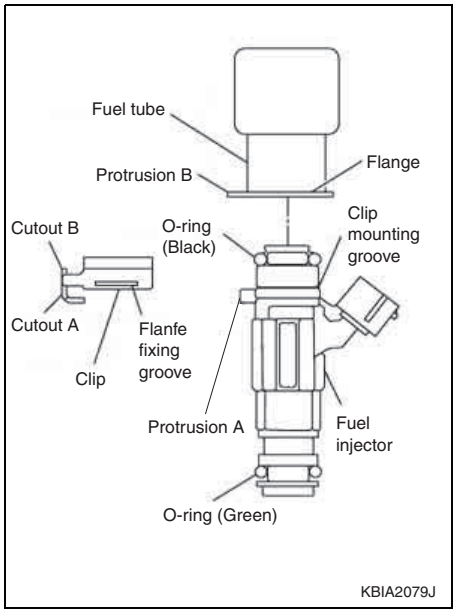
Upper (Fuel tube side): Black
Lower (Intake manifold side): Green

- **Handle O-ring with bare hands. Do not wear gloves.**
- **Lubricate O-ring with new engine oil (low viscosity grade such as 5W-30).**
- **Do not clean O-ring with solvent.**
- **Make sure that O-ring and its mating part are free of foreign material.**
- **When installing O-ring, be careful not to scratch it with tool or fingernails. Also be careful not to twist or stretch O-ring. If O-ring was stretched while it was being attached, do not insert it quickly into fuel tube.**
- **Insert new O-ring straight into fuel damper. Do not decenter or twist it.**

3. Install fuel injector to fuel tube as follows:
   a. Insert new clip into clip mounting groove on fuel injector.
      - Insert clip so that protrusion "A" of fuel injector matches cutout "A" of clip.

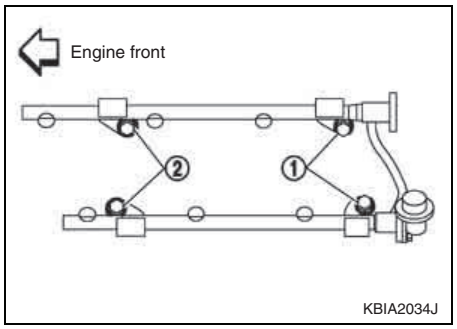
⚠ CAUTION

Be careful to keep clip from interfering with O-ring. If interference occurs, replace O-ring.



b. Insert fuel injector into fuel tube with clip attached.
- Insert it while matching it to the axial center.
- Insert fuel injector so that protrusion "B" of fuel tube matches cutout "B" of clip.
- Make sure that fuel tube flange is securely fixed in flange fixing groove on clip.

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



4. Install fuel tube and fuel injector assembly to intake manifold.

CAUTION

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

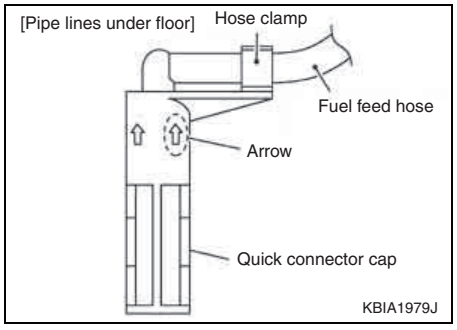
- Tighten mounting bolts in two steps in numerical order as shown in the figure.

REFERENCE

No orders between bolts with same fastening number.
1st step: 10.1 N·m (1.0 kgf-m)
2nd step: 23.6 N·m (2.4 kgf-m)

5. Connect fuel injector harness connector.
6. Install intake manifold collectors (upper and lower). Refer to "INTAKE MANIFOLD COLLECTOR".
7. Connect fuel feed hose (with damper).
- Handling procedure of O-ring is the same as that of fuel damper.
- Insert fuel damper straight into fuel tube.
- Tighten mounting bolts evenly in turn.
- After tightening mounting bolts, make sure that there is no gap between flange and fuel tube.

8. Connect quick connector between fuel feed hose (with damper) and centralized under-floor piping connection as follows:
a. Connect quick connector. Refer to FUEL GAUGE, FUEL FILTER AND FUEL PUMP ASSEMBLY.
b. Install quick connector cap.
- Install so that the arrow mark on the side faces up.



CAUTION

- **Make sure that quick connector and fuel tube are securely fit into quick connector cap installation groove.**
- **If quick connector cap cannot be installed smoothly, quick connector may have not been installed correctly. Remove quick connector cap to check connection again.**

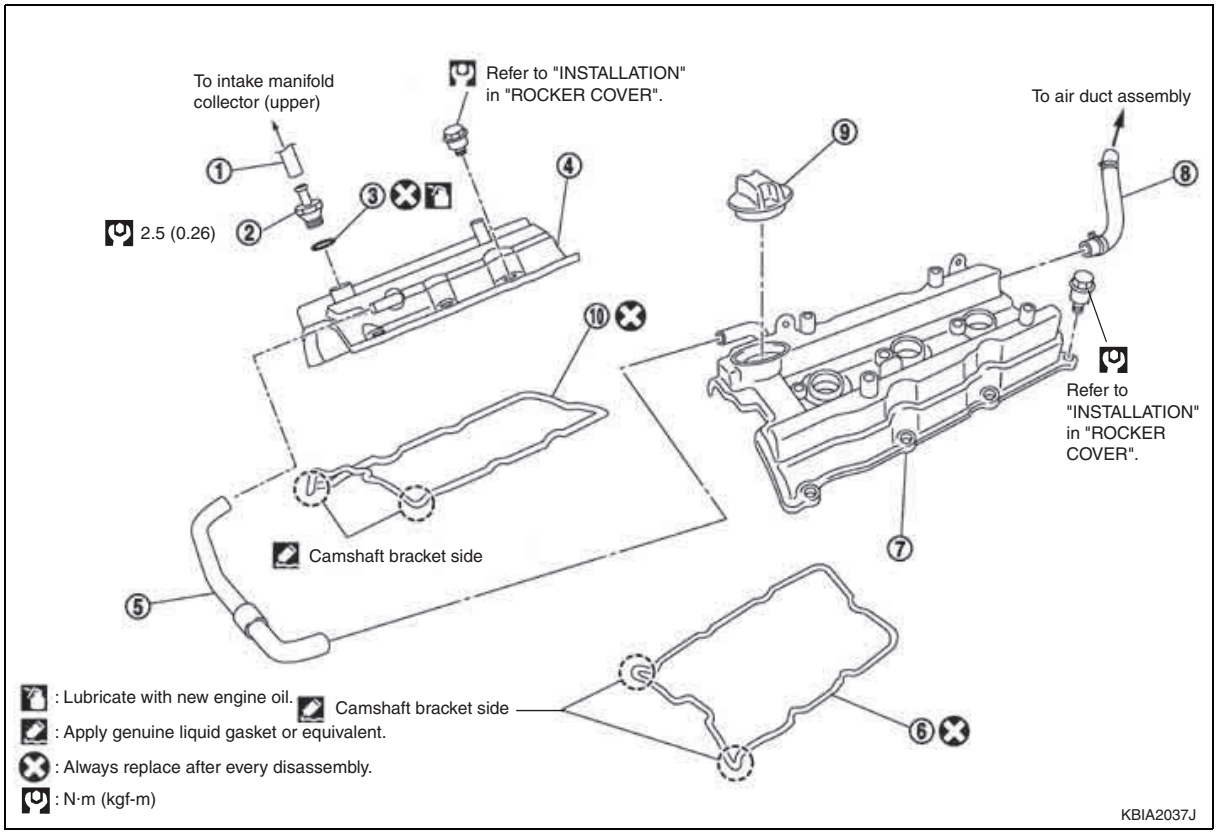
c. Install fuel feed hose to hose clamp on quick connector cap.
9. Install in the reverse order of removal after this step.

Inspection after Installation

- Use the following procedure to check for fuel leaks.
  - Turn ignition switch "ON" (with engine stopped), then check connections for leaks by applying fuel pressure to fuel piping.
  - Start engine, rev it up and make sure there are no fuel leaks at the fuel system connections.

Rocker Cover

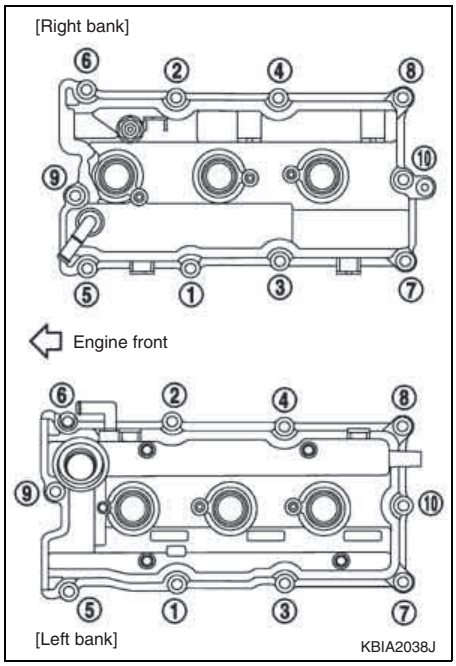
Components



1. Blow-by hose
2. Blow-by control valve
3. O-ring
4. Rocker cover (right bank)
5. Blow-by hose
6. Rocker cover gasket
7. Rocker cover (left bank)
8. Blow-by hose
9. Oil filler cap
10. Rocker cover gasket

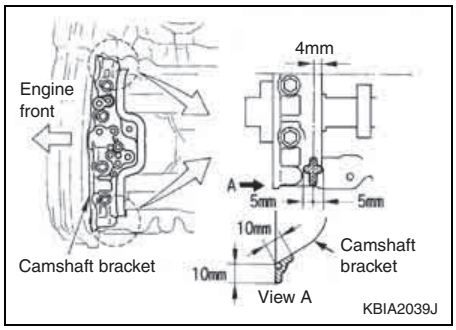
Removal

1. Remove engine cover. Refer to "INTAKE MANIFOLD COLLECTOR".
2. Remove intake manifold collectors (upper and lower). (At the right bank side, remove ignition coil) Refer to "INTAKE MANIFOLD COLLECTOR".
3. Remove ignition coil. Refer to "IGNITION COIL".
4. Remove blow-by hoses from rocker covers.



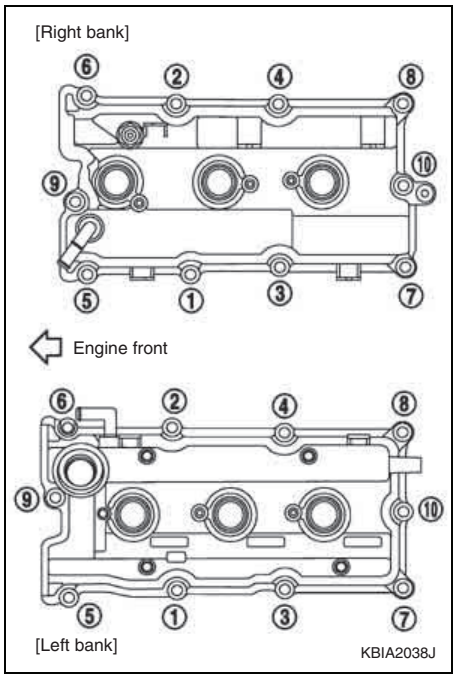
5. Loosen mounting bolts in reverse order as shown in the figure. Remove rocker covers.

Installation



1. Apply liquid gasket (Threebond 1217 F or equivalent) with a bead of 3.0 mm diameter to the area (for both banks) shown in the figure.
   - Apply to the "A" area in the figure first. Refer to "LIQUID GASKET APPLICATION PROCEDURE".

2. Install rocker cover.
   - Check if rocker cover gasket is not dropped from installation groove of rocker cover.



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

1st step tightening torque : 1.96 N·m (0.20 kgf-m)
2nd step tightening torque : 8.33 N·m (0.85 kgf-m)

4. Install blow-by hoses.
   - Insert blow-by hose by 25 to 30 mm (0.98 to 1.18 in) from connector end.
   - When installing, be careful not to twist or come in contact with other parts.

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

Front Timing Chain Case

REFERENCE

- **This section describes removal/installation procedure of front timing chain case and timing chain related parts without removing oil pan (upper) on vehicle.**
- **When oil pan (upper) needs to be removed or installed, or when rear timing chain case is removed or installed, remove oil pan (upper) first. Then remove front timing chain case, timing chain related parts and rear timing chain case in this order, and install in reverse order of removal.**
- **Refer to "TIMING CHAIN".**
- **Refer to "TIMING CHAIN" for component parts location.**

Removal

1. Remove air duct (inlet), air cleaner case with mass air flow sensor and air duct assembly. Refer to "AIR CLEANER AND AIR DUCT".
2. Remove engine cover. Refer to "INTAKE MANIFOLD COLLECTOR".
3. Remove undercover and splash guard (RH).
4. Remove right side front road wheel and tire. Refer to "ROAD WHEEL TIRE".
5. Drain engine oil. Refer to "Engine Oil".

CAUTION

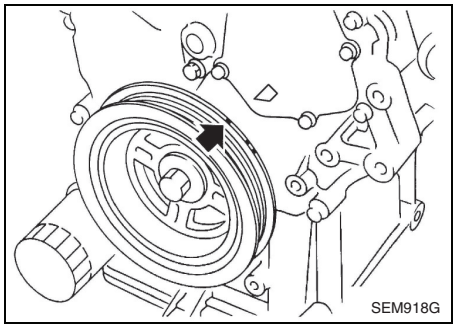
Perform this step when engine is cold.

6. Drain engine coolant. Refer to "Changing Engine Coolant".
7. Remove following parts:
   - Intake manifold collectors (upper and lower). Refer to "INTAKE MANIFOLD COLLECTOR".
   - Drive belts. Refer to "DRIVE BELTS".
   - Alternator. Refer to "CHARGING SYSTEM".
   - Power steering oil pump(from bracket with piping connected, and temporarily secure it to aside) and power steering oil pump bracket. Refer to "POWER STEERING OIL PUMP".
   - Boggy brackets from front timing chain case

8. Remove roker cover (right and left bank). Refer to "ROCKER COVER".

REFERENCE

When timing chain (secondary) is not removed/installed, this step is not required.

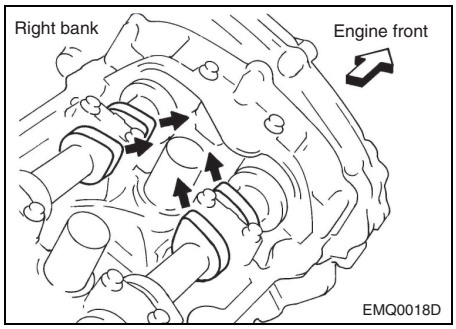


9. Obtain No. 1 cylinder at TDC of its compression stroke as follows.

REFERENCE

When timing chain is not removed/installed, this step is not required.

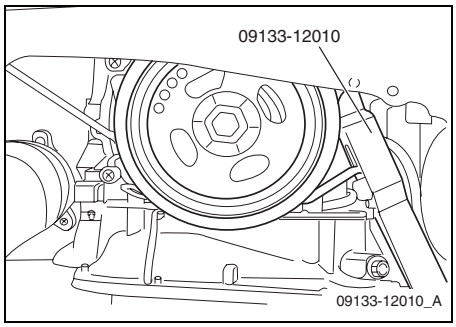
   a. Rotate crankshaft pulley clockwise to align timing mark (grooved line without color) with timing indicator.



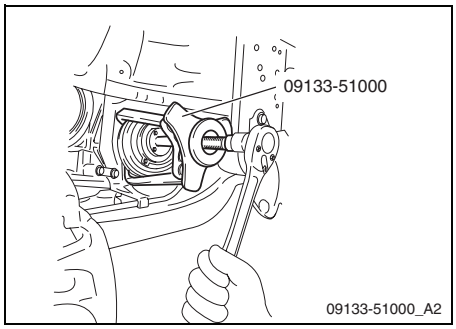
b. Make sure that intake and exhaust cam noses on No. 1 cylinder (engine front side of right bank) are located as shown in the figure.
   - If not, turn crankshaft pulley one revolution (360 degrees) and align as shown in the figure.

REFERENCE

When only timing chain (primary) is removed, rocker cover does not need to be removed. To make sure that No. 1 cylinder is at its compression TDC, remove front timing chain case first. Then check mating marks on camshaft sprockets. Refer to "TIMING CHAIN".



10. Remove crankshaft pulley as follows.
    a. Fix crankshaft with pulley holder (09133-12010).
    b. Loosen crankshaft pulley bolt and locate bolt seating surface at 10 mm (0.39 in) from its original position.

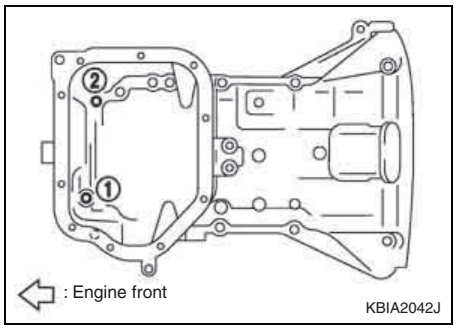


c. Remove crankshaft pulley using crankshaft pulley puller (09133-51000).

CAUTION

Do not put suitable puller tab on crankshaft pulley periphery.

11. Remove oil pans (lower). Refer to "OIL PAN AND OIL STRAINER".

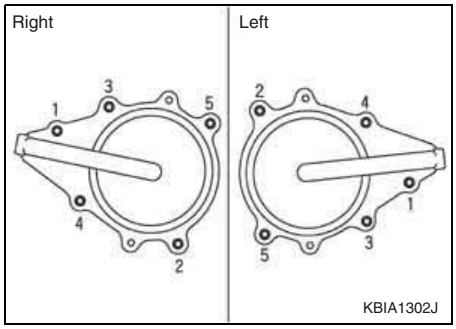


12. Loosen two mounting bolts in front of oil pan (upper) in reverse order as shown in the figure.

13. Install oil pan (lower) temporarily and perform following operating with engine front-side supported with jack.
    - Applying liquid gasket is unnecessary.
14. Support the oil pan (lower) bottom with jack.

⚠ CAUTION

Put a piece of wood or something similar as the supporting surface and be careful not to damage oil pan (lower).

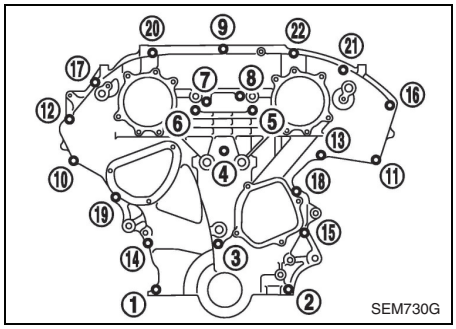


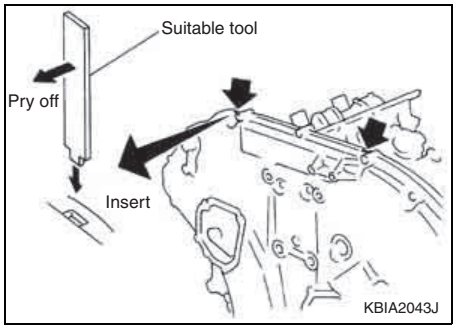
15. Remove right and left CVTC covers.
    - Loosen mounting bolts in reverse order as shown in the figure.
    - Use seal cutter (09112-12010) or equivalent tool to cut liquid gasket for removal.

⚠ CAUTION

Shaft is internally jointed with camshaft sprocket center hole. When removing, keep it horizontal until it is completely disconnected.

16. Remove engine front mounting insulator and engine mounting bracket.
    Refer to "Removal and Installation" in "ENGINE ASSEMBLY" section.
17. Raise engine front-side with jack.
18. Remove front timing chain case as follows:
    a. Loosen and remove mounting bolts in reverse order as shown in the figure.



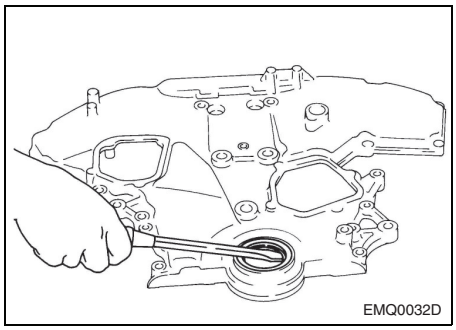


    b. Insert suitable tool into the notch at the top of rear timing chain case as shown in the figure and pry off case to remove front timing chain case.

⚠ CAUTION

- **Be careful not to damage the seal surfaces.**
- **After removal, handle front timing chain case carefully so it does not tilt, cant, or warp under a load.**

19. Remove water pump cover and chain tensioner cover from front timing chain case.
    - Use seal cutter (09112-12010) or equivalent tool to cut liquid gasket for removal.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20. Remove front oil seal from front timing chain case using suitable tool.
    - Use screwdriver for removal.

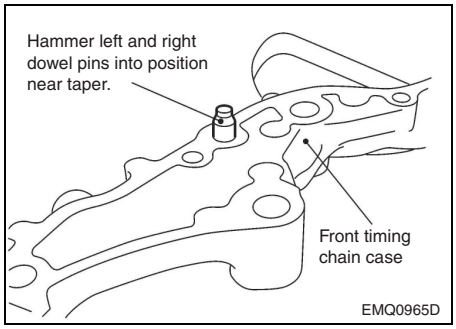
CAUTION

Be careful not to damage front timing chain case.

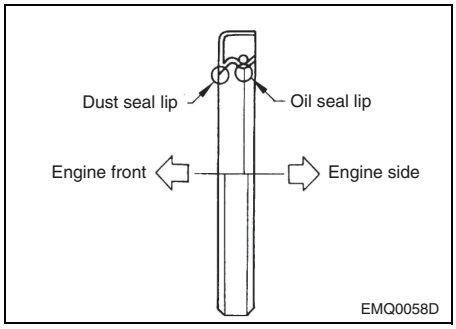
21. Remove timing chain and related parts. Refer to "TIMING CHAIN".

Installation

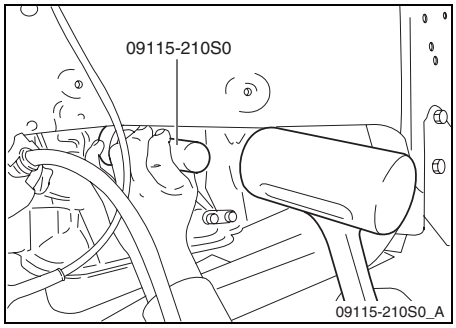
1. Install timing chain and related parts. Refer to "TIMING CHAIN".



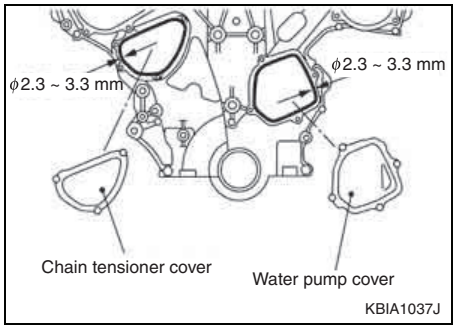
2. Hammer dowel pins (right and left) into front timing chain case up to a point close to taper in order to shorten protrusion length.



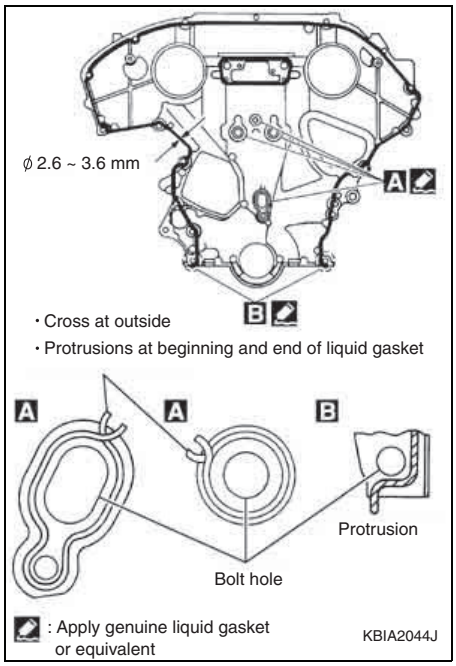
3. Install new front oil seal on front timing chain case.
   - Install it so that each seal lip is oriented as shown in the figure.



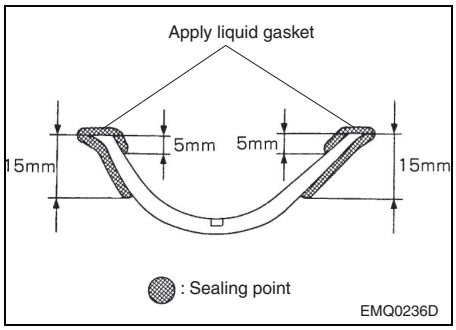
   - Using front oil seal drift (09115-21010 and 09115-21030), press-fit oil seal until it becomes flush with front timing chain case end face.
   - Make sure the garter spring is in position and seal lip is not inverted.



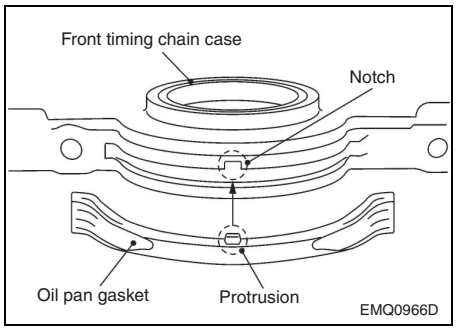
4. Install water pump cover and timing chain tensioner cover to front cover.
   - Apply a continuous bead of liquid gasket (Threebond 1217 F or equivalent) to front timing chain case as shown in the figure. Refer to "LIQUID GASKET APPLICATION PROCEDURE".



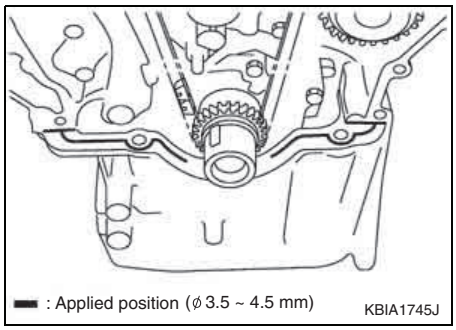
5. Install front timing chain case as follows:
   a. Apply a continuous bead of liquid gasket (Threebond 1217 H or equivalent) to front timing chain case back side as shown in the figure. Refer to "LIQUID GASKET APPLICATION PROCEDURE".



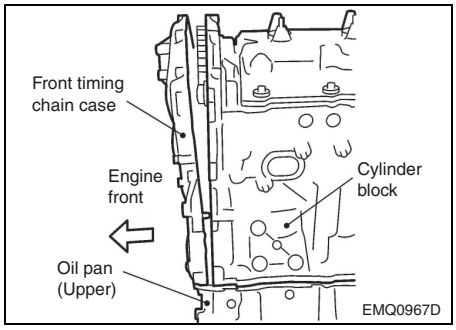
   b. Install oil pan gasket.
   - Apply liquid gasket (Threebond 1217 F or equivalent) to oil pan gasket as shown in the figure.



   - Align notch of front timing chain case with protrusion of oil pan gasket.



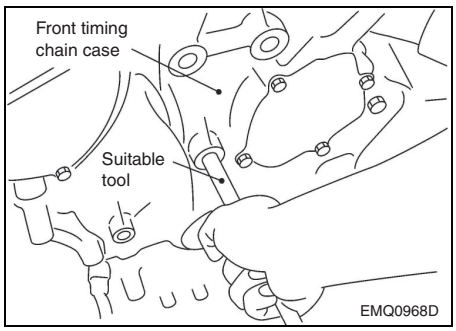
   - Apply liquid gasket (Threebond 1217 H or equivalent) to top surface of oil pan (upper) as shown in the figure.



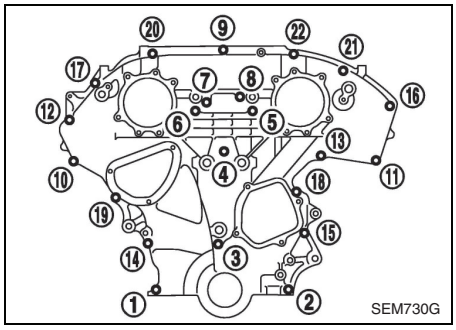
c. Assemble front timing chain case as follows:
   i. Fit lower end of front timing chain case tightly onto top face of oil pan (upper). From the fitting point, make entire front timing chain case contact rear timing chain case completely.

⚠ CAUTION

Be careful that oil pan gasket is in place.



   ii. Since front timing chain case is offset for difference of bolt holes, tighten bolts temporarily with holding front timing chain case from front and top as shown in the figure.
   iii. Same as the step ii, insert dowel pin with holding front timing chain case from front and top completely.

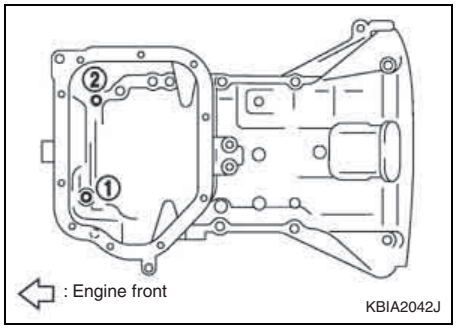


d. Tighten mounting bolts in numerical order as shown in the figure.
   • There are two types of mounting bolt. Refer to the following figure for locating bolts.

   Bolt diameter M8 (1, 2 in the figure)
   M6 (except 1, 2 in the figure)

e. After all bolts tightening, retighten them to the specified torque in numerical order as shown in the figure.

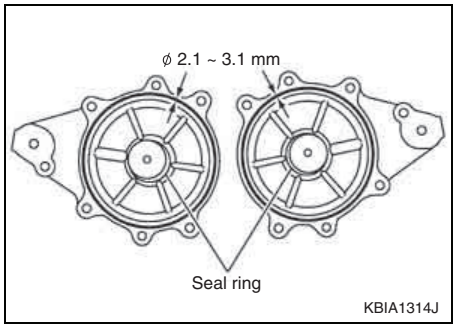
6. Install engine mounting bracket (RH) and engine mounting insulator (RH). Refer to "Removal and Installation" in "ENGINE ASSEMBLY" section.
7. Remove floor jack which supports the oil pan (lower) bottom.
8. Remove oil pan (lower).



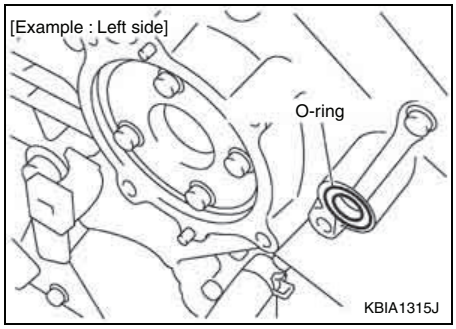
9. Install two mounting bolts in front of oil pan (upper) in numerical order as shown in the figure.

   Tightening torque : 17.15 N·m (1.7 kgf-m)

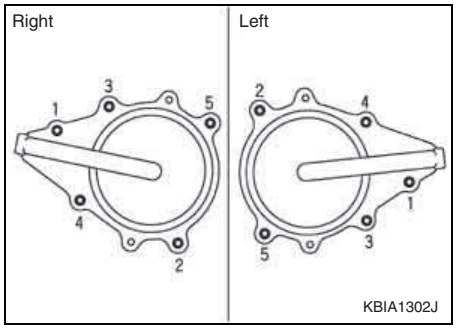
10. Install oil pan (lower). Refer to "OIL PAN AND OIL STRAINER".



11. Install right and left CVTC covers as follows:
    a. Install new seal rings in shaft grooves.
    b. Apply a continuous bead of liquid gasket (Threebond 1217 F or equivalent) to front timing chain case as shown in the figure. Refer to "LIQUID GASKET APPLICATION PROCEDURE".



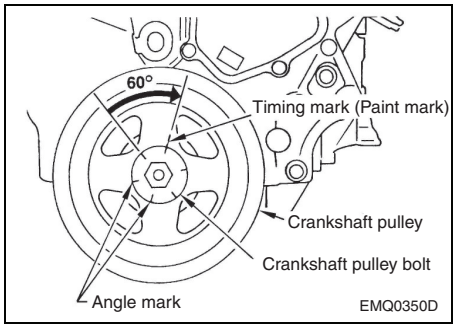
    c. Install new collared O-rings in front cover oil holes (left and right sides).



    d. Being careful not to move seal rings from the installation grooves, align dowel pins on front timing chain case with the holes to CVTC covers.
    e. Tighten mounting bolts in numerical order as shown in the figure.

12. Install crankshaft pulley as follows:
    a. Install crankshaft pulley, taking care not to damage front oil seal.
        • When press-fitting crankshaft pulley with plastic hammer, tap on its center portion (not circumference).
    b. Fix crankshaft pulley with pulley holder and tighten crankshaft pulley mounting bolt.

Tightening torque : 44 N·m (4.5 kgf-m)



    c. Put a paint mark on crankshaft pulley aligning with angle mark on crankshaft pulley mounting bolt. Then, further retighten bolt by 60 to 65 degrees. (Angle tightening)

13. Rotate crankshaft pulley in normal direction (clockwise when viewed from engine front) to confirm it turns smoothly.

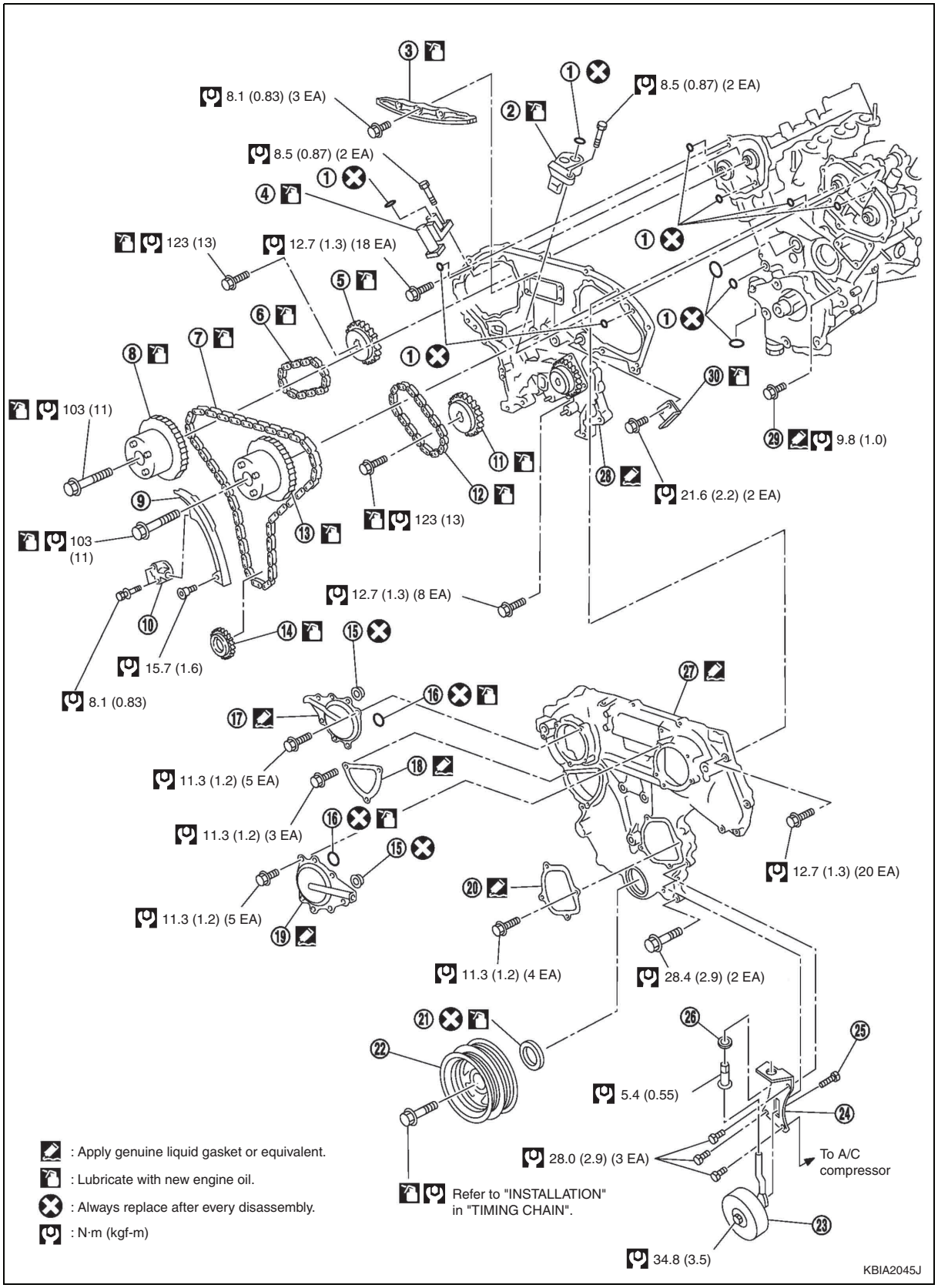
14. Install in the reverse order of removal after this step.

REFERENCE

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

Timing Chain

Components



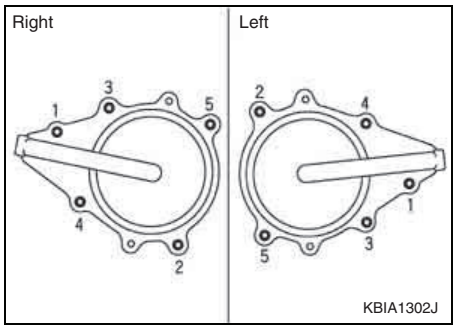
1. O-ring
2. Timing chain tensiner (secondary)
3. Internal chain guide
4. Timing chain tensioner (secondary)
5. Camshaft sprocket(EXH)
6. Timing chain (secondary)
7. Timing chain (primary)
8. Camshaft sprocket (INT) (CVTC)
9. Slack guide
10. Timing chain tensioner (primary)
11. Camshaft sprocket(EXH)
12. Timing chain (secondary)
13. CVTC
14. Crankshaft sprocket
15. Collared O-ring
16. Seal ring
17. CVTC cover(bank RH)
18. Chain tensioner cover
19. CVTC cover(bank LH)
20. Water pump cover
21. Front oil seal
22. Crankshaft pulley
23. Idler pulley
24. Idler pulley bracket
25. Center shaft
26. Washer
27. Front timing chain case
28. Rear timing chain case
29. Water drain plug
30. Tension guide

REFERENCE

- **This section describes procedures for removal/installation front timing chain case and timing chain related parts, and rear timing chain case, when oil pan (upper) needs to be removed/installed for engine overhaul, etc.**
- **To remove/install front timing chain case, timing chain, and timing chain related parts without removing oil pan (upper), refer to "FRONT TIMING CHAIN CASE".**
- **To remove/install rear timing chain case, remove engine assembly from vehicle. Then, perform the operations after step 2 in this section. Foe engine removal, refer to "Removal and Installation" in "ENGINE ASSEMBLY" section.**

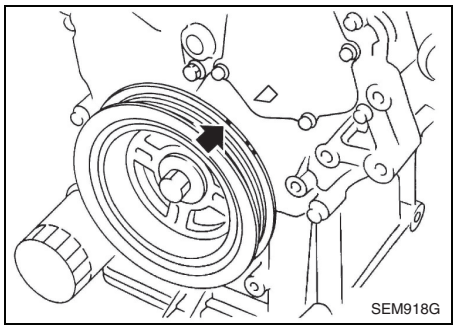
Removal

1. Remove engine and transaxle assembly with front suspension member from vehicle, and separate front suspension member and transaxle from engine. Refer to "Removal and Installation" in "ENGINE ASSEMBLY" section.
2. Install engine assembly onto engine stand. Refer to "CYLINDER BLOCK".
3. Drain engine oil and coolant. Refer to "Changing Engine Oil and Coolant".
4. Remove the following parts:
   - Intake manifold collector (upper and lower) (Refer to "INTAKE MANIFOLD COLLECTOR".)
   - Rocker cover (right and left banks). (Refer to "ROCKER COVER".)
   - Drive brackets around front timing chain case
   - Oil pans (lower and upper) and oil strainer. (Refer to "OIL PAN AND OIL STRAINER".)
5. Remove CVTC cover (right and left banks).
   - Loosen mounting bolts in reverse order as shown in the figure.
   - Use seal cutter (09112-12010) to cut liquid gasket for removal.

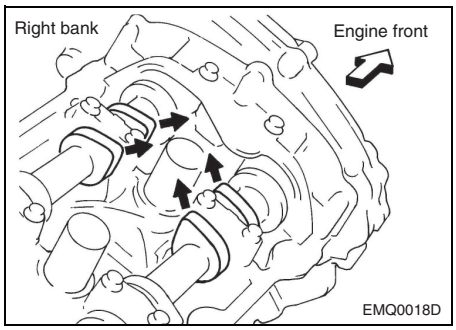


⚠ CAUTION

Shaft is internally jointed with intake camshaft sprocket center hole. When removing, keep it horizontal until it is completely disconnected.



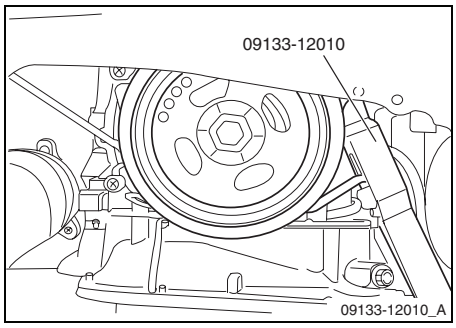
6. Obtain No. 1 cylinder at TDC of its compression stroke as follows.
   a. Rotate crankshaft pulley clockwise to align timing mark (grooved line without color) with timing indicator.



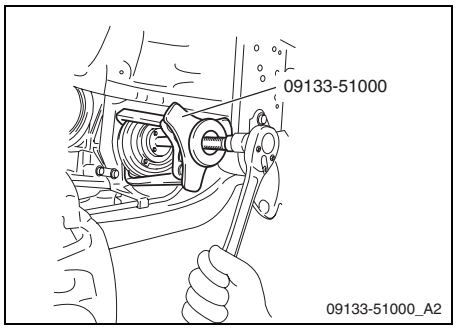
   b. Make sure that cam noses on No. 1 cylinder (engine front side of right bank) are located as shown in the figure.
      • If not, turn crankshaft pulley one revolution (360 degrees).

REFERENCE

When only timing chain (primary) is removed, rocker cover does not need to be removed. To make sure that No. 1 cylinder is at its compression TDC, remove front timing chain case first. Then check mating marks on camshaft sprockets. Refer to "TIMING CHAIN".



7. Remove crankshaft pulley as follows:
   a. Fix crankshaft with pulley holder (09133-12010).
   b. Loosen crankshaft pulley bolt and locate bolt seating surface at 10 mm (0.39 in) from its original position.

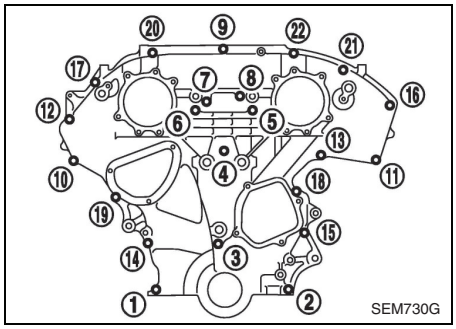


c. Place crankshaft pulley puller (09133-51000) tab on holes of crankshaft pulley, and pull crankshaft pulley through.

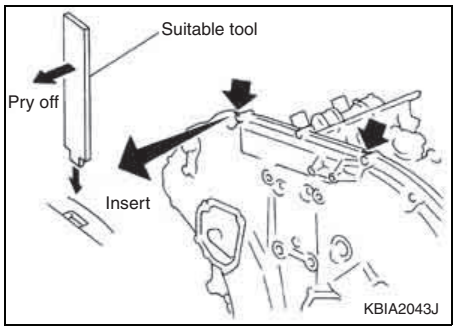
⚠ CAUTION

Do not put crankshaft pulley puller tab on crankshaft pulley periphery, as this will damage internal damper.

8. Remove front timing chain case as follows:



a. Loosen and remove mounting bolts in reverse order as shown in the figure.

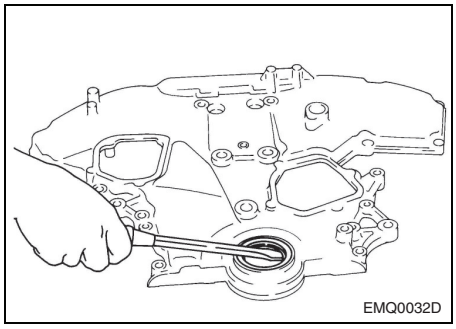


b. Insert suitable tool into the notch at the top of rear timing chain case as shown in the figure and pry off case to remove front timing chain case.

⚠ CAUTION

- **Be careful not to damage the seal surfaces.**
- **After removal, handle front timing chain case carefully so it does not tilt, cant, or warp under a load.**

9. Remove water pump cover and timing chain tensioner cover from front timing chain case.
   - Use seal cutter (09112-12010) to cut liquid gasket for removal.

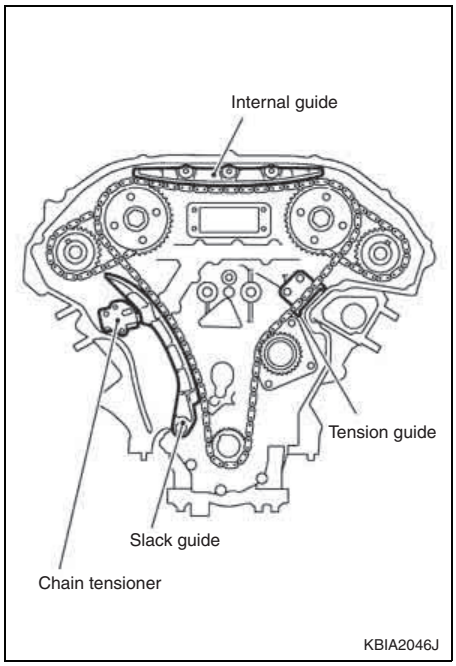


10. Remove front oil seal from front timing chain case.
    - Use screwdriver for removal.

⚠ CAUTION

Be careful not to damage front timing chain case.

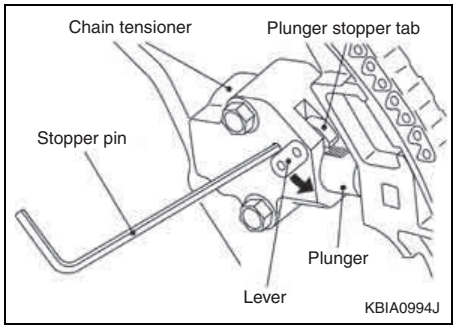
11. Remove timing chain and timing chain related parts. Refer to "TIMING CHAIN".



12. Remove internal guide, timing chain tensioner, slack guide and tension guide.

REFERENCE

- **Tension guide can be removed after removing timing chain (primary).**
- **Slack guide mounting bolts: Hexagon socket head bolt (size: 8 mm)**

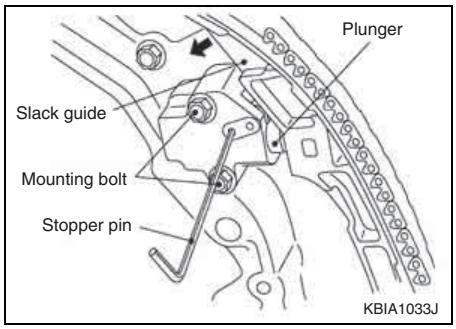


- **Remove timing chain tensioner as follows:**

a. Pull lever down and release plunger stopper tab.
   Plunger stopper tab can be pushed up to released (coaxial structure with lever).
b. Insert stopper pin into tensioner body hole to hold lever, and keep tab released.

REFERENCE

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

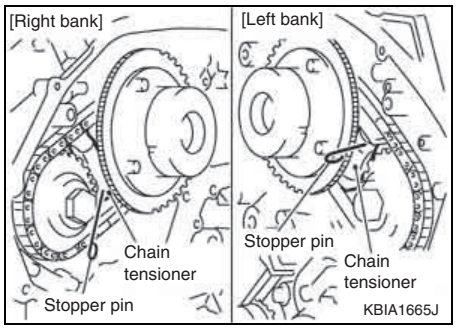


c. Insert plunger into tensioner body by pressing slack guide.
d. Keep slack guide pressed and hold it by pushing stopper pin through the lever hole and body hole.
e. Remove mounting bolts and remove timing chain tensioner.

13. Remove timing chain (primary), tension guide and crankshaft sprocket.

⚠ CAUTION

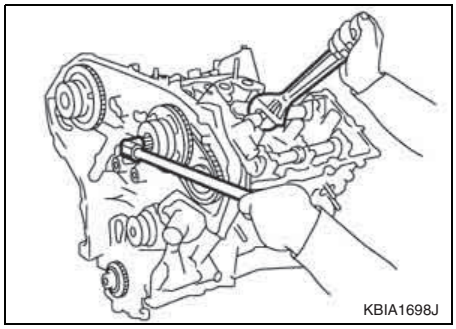
After removing timing chain (primary), do not turn crankshaft and camshaft separately, or valves will strike the piston heads.



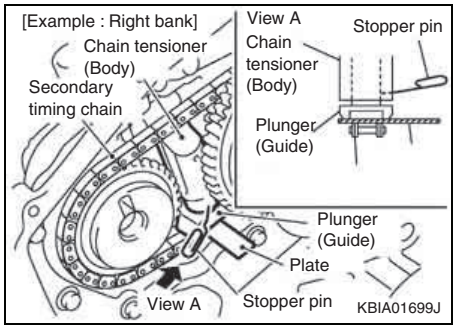
14. Remove timing chain (secondary) and camshaft sprockets as follows:
    a. Attach suitable stopper pin to the right and left timing chain tensioners (secondary).
       • Use approximately 0.5 mm dia. hard metal pin as a stopper pin.

REFERENCE

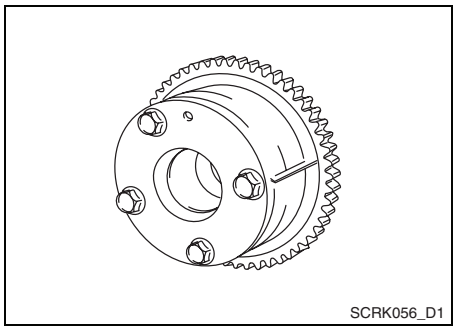
For removal and installation of timing chain tensioner (secondary), refer to "CAMSHAFT". [Removing camshaft bracket (No. 1) is required.]



    b. Remove camshaft sprockets (INT and EXH) mounting bolts.
       • Secure the hexagonal portion of camshaft using wrench to loosen mounting bolts.



    c. Remove timing chain (secondary) together with camshaft sprocket.
       • Turn camshaft slightly to secure slackness of timing chain on timing chain tensioner side.
       • Insert 0.5 mm-thick metal or resin plate between timing chain and timing chain tensioner plunger (guide). Remove timing chain (secondary) together with camshaft sprockets with timing chain loose from guide groove.

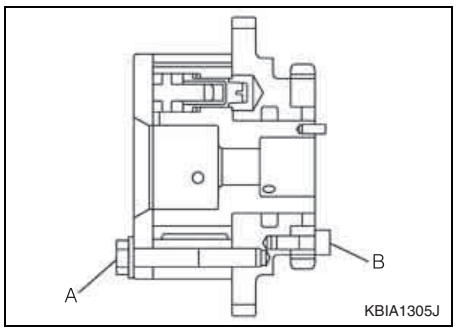


⚠ CAUTION

Be careful of plunger coming-off when removing timing chain (secondary). This is because plunger of timing chain tensioner (secondary) moves during operation, leading to coming-off of fixed stopper pin.

REFERENCE

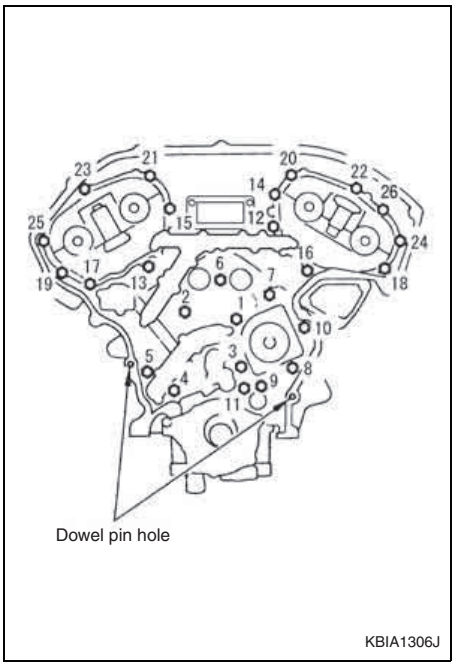
Camshaft sprocket (INT) is two-for-one structure of sprockets for timing chain (primary) and for timing chain (secondary).



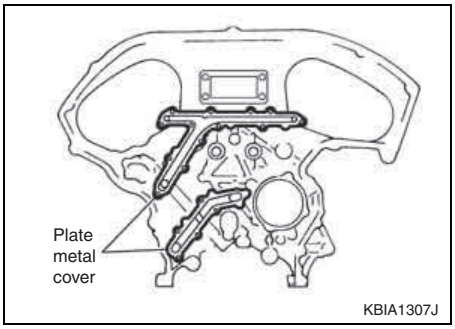
       • When handling camshaft sprocket (INT), be careful of the following.

⚠ CAUTION

- **Handle carefully to avoid any shock to camshaft sprocket.**
- **Do not disassemble. (Do not loosen bolts "A" and "B").**



15. Remove rear timing chain case as follows:
    a. Loosen mounting bolts in reverse order as shown in the figure.
    b. Cut liquid gasket using seal cutter (09112-12010) and remove rear timing chain case.

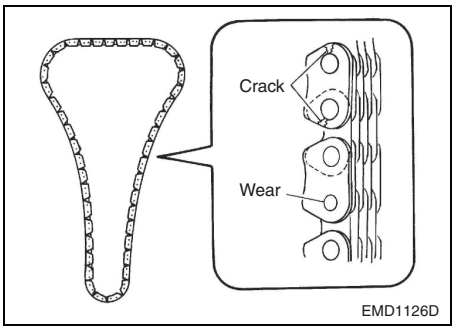


CAUTION

- **Do not remove plate metal cover of oil passage.**
- **After removal, handle rear timing chain case carefully so it does not tilt, cant, or warp under a load.**

Inspection after Removal

TIMING CHAIN

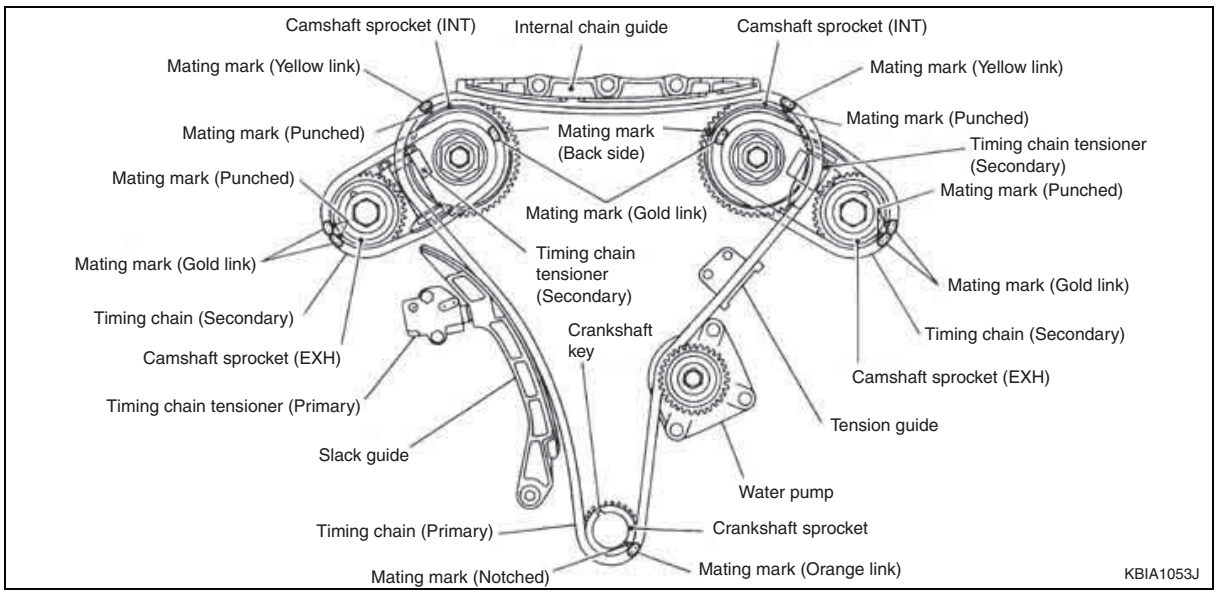


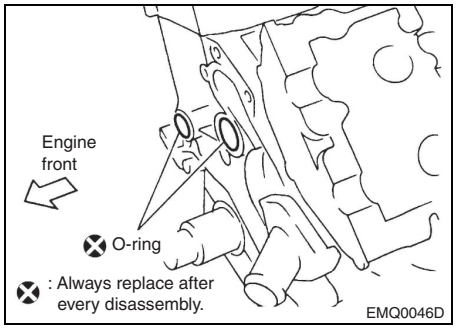
- Check for cracks and any excessive wear at link plates and roller links of timing chain.
- Replace timing chain if there are.

Installation

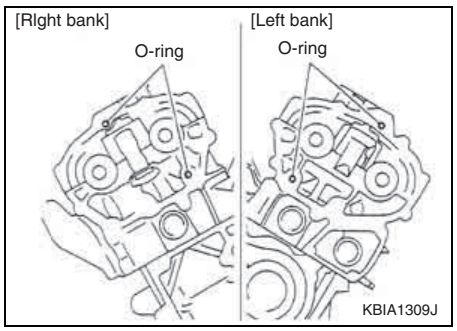
REFERENCE

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





1. Install rear timing chain case as follows:
   a. Install new O-rings onto cylinder block.



   b. Install new O-rings onto cylinder head front surface (RH and LH).

   c. Apply liquid gasket to rear timing chain case back side as shown in the figure. Refer to LIQUID "GASKET APPLICATION PROCEDURE".

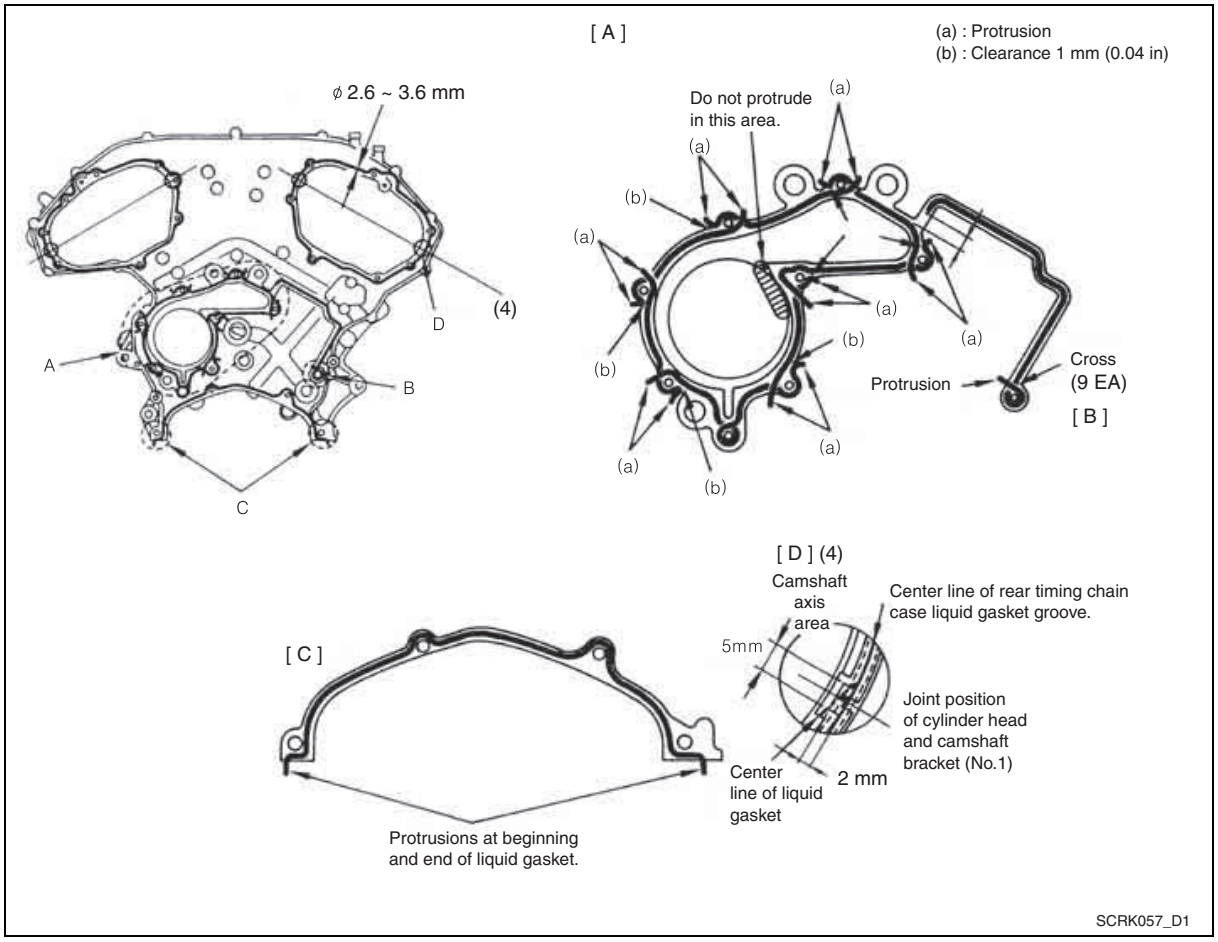
   Liquid gasket:

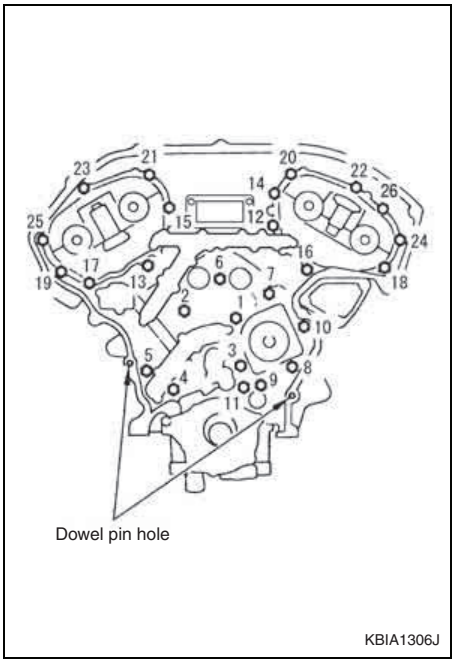
   A - Threebond 1217F or equivalent

   B, C, D - Threebond 1217 F, 1217 H or equivalent

CAUTION

- **For "A" in the figure, completely wipe out liquid gasket extended on a portion touching at engine coolant.**
- **Apply liquid gasket on installation position of water pump and cylinder head very completely.**



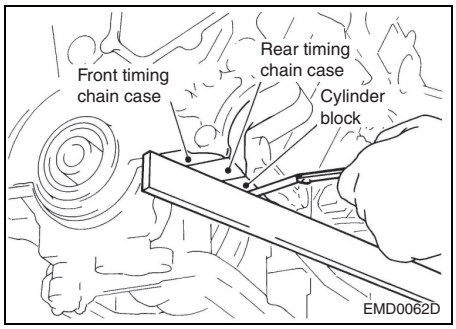


d. Align rear timing chain case and water pump assembly with dowel pins (right and left) on cylinder block and install rear timing chain case.
   - Make sure O-rings stay in place during installation to cylinder block and cylinder head.

e. Tighten bolts in numerical order as shown in the figure.
   - There are two types of mounting bolt. Refer to the following for locating bolts.

   Bolt length : 20 mm (1, 2, 3, 6, 7, 8, 9, 10 in the figure)
   : 16 mm (Except above conditions)

f. After all bolts tightening, retighten them to the specified torque in numerical order as shown in the figure.



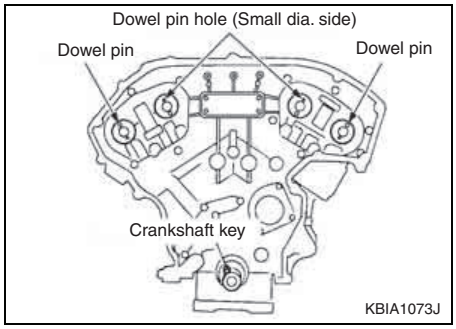
g. After installing rear timing chain case, check surface height difference between the following parts on the oil pan (upper) mounting surface.

Standard

Rear timing chain case to cylinder block:

-0.24 ~ 0.14 mm

- If not within standard, repeat the installation procedure.



2. Install chain tension guide.
3. Make sure that camshaft and crankshaft are located as shown in the figure. (No. 1 cylinder at compression TDC)
   - Make sure that dowel pin hole, dowel pin and crankshaft key are located as shown in the figure.

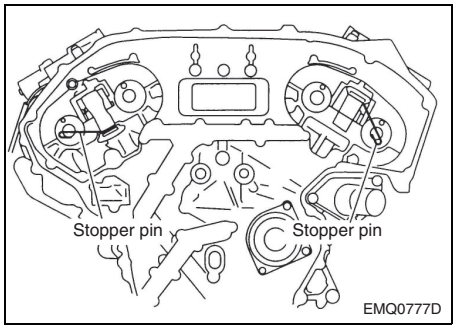
REFERENCE

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

Camshaft dowel pin hole (intake side)
: At cylinder head upper face side in each bank
Camshaft dowel pin (exhaust side)
: At cylinder head upper face side in each bank
Crankshaft key
: At cylinder head side of right bank

⚠ CAUTION

Hole on small dia. side must be used for intake side dowel pin hole. Do not misidentify (ignore big dia. side).

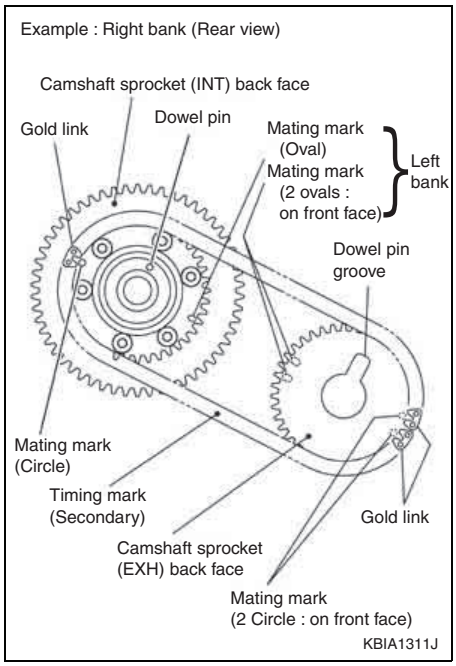


4. Install timing chain (secondary) and camshaft sprockets (INT and EXH) as follows:

⚠ CAUTION

Mating marks between timing chain and sprockets slip easily. Confirm all mating mark positions repeatedly during the installation process.

a. Push plunger of chain tensioner (secondary) and keep it pressed in with stopper pin.



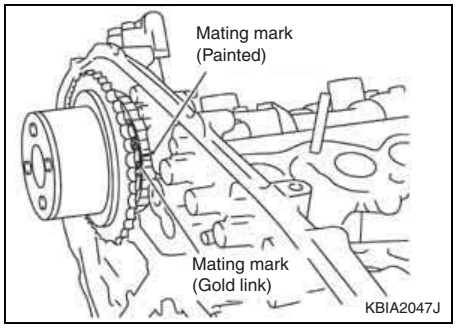
b. Install timing chain (secondary) and camshaft sprockets (INT and EXH).
   - Align the mating marks on timing chain (secondary) (gold link) with the ones on camshaft sprockets (INT and EXH) (punched), and install them.

REFERENCE

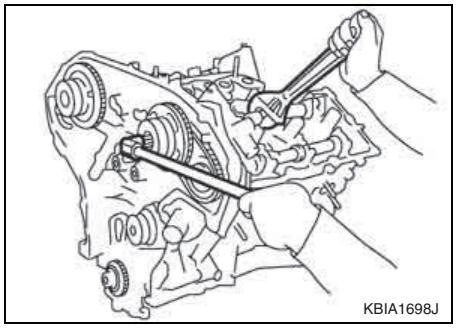
- **Mating marks for camshaft sprocket (INT) are on the inside of camshaft sprocket (secondary).**
- **There are two types of mating mark, circle and oval types. They should be used for the right and left banks, respectively. (spare parts are same for both banks)**

  Right bank: Use circle type.
  Left bank: Use oval type.

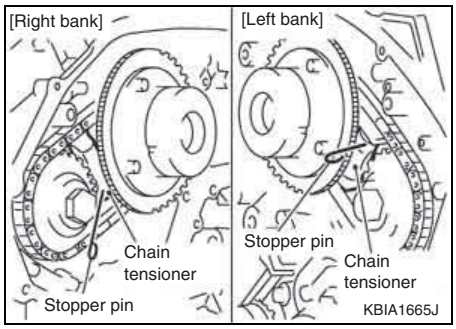
  - Align dowel pin and pin hole on camshafts with the groove and dowel pin on sprockets, and install them.
  - On the intake side, align pin hole on the small diameter side of the camshaft front end with dowel pin on the back side of camshaft sprocket, and install them.
  - On the exhaust side, align dowel pin on camshaft front end with pin groove on camshaft sprocket, and install them.
  - In case that positions of each mating mark and each dowel pin are not fit on mating parts, make fine adjustment to the position holding the hexagonal portion on camshaft with wrench or equivalent.
  - Mounting bolts for camshaft sprockets must be tightened in step 3. Tightening them by hand is enough to prevent the dislocation of dowel pins.



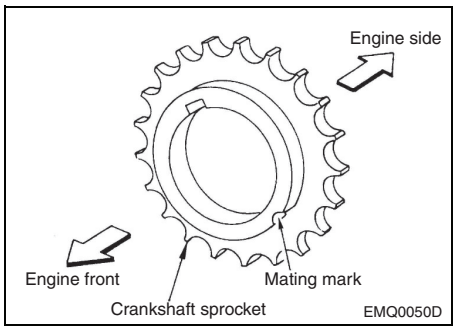
- It may be difficult to visually check the dislocation of mating marks during and after installation. To make the matching easier, make a mating mark on the top of sprocket teeth and its extended line in advance with paint.



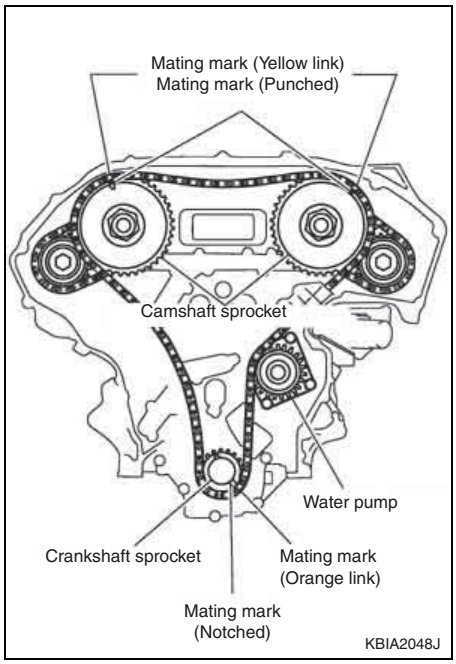
c. After confirming the mating marks are aligned, tighten camshaft sprocket mounting bolts.
   - Secure camshaft using wrench at the hexagonal portion to tighten mounting bolts.



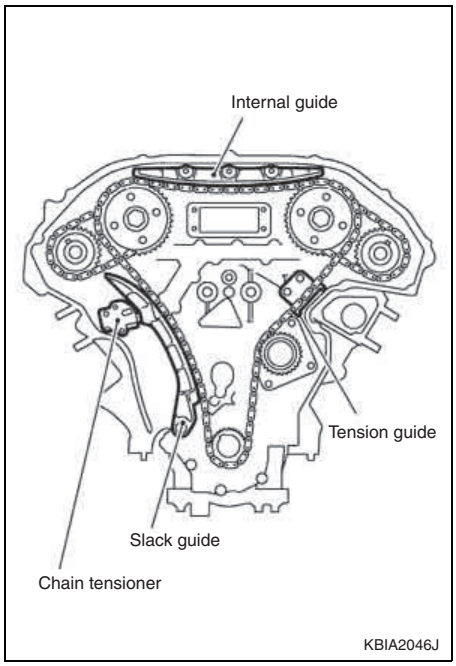
d. Pull stopper pins out from timing chain tensioners (secondary) and open plunger.



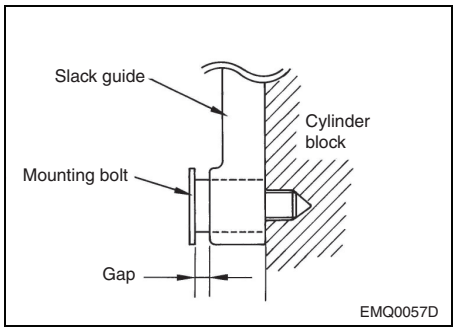
5. Install timing chain (primary) as follows:
   a. Install crankshaft sprocket.
      - Make sure the mating marks on crankshaft sprocket face the front of engine.



   b. Install timing chain (primary).
      - Install timing chain (primary) so the mating mark (punched) on camshaft sprocket is aligned with the yellow link on timing chain, while the mating mark (notched) on crankshaft sprocket is aligned with the orange one on timing chain.
      - When it is difficult to align mating marks of timing chain (primary) with each sprocket, gradually turn camshaft using wrench on the hexagonal portion to align it with the mating marks.

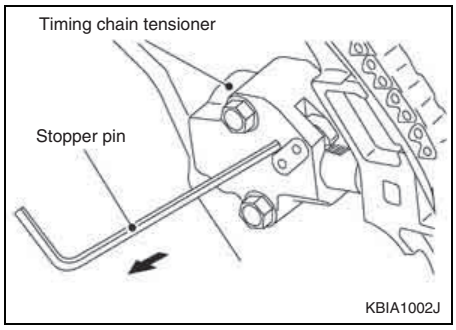


6. Install tension guide, internal chain guide, timing chain tensioner and slack guide.



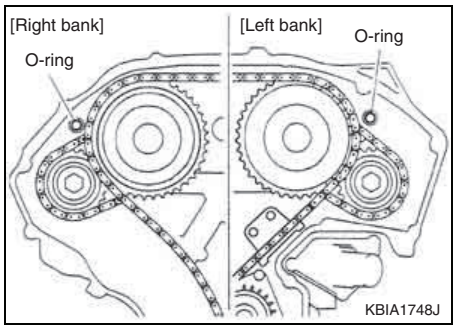
CAUTION

- **Do not overtighten slack guide mounting bolt. It is normal for a gap to exist under the bolt seat when mounting bolt is tightened to specification.**

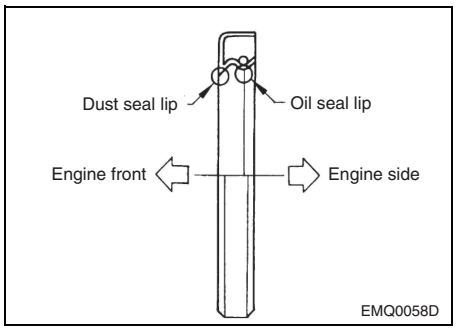


- When installing timing chain tensioner, push in plunger and keep it pressed in with stopper pin.
- Remove any dirt and foreign materials completely from the back and the mounting surfaces of timing chain tensioner.
- After installation, pull out stopper pin. Release plunger to move forward.

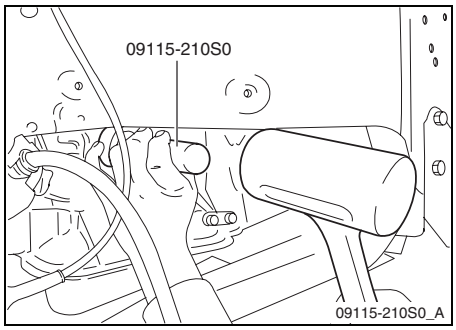
7. Make sure again that the mating marks on each sprocket and each timing chain have not slipped out of alignment.



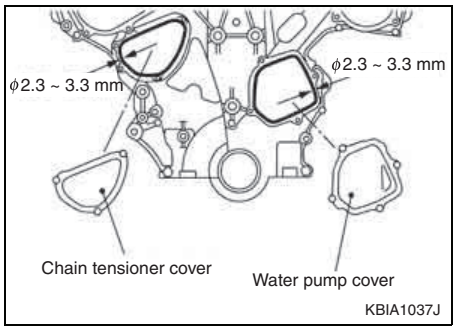
8. Install O-rings on rear timing chain case.



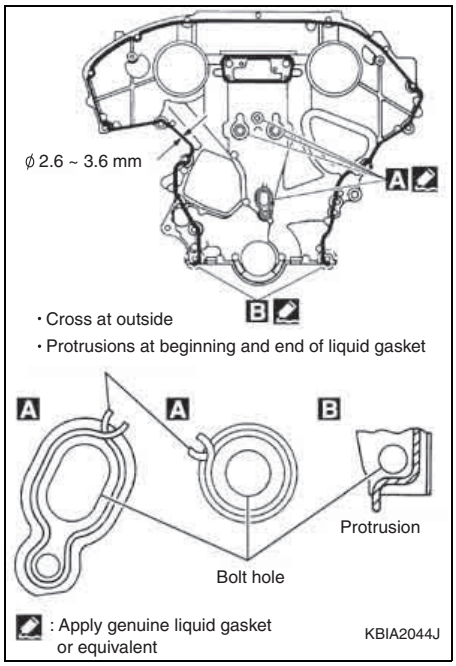
9. Install new front oil seal on front timing chain case.
   - Install it so that each seal lip is oriented as shown in the figure.



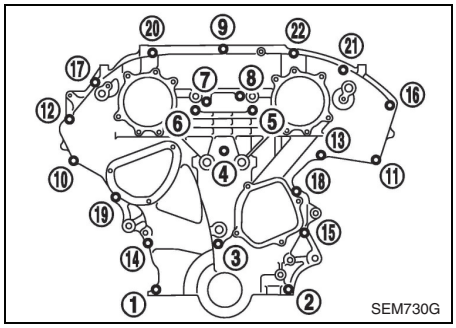
- Using front oil seal drift (09115-21010 and 09115-21030), press-fit oil seal until it becomes flush with front timing chain case end face.
- Make sure the garter spring is in position and seal lip is not inverted.



10. Install water pump cover and chain tensioner cover to front timing chain case.
    - Apply a continuous bead of liquid gasket (Threebond 1217 H or equivalent) to front timing chain case as shown in the figure.



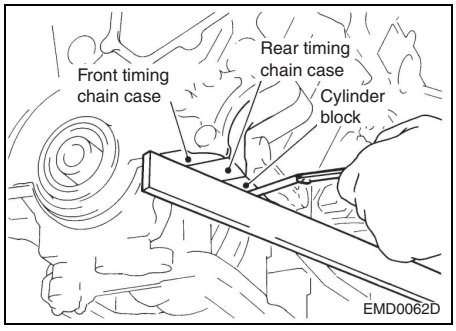
11. Install front timing chain case as follows:
    a. Apply a continuous bead of liquid gasket (Threebond 1217 H or equivalent) to front timing chain case back side as shown in the figure. Refer to "LIQUID GASKET APPLICATION PROCEDURE".
    b. Install front timing chain case as to fit its dowel pin hole (RH/LH) together dowel pin on rear timing chain case.



    c. Tighten mounting bolts in numerical order as shown in the figure.
        • There are two types of mounting bolt. Refer to the following for locating bolts.

        Bolt diameter : M8 (1, 2 in the figure)
        M6 (Except the above)

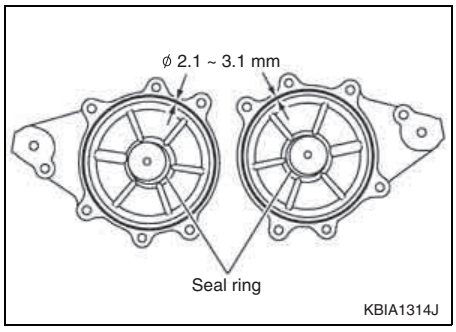
    d. After all bolts tightening, retighten them to the specified torque in numerical order as shown in the figure.



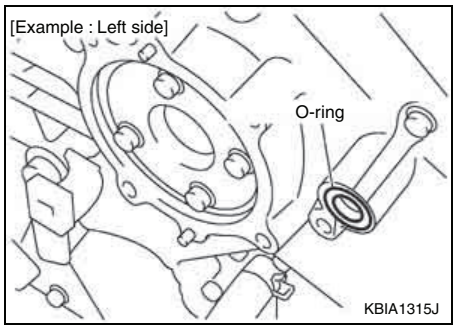
    e. After installing front timing chain case, check the surface height difference between the rear timing chain case on the oil pan (upper) mounting surface.

    Standard: -0.14 ~ 0.14 mm

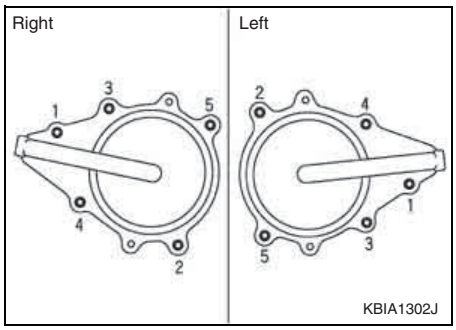
        • If not within standard, reinstall front timing chain case.



12. Install right and left CVTC covers as follows:
    a. Install new seal rings in shaft grooves.
    b. Apply a continuous bead of liquid gasket (Threebond 1217 H or equivalent) to oil pan (lower) as shown in the figure. Refer to "LIQUID GASKET APPLICATION PROCEDURE".



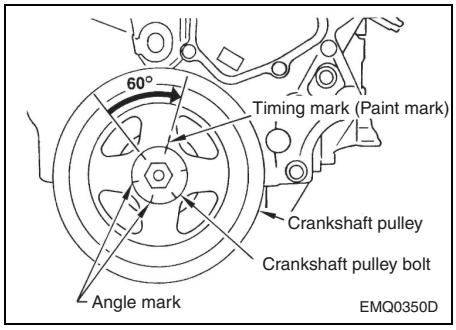
c. Install O-ring in front timing chain case oil hole.
(left and right sides)



d. Being careful not to move seal rings from the installation grooves, align dowel pins on front timing chain case with the holes to install CVTC covers.
e. Tighten bolts in numerical order as shown in the figure.

13. Install crankshaft pulley as follows:
a. Install crankshaft pulley, taking care not to damage front oil seal.
• When press-fitting crankshaft pulley with plastic hammer, tap on its center portion (not circumference).
b. Fix crankshaft and tighten crankshaft pulley mounting bolt.

Tightening torque : 44 N·m (4.5 kgf-m)



c. Put a paint mark on crankshaft pulley aligning with angle mark on crankshaft pulley bolt. Then, further retighten bolt by 60 to 65 degrees.
(Angle tightening)

14. Manually rotate crankshaft pulley in normal direction (clockwise when viewed from engine front) to confirm it turns smoothly.

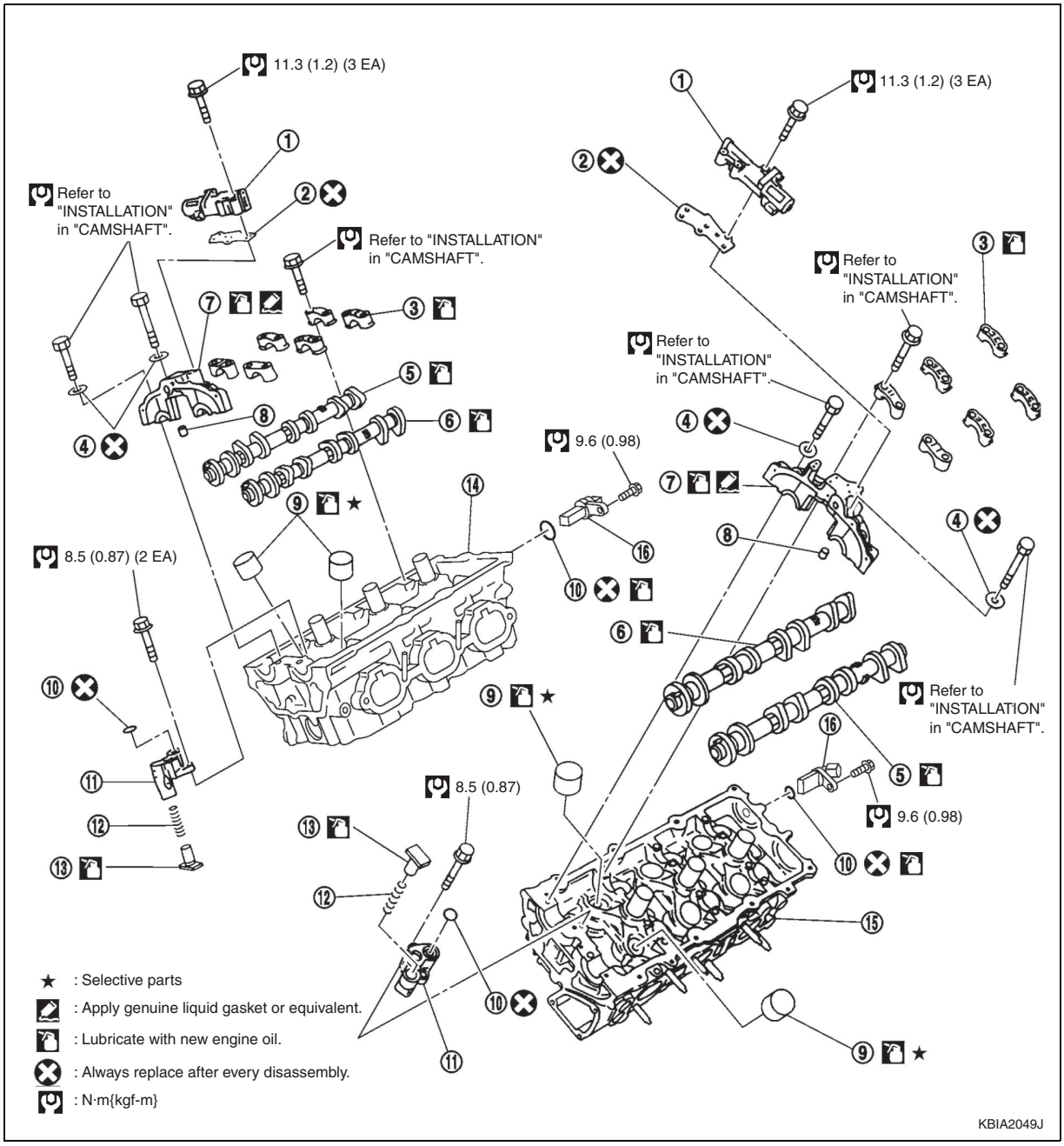
15. Install in the reverse order of removal after this step.

REFERENCE

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

Camshaft

Components



1. CVTC valve
2. Gasket
3. Camshaft bracket (No.2 to 4)
4. Seal washer
5. Camshaft (EXH)
6. Camshaft (INT)
7. Camshaft bracket (No. 1)
8. Dowel pins (2)
9. Valve lifter
10. O-ring
11. Timing chain tensioner (secondary)
12. Spring
13. Plunger
14. Cylinder head (right bank)
15. Cylinder head (left bank)
16. Camshaft position sensor (PHASE)

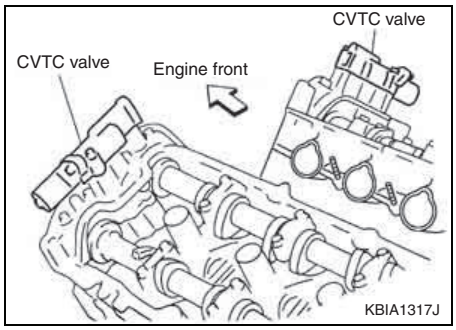
Removal

1. Remove front timing chain case, camshaft sprocket, timing chain and rear timing chain case. Refer to "TIMING CHAIN".

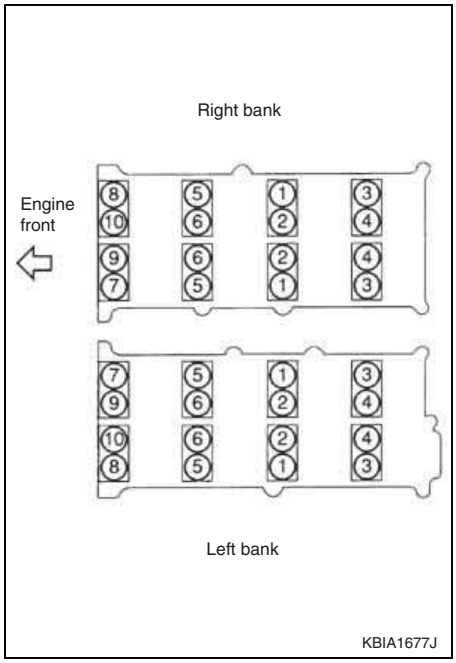
2. Remove camshaft position sensors (PHASE) (right and left banks) from cylinder head (right and left banks) back side.

CAUTION

- **Handle carefully to avoid dropping and shocks.**
- **Do not disassemble. (disassembly prohibited parts)**



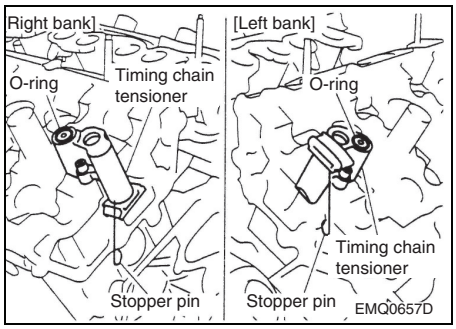
3. Remove CVTC valves from camshaft bracket (No. 1).



4. Equally loosen camshaft bracket bolts in several steps in reverse order as shown in the figure and remove camshaft brackets.

5. Remove camshafts.

6. Remove valve lifters.
   - Identify installation positions, and store them without mixing them up.



7. Remove timing chain tensioners (secondary) from both cylinder heads (right and left banks).
   - Remove timing chain tensioner (secondary) with its stopper pin attached.

REFERENCE

Stopper pin was attached when timing chain (secondary) was removed.

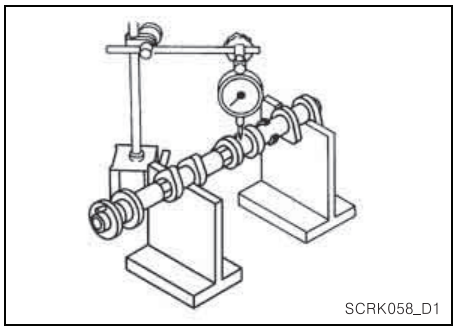
Inspection after Removal

CAMSHAFT RUNOUT

- Put V-block on precise flat table, and support No. 2 and 4 journal of camshaft.

⚠ CAUTION

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

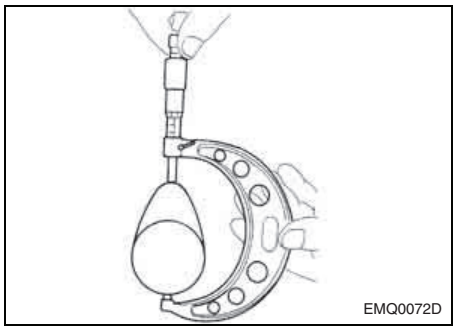


- Set dial gauge vertically to No. 3 journal.
- Turn camshaft to one direction with hands, and measure camshaft runout on dial gauge. (Camshaft runout is half of total indicator reading)

  Standard: 0.05 mm or less

- If out of the standard, replace camshaft.

CAMSHAFT CAM HEIGHT



- Measure height with micrometer.

  Standard

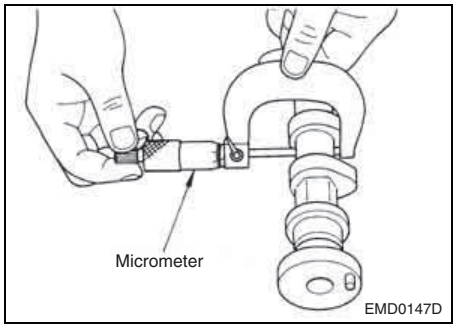
	VQ23DE	VQ35DE
Intake:	**44.265 ~ 44.455 mm**	**44.865 ~ 45.055 mm**
Exhaust:	**43.405 ~ 43.595 mm**	**44.865 ~ 45.055 mm**

  Wear limit: 0.2 mm

- If wear is beyond the limit, replace camshaft.

CAMSHAFT JOURNAL OIL CLEARANCE

Camshaft Journal Outer Diameter

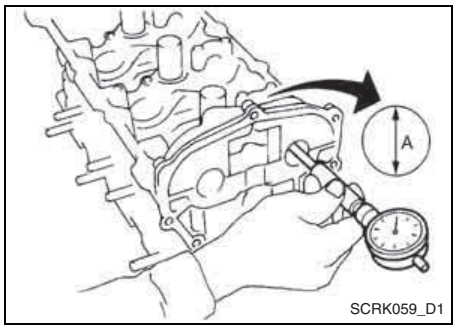


- Measure outer diameter of camshaft journal with micrometer.

  Standard

  No. 1: 25.935 ~ 25.955 mm

  No. 2, 3, 4: 23.445 ~ 23.465 mm



CAMSHAFT BRACKET INNER DIAMETER

- Tighten camshaft bracket bolt to the specified torque.
- Refer to "INSTALLATION" for the tightening procedure.
- Measure inner diameter "A" of camshaft bracket with inside micrometer.

Standard
No.1: ϕ 26.000 ~ 26.021 mm
No. 2, 3, 4: ϕ 23.500 ~ 23.521 mm

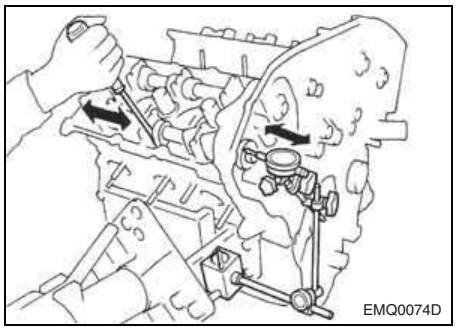
Camshaft Journal Oil Clearance

(Oil Clearance) = (Camshaft bracket inner diameter) - (Camshaft journal diameter)

Standard
No. 1: 0.045 ~ 0.086 mm
No. 2, 3, 4: 0.035 ~ 0.076 mm

Limit: 0.15 mm

- If it exceeds the limit, replace either or both camshaft and cylinder head based on each standard value.
- Camshaft bracket cannot be replaced as a single part, because it is machined together with cylinder head.

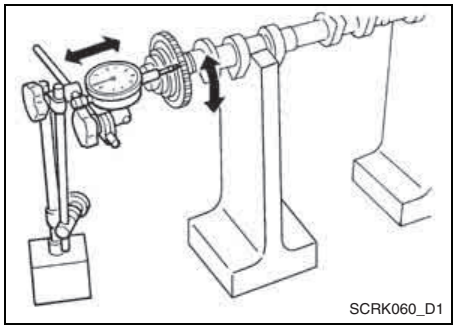


CAMSHAFT END PLAY

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

Standard: 0.115 ~ 0.188 mm
Limit: 0.24 mm

- If out of the limit, replace camshaft and measure it again.
- If it still exceeds the limit, replace cylinder head.

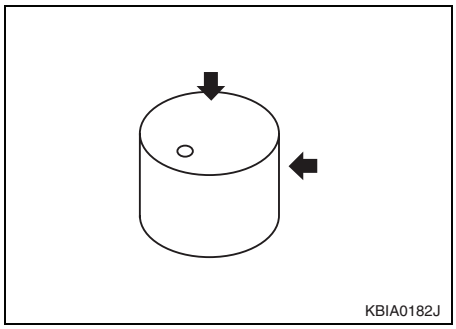


CAMSHAFT SPROCKET RUNOUT

- Put V-block on precise flat table, and support No. 2 ~ No.4 journal of camshaft.
- Install camshaft sprocket on camshaft and measure the camshaft sprocket runout with dial gauge.

Limit: 0.15 mm

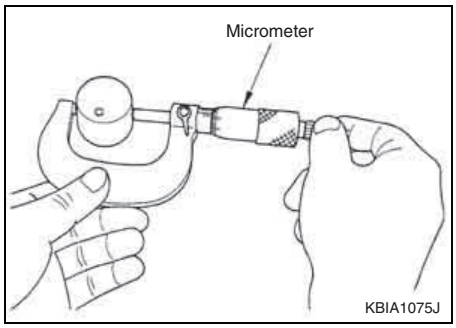
- If it exceeds the limit, replace camshaft sprocket.


KBIA0182J

VALVE LIFTER

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

- If anything above is found, replace valve lifter.
- When replacing, refer to "Valve Clearance".



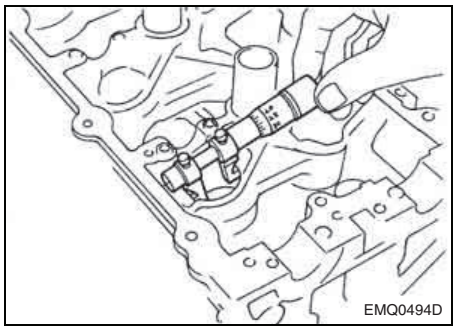
KBIA1075J

VALVE LIFTER CLEARANCE

Valve Lifter Outer Diameter

- Measure outer diameter of valve lifter with micrometer.

VQ23DE: ϕ 29.977 ~ 29.987 mm
VQ35DE: ϕ 33.977 ~ 33.987 mm


EMQ0494D

Valve Lifter Hole Diameter

- Measure inner diameter of valve lifter hole of cylinder head with inside micrometer.

	VQ23DE	VQ35DE
Intake	: ϕ 30.015 ~ 30.031 mm	ϕ 34.000 ~ 34.016 mm
Exhaust	: ϕ 30.003 ~ 30.019 mm	ϕ 34.000 ~ 34.016 mm

Valve Lifter Clearance

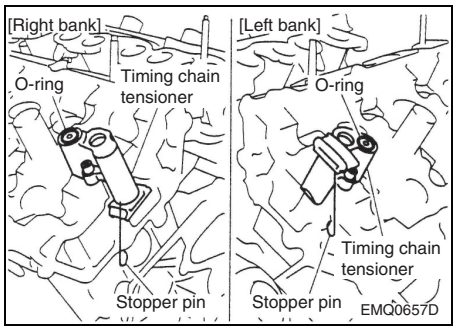
(Valve lifter clearance) = (Valve lifter hole diameter) - (Valve lifter outer diameter)

Standard

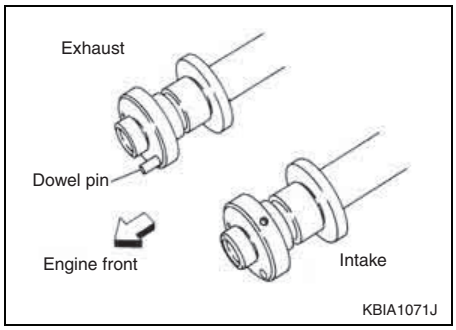
	VQ23DE	VQ35DE
Intake	: 0.028 ~ 0.054 mm	0.013 ~ 0.039 mm
Exhaust	: 0.016 ~ 0.042 mm	0.013 ~ 0.039 mm

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

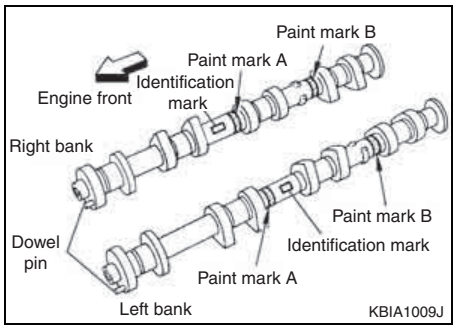
Installation



1. Install timing chain tensioner.
   - Install timing chain tensioner (secondary) with its stopper pin attached.
   - Install timing chain tensioner (secondary) with sliding part facing downward on cylinder head (right bank), and with sliding part facing upward on cylinder head (left bank).
   - Install new O-ring as shown in the figure.
2. Install valve lifters.
   - Install them in the original position.



3. Install camshafts.
   - Install camshaft with dowel pin hole attached to its front end face on the Intake side.
   - Install camshaft with dowel pin attached to its front end face on the exhaust side.



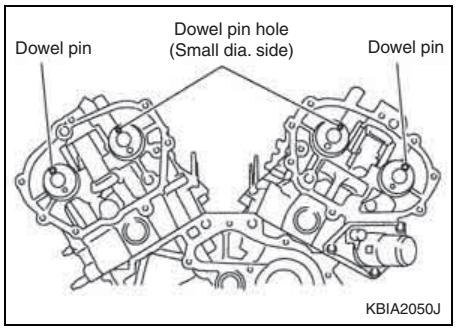
- For details, refer to below:
  Paint mark B: Exhaust
  Paint mark A: Intake

VQ23DE

Bank	INT/EXH	Dowel Pin	Paint Marks		Identification Mark
			A	B	
RH	INT	No	White	-	RE
	EXH	Yes	-	Blue	RE
LH	INT	No	White	-	LH
	EXH	Yes	-	Blue	LH

VQ35DE

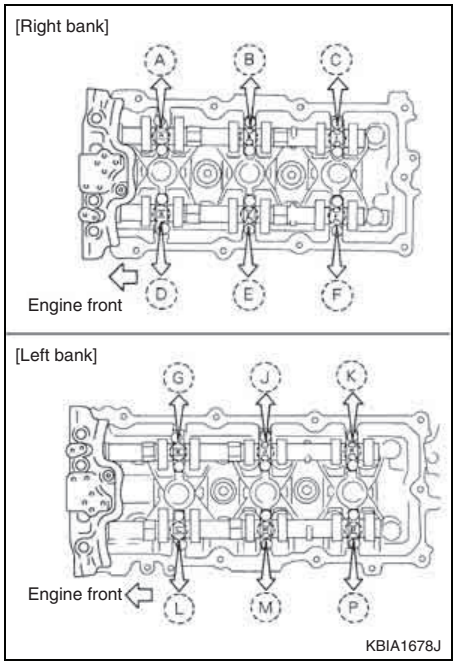
Bank	INT/EXH	Dowel Pin	Paint Marks		Identification Mark
			A	B	
RH	INT	No	Pink	-	RE
	EXH	Yes	-	Orange	RE
LH	INT	No	Pink	-	LH
	EXH	Yes	-	Orange	LH



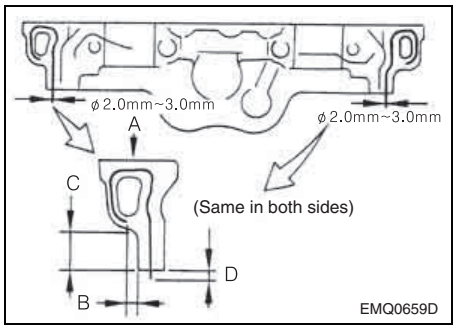
- Install camshafts so that dowel pin hole and dowel pin on front end face are positioned as shown in the figure. (No. 1 cylinder TDC on its compression stroke)

REFERENCE

Large and small pin holes are located on front end face of camshaft (INT), at intervals of 180 degrees. Face small dia.side pin hole upward (in cylinder head upper face direction).

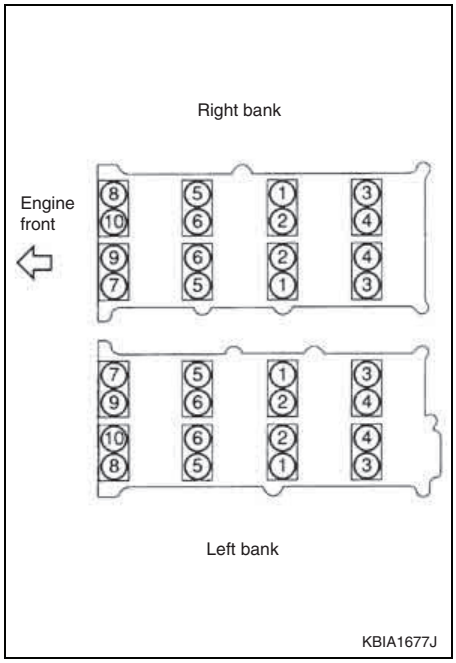


4. Install camshaft brackets.
   - Remove foreign material completely from camshaft bracket backside and from cylinder head installation face.
   - Install camshaft bracket in original position and direction as shown in the figure.



- Apply liquid gasket to mating surface of camshaft bracket (No. 1).
- Apply liquid gasket (Threebond 1217 H or equivalent) to mating surface of camshaft bracket (No. 1) as shown on right and left banks. Refer to "LIQUID GASKET APPLICATION PROCEDURE"
- For items with symbol, refer to below:

A: Be sure to wipe off excessive liquid gasket from the front end face of camshaft bracket.
B: Kepp away 5 mm.
C: Remove the protruding liquid gasket from face (by 8.5 mm).
D: The liquid gasket is protruding by 2 mm from the rear end of camshaft bracket.



5. Tighten camshaft bracket bolts in the following steps.

   a. After tightening No. 7 to 10 in order as shown, tighten No. 1 to 6 in order as shown.

      Tightening torque : 2.0 N·m (0.2 kgf-m)

   b. Tighten No. 1 to 10 in numerical order as shown.

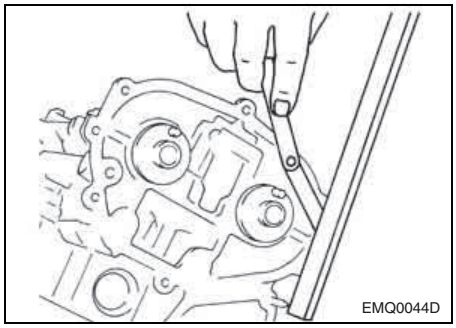
      Tightening torque : 5.9 N·m (0.6 kgf-m)

   c. Tighten No. 1 to 6 in numerical order as shown.

      Tightening torque : 10.41 N·m (1.06 kgf-m)

   d. Tighten No. 7 to 10 in numerical order as shown.

      Tightening torque : 9.3 N·m (0.95 kgf-m)



6. Measure the difference in levels between front end faces of camshaft bracket (No. 1) and cylinder head.

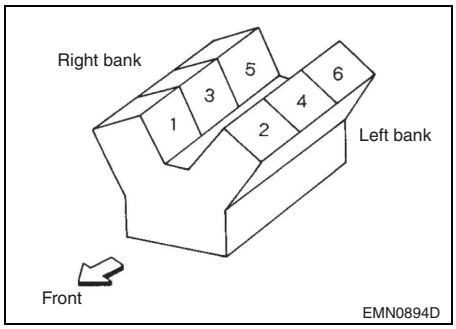
   Standard:
   -0.14 ~ 0.14 mm or less (both right and left banks)

   - If measured value is out of the standard, re-install camshaft and camshaft bracket.

7. Check and adjust the valve clearance. Refer to "Valve Clearance".

8. Assemble in the reverse order of disassembly.

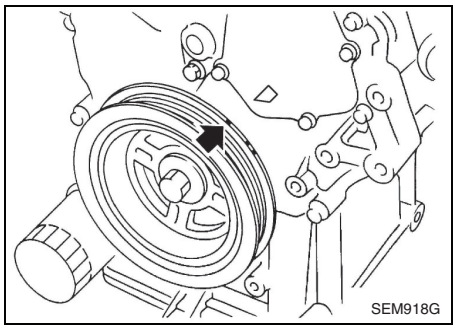
Inspection and Adjustment



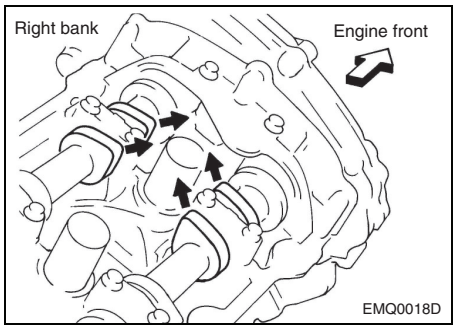
INSPECTION

- In cases of removing/installing or replacing camshaft and valve-related parts, or of unusual engine conditions due to changes in valve clearance (found malfunctions during stating, idling or causing noise), perform inspection of valve clearance as follows:

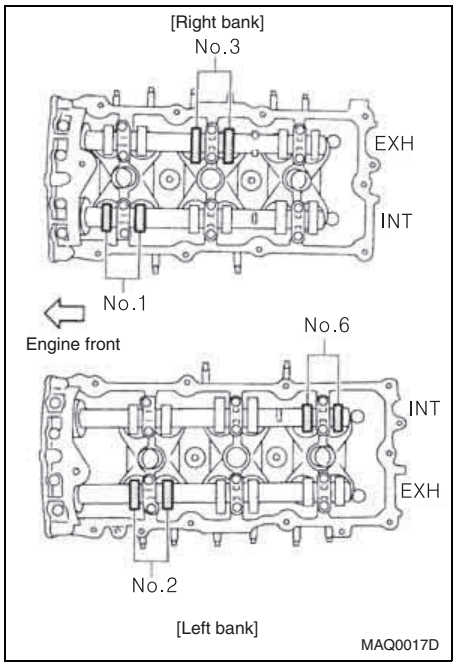
1. Remove rocker covers. Refer to "ROCKER COVER".



2. Remove splash guard (RH).
3. Rotate crankshaft pulley clockwise(when viewed from engine front) to align timing mark (grooved line without color) with timing indicator.



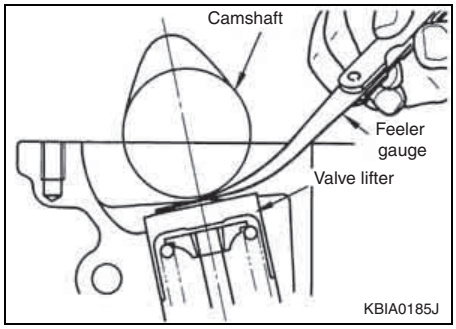
4. Make sure that intake and exhaust cam noses on No. 1 cylinder (engine front side of right bank) are located as shown in the figure.
   - If not, rotate crankshaft one revolution (360 degrees).

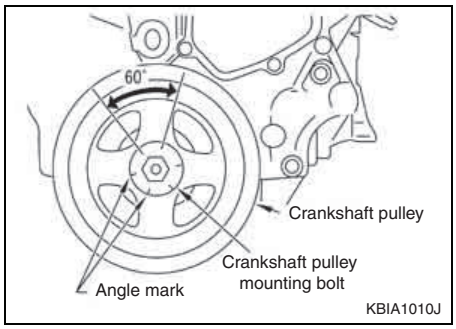


5. By referring to the figure, measure the valve clearances at locations marked "○" as shown in the table below (locations indicated in the figure).

Valve clearance standard:
Cold
Intake: 0.26 ~ 0.34 mm
Exhaust: 0.29 ~ 0.37 mm
Hot (Reference data)
Intake: 0.304 ~ 0.416 mm
Exhaust: 0.308 ~ 0.432 mm

Measuring position (right bank)		No.1	No.3	No.5
No.1 cylinder at compression TDC	EXH		○	
	INT	○		
Measuring position (left bank)		No.2	No.4	No.6
No.1 cylinder at compression TDC	INT			○
	EXH	○		

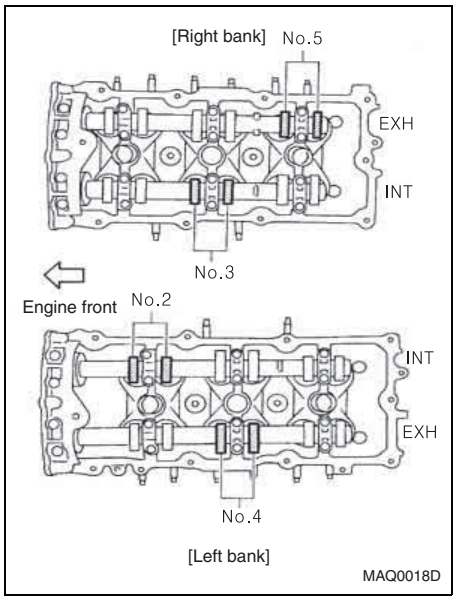




6. Rotate crankshaft by 240 degrees clockwise (when viewed from engine front) to align No. 3 cylinder at TDC of its compression stroke.

REFERENCE

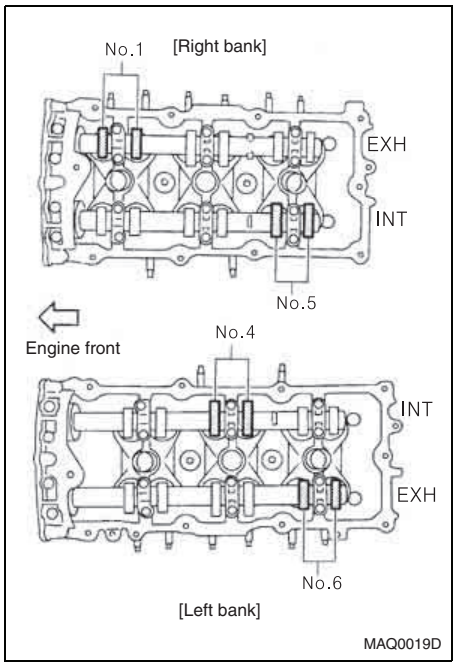
Crankshaft pulley mounting bolt flange has a stamped line every 60 degrees. They can be used as a guide to rotation angle.



7. By referring to the figure, measure the valve clearances at locations marked " ○ " as shown in the table below (locations indicated in the figure).

Measuring position (right bank)		No.1	No.3	No.5
No.3 cylinder at compression TDC	EXH			○
	INT		○	
Measuring position (left bank)		No. 2	No. 4	No. 6
No.3 cylinder at compression TDC	INT	○		
	EXH		○	

8. Rotate crankshaft by 240° degrees clockwise (when viewed from engine front) to align No. 5 cylinder at TDC of its compression stroke.



9. By referring to the figure, measure the valve clearances at locations marked " ○ " as shown in the table below (locations indicated in the figure).

Measuring position (right bank)		No. 1	No. 3	No. 5
No.5 cylinder at compression TDC	EXH	○		
	INT			○
Measuring position (left bank)		No. 2	No. 4	No. 6
No.5 cylinder at compression TDC	INT		○	
	EXH			○

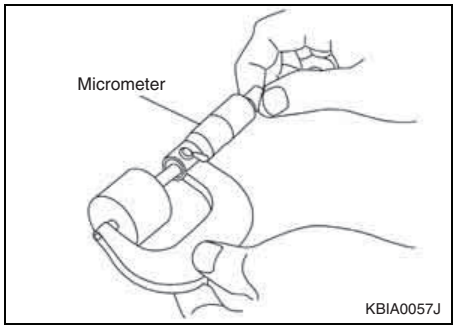
10. For the measured value are out of the standard, perform adjustment.

ADJUSTMENT

REFERENCE

Perform adjustment depending on selected head thickness of valve lifter. (Adjustment by shim is not available.)

1. Remove camshaft. Refer to "Removal and Installation".
2. Remove valve lifters at the locations that are out of the standard.
3. Measure the center thickness of removed valve lifters with micrometer.



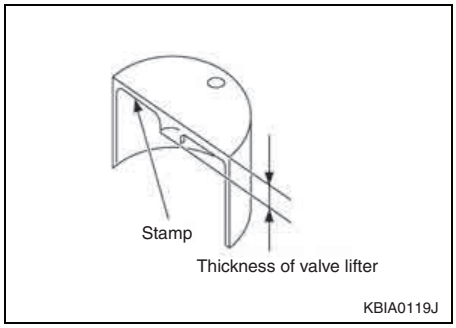
4. Use the equation below to calculate valve lifter thickness for replacement. (unit: mm)

Valve lifter thickness calculation: t = t1 + (C1 - C2)

t = Valve lifter thickness to be replaced
t1 = Removed valve lifter thickness
C1 = Measured valve clearance
C2 = Standard valve clearance

Intake: 0.30
Exhaust: 0.33

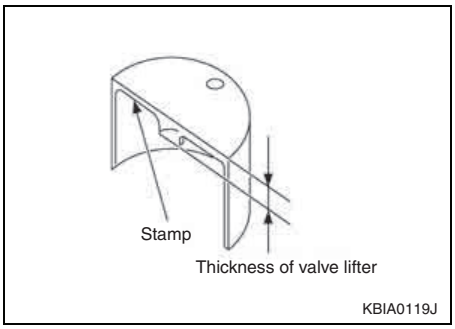
- Thickness of new valve lifter can be identified by stamp marks on the reverse side (inside the cylinder).



VQ23DE

Stamp Mark INT • EXH	Valve Lifter Thickness
666U	6.66 mm
668U	6.68 mm
.	.
.	.
718U	7.18 mm

- Available thickness of valve lifter (when manufactured at factory)
  6.66 ~ 7.18 mm (in steps of 0.02 mm), 27 sizes



VQ35DE

Stamp Mark	Valve Lifter Thickness
INT • EXH	
788U or 788R	7.88 mm
790U 790R	7.90 mm
. .	.
. .	.
840U 840R	8.40 mm

- Available thickness of valve lifter (when manufactured at factory)
  7.88 ~ 8.40 mm (in steps of 0.02 mm), 27 sizes

5. Install selected valve lifter.

6. Install camshaft. Refer to "INSTALLATION".

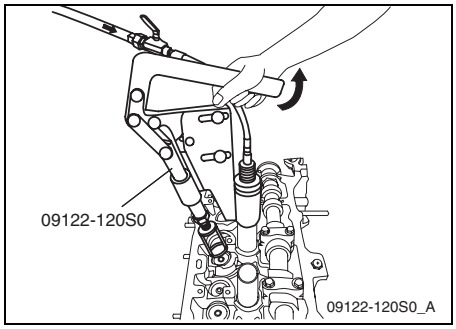
7. Manually rotate crankshaft pulley clockwise for a few rotations.

8. Make sure that the valve clearances for cold engine are within the specifications by referring to the specified values.

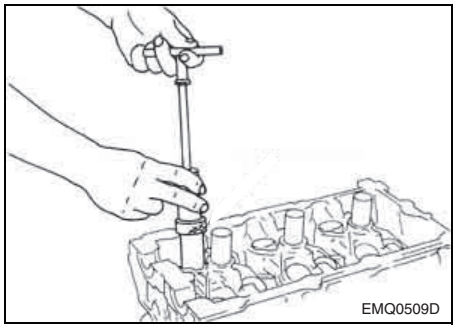
Oil Seal

Removal and Installation of Valve Oil Seal

REMOVAL

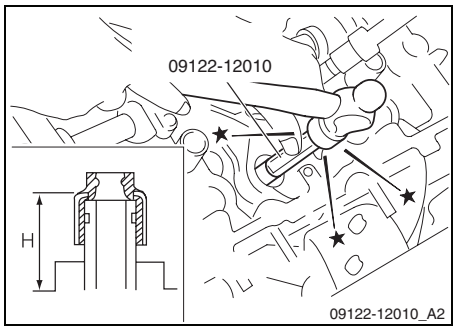


1. Remove camshaft. Refer to "CAMSHAFT".
2. Remove valve lifters. Refer to "CAMSHAFT".
3. Rotate crankshaft until the cylinder requiring new oil seals is at TDC. This will prevent valve from dropping into cylinder.
4. Remove valve collet with valve spring compressor set (09122-120S0) and remove valve spring and valve spring seat.



5. Remove valve oil seal using valve oil seal puller.

INSTALLATION



1. Apply new engine oil on new valve oil seal joint and seal lip.
2. Using valve oil seal drift (09122-12010), press-fit valve oil seal to height "H" shown in the figure.

REFERENCE

Dimension "H": Height measured before valve spring seat installation

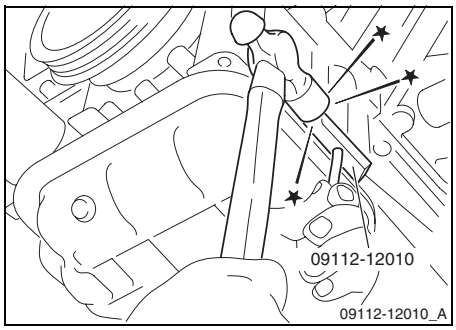
Dimension "H"
Intake and exhaust: 14.3 ~ 14.9 mm

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

Removal and Installation of Front Oil Seal

REMOVAL

1. Remove following parts:
   - Undercover
   - Right side front road wheel and tire (Refer to "ROAD WHEEL TIRE").
   - Splash guard (RH)
   - Drive belts (Refer to "DRIVE BELTS").
   - Crankshaft pulley (Refer to "FRONT TIMING CHAIN CASE").



2. Remove front oil seal using a screwdriver or a suitable tool.

CAUTION

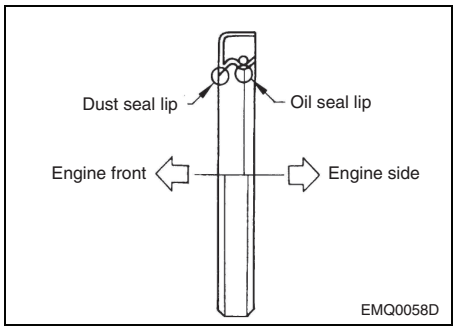
Be careful not to damage front timing chain case and crankshaft.

INSTALLATION

1. Apply engine oil to both new front oil seal joint and seal lip.
2. Using front oil seal drift (09115-21010 and 09115-21030), press-fit until the height of front oil seal is level with the mounting surface.

CAUTION

- **Be careful not to damage front timing chain case and crankshaft.**
- **Press-fit straight and avoid causing burrs or tilting oil seal.**
- **Install front oil seal so that each seal lip is oriented as shown in the figure.**

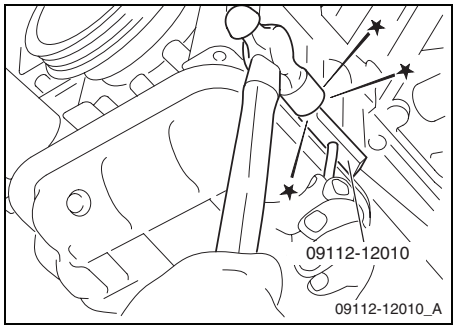


3. Install in the reverse order of removal after this step.

Removal and Installation of Rear Oil Seal

REMOVAL

1. Remove transaxle assembly.
   (Refer to "TRANSAXLE ASSEMBLY".)



2. Remove oil pan (upper).
   (Refer to "OIL PAN AND OIL STRAINER".)

3. Use seal cutter (09112-12010) to cut away liquid gasket and remove rear oil seal retainer.

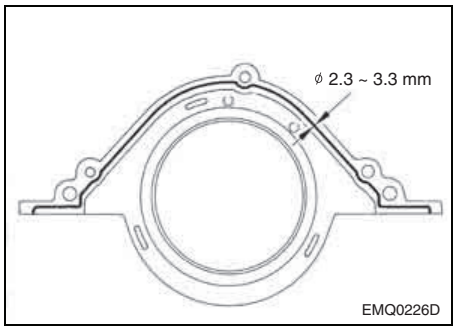
CAUTION

Be careful not to damage the mating surfaces.

REFERENCE

Regard both rear oil seal and rear oil seal as an assembly.

INSTALLATION



1. Remove old liquid gasket on mating surface of cylinder block using scraper.

2. Apply new engine oil to both oil seal lip and dust seal lip of new rear oil seal retainer.

3. Apply a continuous bead of liquid gasket (Threebond 1217 H or equivalent) to front timing chain case as shown in the figure. Refer to "LIQUID GASKET APPLICATION PROCEDURE".

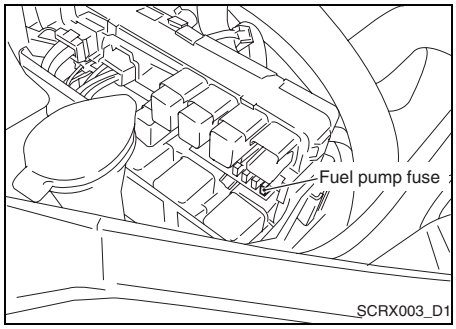
4. Install rear oil seal retainer to cylinder block.

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

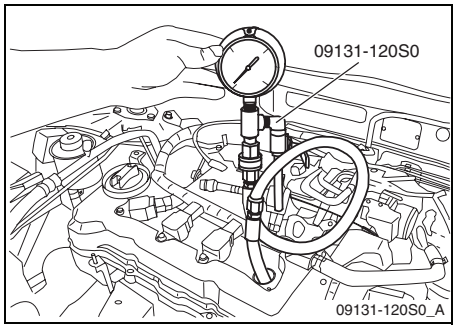
Cylinder Head

On-Vehicle Service

CHECKING COMPRESSION PRESSURE



1. Warm up engine thoroughly. Then, stop it.
2. Release fuel pressure. Refer to "FUEL PRESSURE RELEASE".
   - Release fuel pressure without using Mr. Tech (with fuel pump fuse removed).
   - Disconnect fuel pump fuse to avoid fuel injection during measurement.
3. Remove ignition coil and spark plug from each cylinder. Refer to "IGNITION COIL" and "SPARK PLUG (PLATINUM-TIPPED TYPE)".
4. Connect engine tachometer or Mr. Tech.



5. Install a compression pressure gauge set (09131-120S0) to spark plug hole.
6. With accelerator pedal fully depressed, turn ignition switch to "START" for cranking. When the gauge pointer stabilizes, read the compression pressure and engine rpm. Perform these steps to check each cylinder.

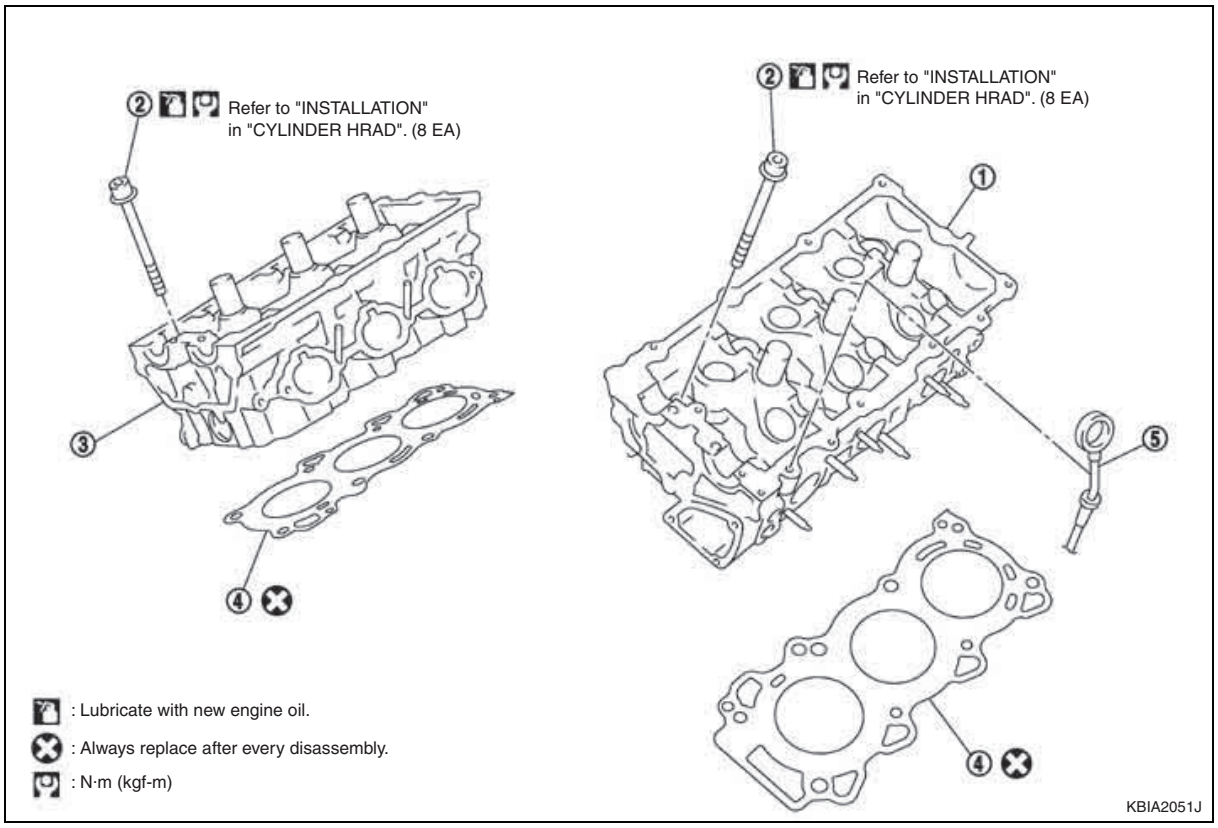
Unit: MPa (kg/cm^2)

Compression pressure (at 300 rpm)	VQ23DE	VQ35DE
Standard	1.05 (10.7)	1.27 (13.0)
Minimum	0.75 (7.7)	0.98 (10.0)
Differential limit between cylinders	0.1 (1.0)	0.1 (1.0)

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

7. After inspection is completed, install removed parts in the reverse order of removal.
8. Start engine, and make sure that engine runs smoothly.
9. Perform trouble diagnosis. Refer to "TROUBLE DIAGNOSIS".

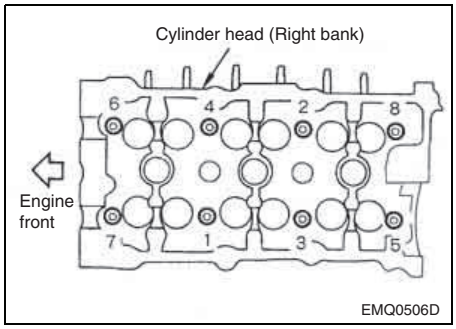
Components



1. Cylinder head (left bank)
2. Cylinder head bolt
3. Cylinder head (right bank)
4. Gasket
5. Oil level gauge

Removal

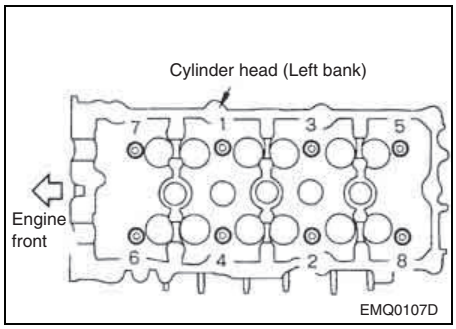
1. Remove camshaft. Refer to "CAMSHAFT".
2. Remove the following parts:
   - Fuel tube and fuel injector assembly; Refer to "FUEL INJECTOR AND FUEL TUBE".
   - Intake manifold; Refer to "INTAKE MANIFOLD".
   - Exhaust manifold; Refer to "EXHAUST MANIFOLD AND THREE WAY CATALYST".
   - Water inlet and thermostat assembly; Refer to "WATER INLET AND THERMOSTAT ASSEMBLY".
   - Water outlet and water pipe: Refer to "WATER OUTLET AND WATER PIPING".



3. Remove cylinder head bolts in reverse order as shown in the figure to remove cylinder heads.

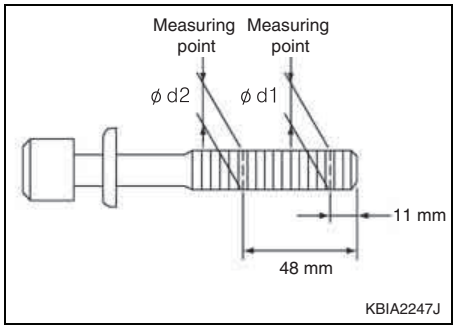
REFERENCE

Head bolts: Hexagon socket head bolt (size: 10 mm)



Inspection after Removal

Cylinder Head Bolts Outer Diameter

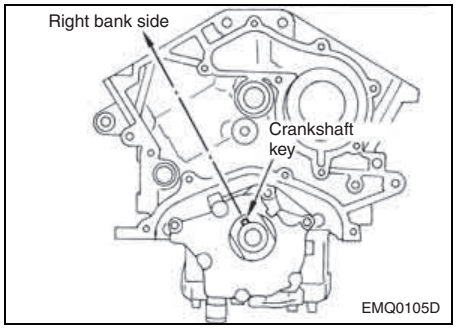


- Measure the outer diameter of bolt thread (d1 and d2) with micrometer.
- If reduction of outer diameter appears in a position other than ϕ d2, use it as a measuring point.
- ϕ Calculate the difference between d1 and d2.

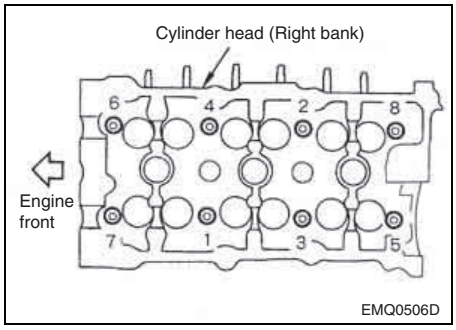
  Limit: 0.11 mm

- If it exceeds the limit, replace cylinder head bolt.

Installation



1. Turn crankshaft until No. 1 piston is set at TDC.
   - Crankshaft key should line up with the right bank cylinder center line as shown in the figure.
2. Install cylinder head gasket.

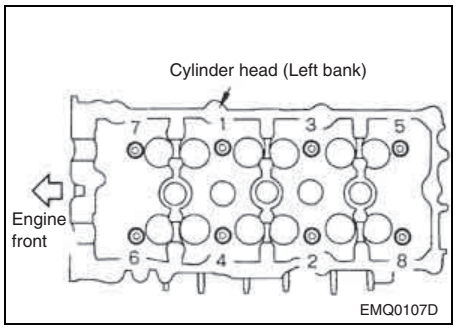


3. Install cylinder head, following the steps below, to tighten cylinder head bolts in numerical order as shown in the figure and install cylinder head.

⚠ CAUTION

- **Check outer diameter prior to work if cylinder head bolt is reused. Refer to "INSPECTION AFTER REMOVAL".**
- **In step "b", loosen bolts in reverse order of that indicated in the figure.**

a. Tighten bolts to 98.1 N·m (10 kgf-m).
b. Completely loosen bolts to 0 N·m (0 kgf-m).
c. Tighten bolts to 39.2 N·m (3.95 kgf-m).
d. Turn all cylinder head bolts 90 degrees clockwise (Angle tightening).



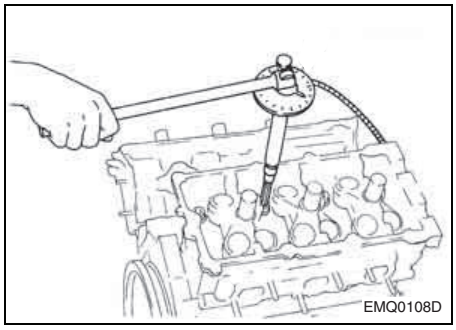
e. Turn all cylinder head bolts 90 degrees clockwise again (Angle tightening).

CAUTION

Check the tightening angle by using protractor or angle wrench. Avoid judgment by visual inspection without tool.

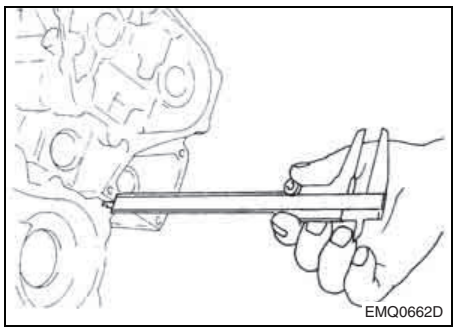
WHEN USING PROTRACTOR

- Paint a mark on the bolt heads of cylinder head bolt and cylinder head surface to check the rotating angle.



WHEN USING ANGLE WRENCH

- Check the rotating angle through scale on angle wrench.



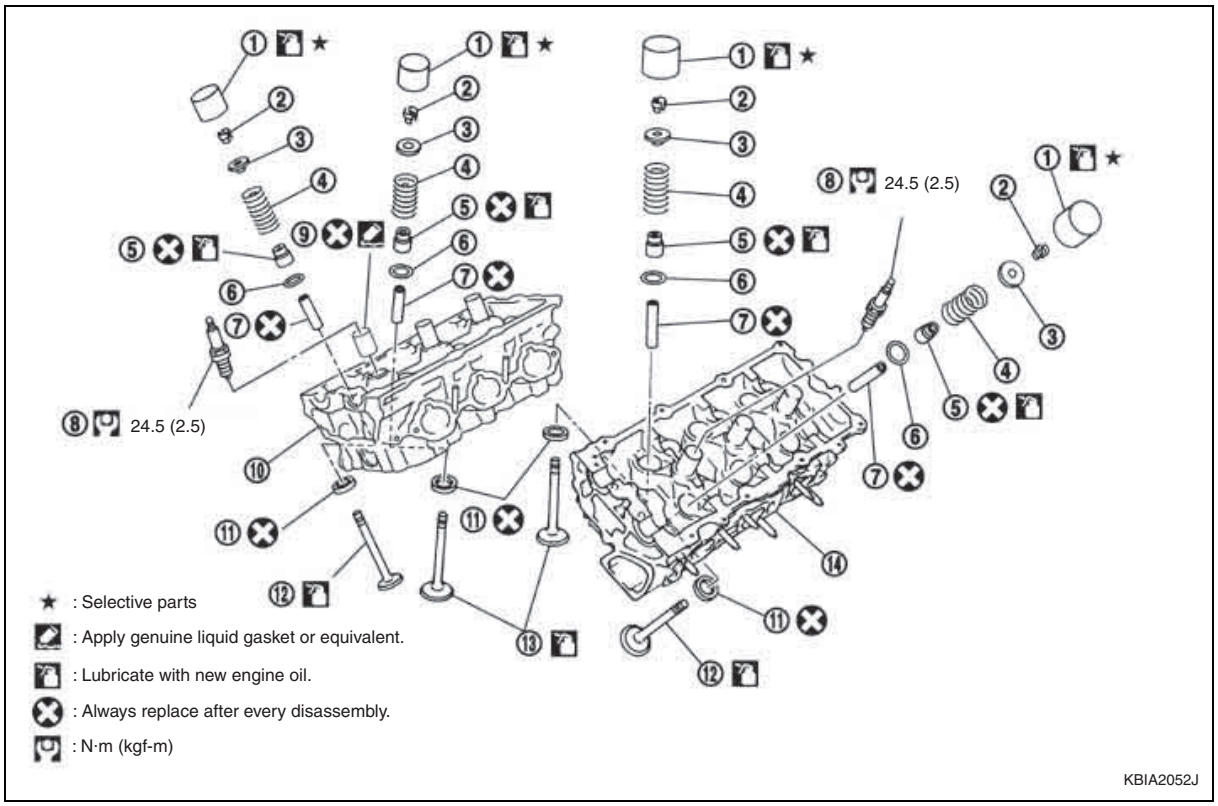
4. After installing cylinder head, measure distance between front end faces of cylinder block and cylinder head (left and right banks).

   Standard: 14.1 ~ 14.9 mm

   - If the measured value is out of the standard, re-install cylinder head.

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

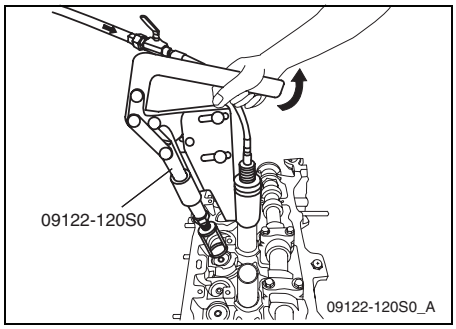
Components



1. Valve lifter
2. Valve collet
3. Valve spring retainer
4. Valve spring
5. Valve oil seal
6. Valve spring seat
7. Valve guide
8. Spark plug
9. Spark plug tube
10. Cylinder head (right bank)
11. Valve seat
12. Valve (EXH)
13. Valve (INT)
14. Cylinder head (left bank)

Disassembly

1. Remove spark plug using spark plug wrench (commercial service tool).

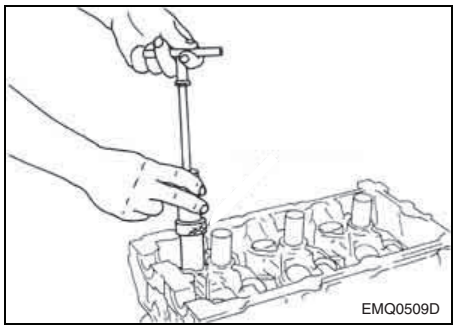


2. Remove valve lifter.
   - Identify installation positions, and store them without mixing them up.
3. Remove valve collet.
   - Compress valve spring with valve spring compressor set (09122-120S0). Remove valve collet with magnet bar.

⚠ CAUTION

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

4. Remove valve spring retainer and valve spring.
5. Push valve stem to combustion chamber side, and remove valve.
   - Before removing, check valve guide clearance. Refer to "VALVE GUIDE CLEARANCE".
   - Identify installation positions, and store them without mixing them up.


EMQ0509D

6. Remove valve oil seal.
   • Remove valve oil seal with valve oil seal puller.
7. Remove valve spring seat.
8. If valve seat must be removed, refer to "VALVE SEAT REPLACEMENT".
9. If valve guide must be removed, refer to "VALVE GUIDE REPLACEMENT".
10. Remove spark plug tube, as necessary.
    • Using pliers, pull spark plug tube out of cylinder head.

⚠ CAUTION

- **Be careful not to damage cylinder heads.**
- **Once removed, spark plug tube will be deformed and cannot be reused. Do not remove it unless absolutely necessary.**

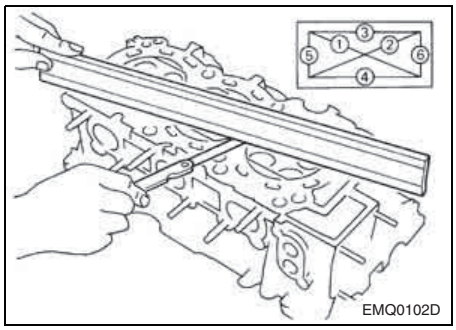
Inspection after Disassembly

CYLINDER HEAD DISTORTION

1. Wipe off oil and remove scale, gasket, sealant and carbon deposits from surface of cylinder head with scraper.

⚠ CAUTION

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



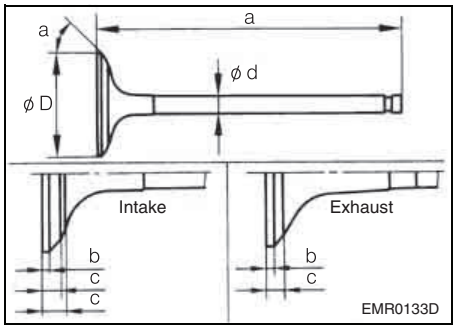
EMQ0102D

2. At each of several locations on bottom surface of cylinder head, measure the distortion in six directions with straightedge and feeler gauge.

   Limit: 0.1 mm

   • If it exceeds the limit, replace cylinder head.

VALVE DIMENSIONS



EMR0133D

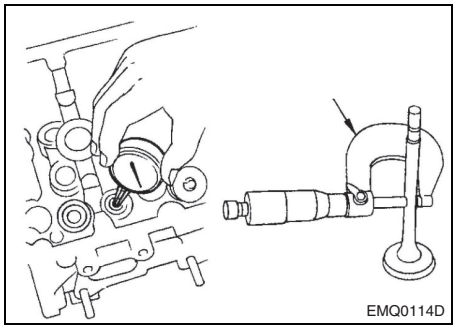
• Measure dimensions of each valve.

Standard

	Intake	Exhaust
a	**: 99.28 mm (VQ23DE)**	**96.81 mm (VQ23DE)**
	96.46 mm (VQ35DE)	**93.99 mm (VQ35DE)**
b	**: 1.1 mm**	**1.3 mm**
c	**: 2.4 ~ 2.8 mm**	**3.0 ~ 3.4 mm**
c′	**: 3.2 mm**	**-**
ϕ d	**: 5.965 ~ 5.980 mm**	**5.955 ~ 5.970 mm**
ϕ D	**: 34.0 ~ 34.3 mm (VQ23DE)**	**29.0 ~ 29.3 mm (VQ23DE)**
	37.0 ~ 37.3 mm (VQ35DE)	**31.2 ~ 31.5 mm (VQ35DE)**
α (°)	**45°15′ ~ 45°45′**	**45°15′ ~ 45°45′**

• If out of the standard, replace valve.

VALVE GUIDE CLEARANCE

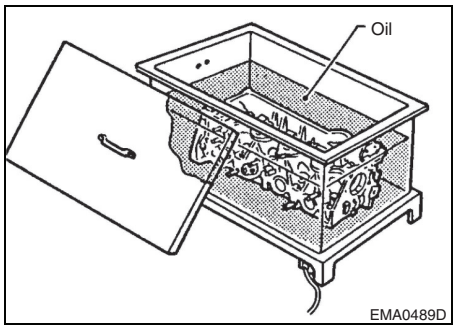


- Measure outer diameter of valve stem and inner diameter of valve guide.

Standard	**Intake**	**: 0.020 ~ 0.053 mm**
	Exhaust	**: 0.030 ~ 0.063 mm**
Limit	**Intake**	**: 0.08 mm**
	Exhaust	**: 0.1 mm**

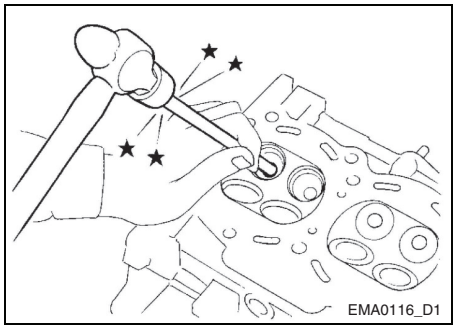
- If it exceeds the limit, replace valve guide. Refer to "VALVE GUIDE REPLACEMENT".

VALVE GUIDE REPLACEMENT



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

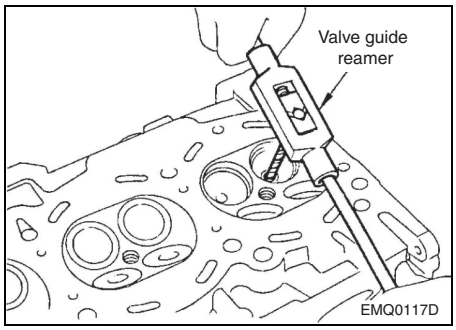
1. To remove valve guide, heat cylinder head to 110 to 130°C (230 to 266°F) by soaking in heated oil.



2. Drive out valve guide from combustion chamber side with valve guide drift (commercial service tool: for ϕ 6.0 mm).

⚠ CAUTION

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

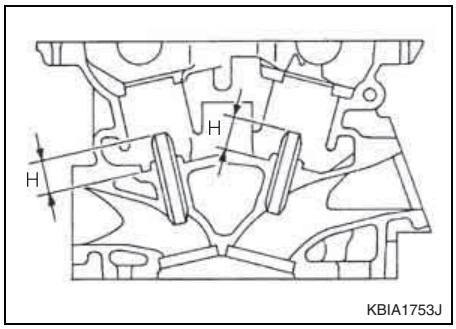


3. Using valve guide reamer (commercial service tool), ream cylinder head valve guide hole.

Valve guide hole diameter
(for service part, 0.2 mm oversize)

Intake and exhaust
: ϕ 10.175 ~ 10.19 6 mm

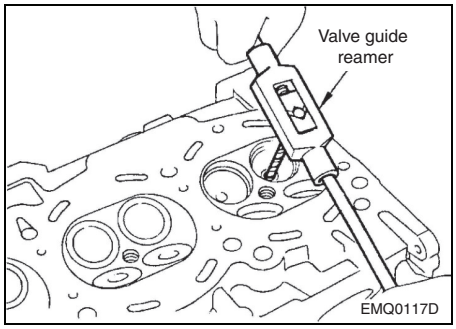
4. Heat cylinder head to 110 to 130°C (230 to 266°F) by soaking in heated oil.



5. Using valve guide drift (commercial service tool: for ϕ 6.0 mm), press valve guide from camshaft side to the dimension "H".

Projection "H"
Intake and exhaust: 12.6 ~ 12.8 mm

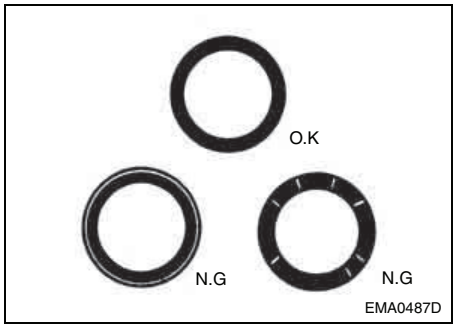
⚠ CAUTION
Cylinder head contains heat. When working, wear protective equipment to avoid getting burned.



6. Using valve guide reamer (commercial service tool), apply reamer finish to valve guide.

Standard: Intake and exhaust: ϕ 6.000 ~ 6.018 mm

VALVE SEAT CONTACT



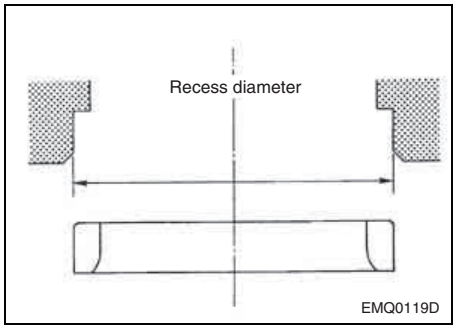
- After confirming that the dimensions of valve guides and valves are within the specifications, perform this procedure.
- Apply prussian blue (or white lead) onto contacting surface of valve seat to check the condition of the valve contact on the surface.
- Check if the contact area band is continuous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

VALVE SEAT REPLACEMENT

When valve seat is removed, replace with oversized (0.5 mm) valve seat.

1. Bore out old seat until it collapses.

⚠ CAUTION
Prevent to scratch cylinder head by excessive boring.



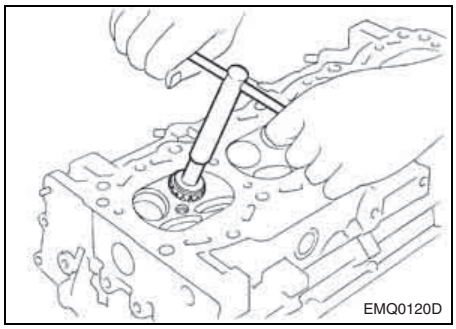
2. Ream cylinder head recess diameter for service valve seat.

Oversize (0.5 mm)

	VQ23DE	VQ35DE
Intake	**: ϕ 35.500 ~ 35.516 mm**	**ϕ 38.500 ~ 38.516 mm**
Exhaust	**: ϕ 30.500 ~ 30.516 mm**	**ϕ 32.700 ~ 32.716 mm**

3. Heat cylinder head to 110 to 130°C (230 to 266°F) by soaking in heated oil.
4. Provide valve seat cooled well with dry ice. Press-fit valve seat into cylinder head.

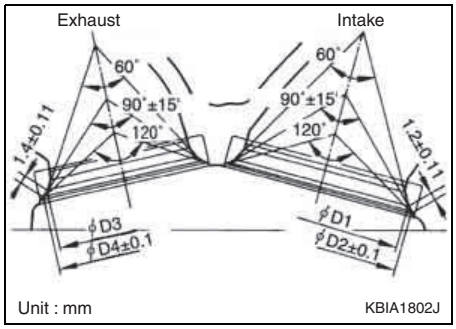
⚠ CAUTION
- **Avoid directly touching cold valve seats.**
- **Cylinder head contains heat. When working, wear protective equipment to avoid getting burned.**


EMQ0120D

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

⚠ CAUTION

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



Unit : mm KBIA1802J

Standard

	VQ23DE	VQ35DE
D1 :	32 mm	35 mm
D2 :	33.7 mm	36.7 mm
D3 :	26.5 mm	28.7 mm
D4 :	28.5 mm	30.7 mm

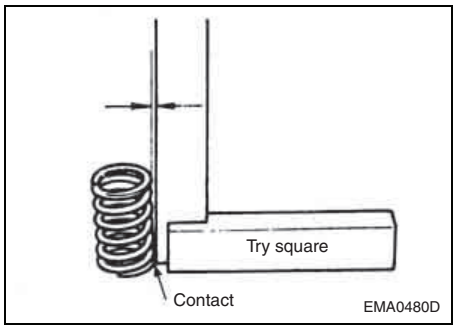
REFERENCE

- **D1, D3: 60° (diameter at cross point of 90° lines)**
- **D2, D4: 90° (diameter at cross point of 120° lines)**

6. Using compound, grind to adjust valve fitting.

7. Check again for normal contact.

VALVE SPRING SQUARENESS



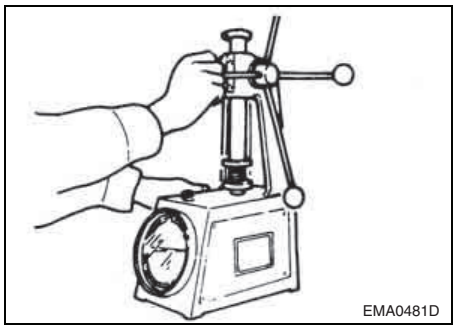
EMA0480D

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

Limit

	VQ23DE	VQ35DE
Intake	: 2.1 mm	2.0 mm
Exhaust	: 2.3 mm	2.0 mm

- If it exceeds the limit, replace valve spring.



VALVE SPRING DIMENSIONS AND VALVE SPRING PRESSURE LOAD

- Check valve spring each load at specified spring height.

Judgement standard (Approx.)

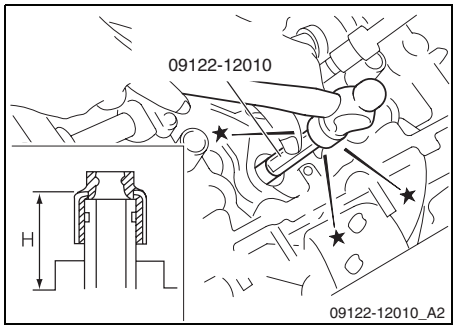
Engine	VQ23DE			VQ35DE
Position	Intake	Exhaust (*)		Intake, Exhaust
Free height	47.15 mm	52.28 mm	52.31 mm	46.52 mm
Installation height	37.00 mm	37.00 mm	37.00 mm	37.00 mm
Installation load	166 ~ 188 N (16.9 ~ 19.2 kg)	153 ~ 173 N (15.6 ~ 17.6 kg)	153 ~ 173 N (15.6 ~ 17.6 kg)	184 ~ 208 N (18.8 ~ 21.2 kg)
Height during valve open	27.20 mm	29.25 mm	29.25 mm	27.80 mm
Load with valve open	373 ~ 421 N (38.0 ~ 42.9 kg)	276 ~ 312 (28.1 ~ 31.8 kg)	276 ~ 312 (28.1 ~ 31.8 kg)	407 ~ 459 N (41.5 ~ 46.8 kg)
Identification color	White	Violet	Orange	Green

(*) : Exhaust side valve spring for VQ23DE has a parallel setting.

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

Assembly

1. If valve guide must be removed, refer to "VALVE GUIDE REPLACEMENT".
2. If valve seat must be removed, refer to "VALVE SEAT REPLACEMENT".
3. Install valve oil seal.
   - Install with valve oil seal drift (09122-12010) to match H dimension in illustration.



REFERENCE

Dimension "H": Height measured before valve spring seat installation

Dimension "H"

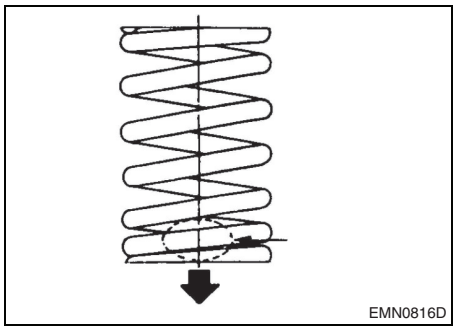
Intake & Exhaust: 14.3 ~ 4.9 mm

4. Install valve spring seat.
5. Install valve.
   - Larger diameter valves are for intake side.
6. Install valve spring.
   - Install narrow pitch end (paint mark) to cylinder head side.
   - Intake side and exhaust side valve springs are different. Install them referring to the following paint mark collar.

   (VQ23DE)

   Intake: White

   Exhaust: Violet or Orange (parallel setting)
7. Install valve spring retainer.



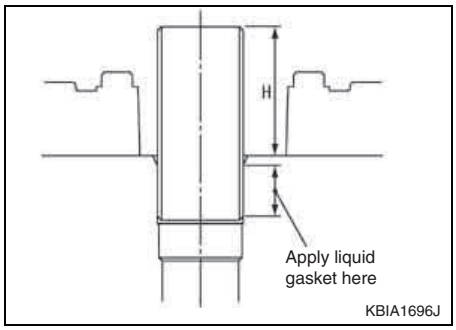
8. Install valve collet.
   • Compress valve spring with valve spring compressor (09122-121S0). Install valve collet with magnet hand.

⚠ CAUTION

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

   • Tap valve stem edge lightly with plastic hammer after installation to check its installed condition.

9. Install valve lifters.
   • Install it in the original position.



10. When spark plug tube is disconnected, install as follows.
   a. Remove old liquid gasket adhering to cylinder head mounting hole.
   b. Apply liquid gasket (Threebond 1386 B or equivalent) to area within approximately 12 mm from edge of spark plug tube press-fit side.
   c. Using drift (commercial service tool), press-fit spark plug tube so that its height "H" is as specified in the figure.

Standard press-fit height "H": 38.55 ~ 38.65 mm

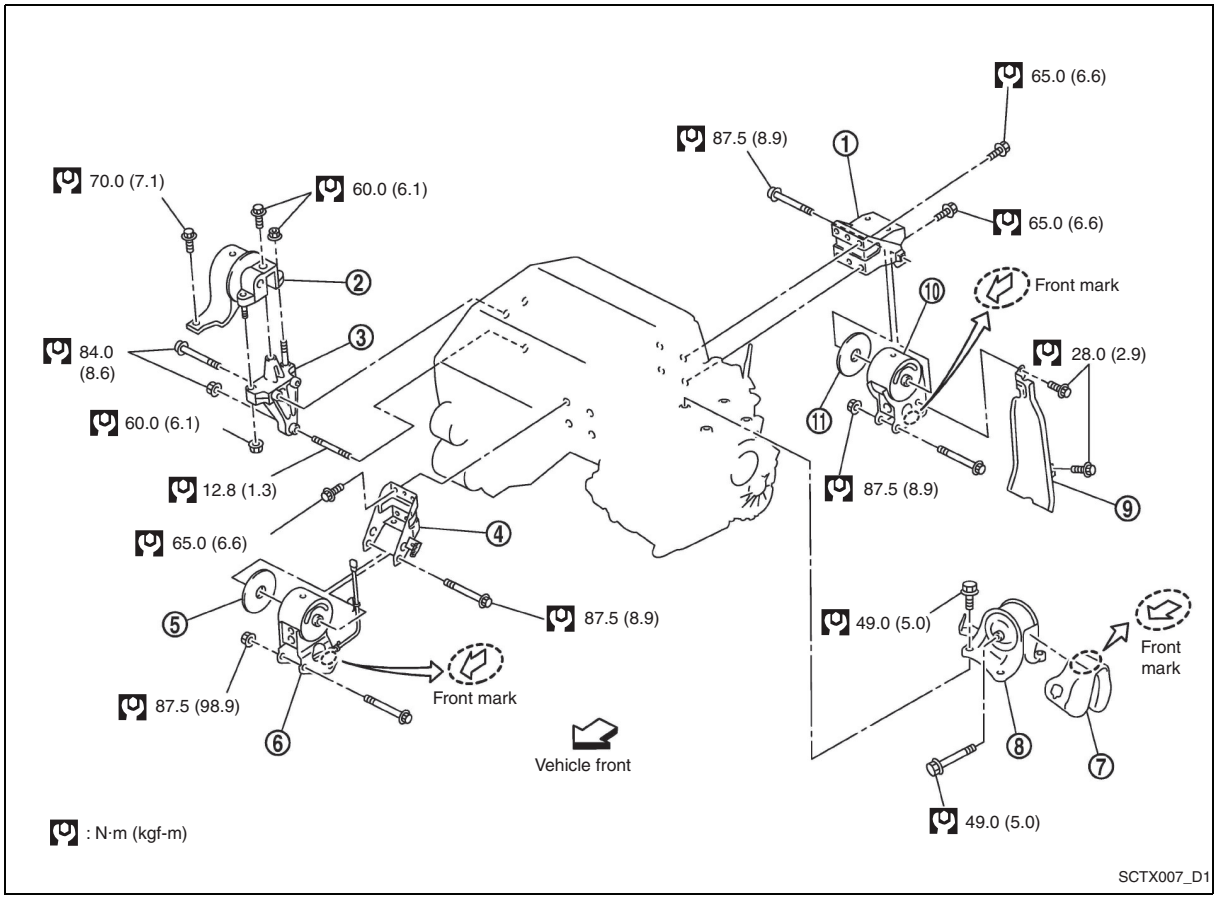
⚠ CAUTION

- **When press-fitting, take care not to deform spark plug tube.**
- **After press-fitting, wipe off liquid gasket protruding onto cylinder-head upper face.**

11. Install spark plug using spark plug wrench (commercial service tool).

Engine Assembly

Removal and Installation



1. Engine mounting bracket (rear)
2. Engine mounting insulator (RH)
3. Engine mounting bracket (RH)
4. Engine mounting bracket (front)
5. Stopper
6. Engine mounting insulator (front)
7. Engine mounting bracket (LH)
8. Engine mounting insulator
9. Stopper
10. Air guide
11. Engine mounting insulator (rear)
12. Stopper
13. Bracket

CAUTION

- **Always be careful to work safely and 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 section, refer to the applicable sections.**
- **Always use the support point specified for lifting.**
- **Use either 2-pole lift type or separate type lift as best you can. If board-on type is used for unavoidable reasons, support at the rear axle jacking point with transmission jack or similar tool before starting work, in preparation for the backward shift of center of gravity.**
- **For supporting points for lifting and jacking point at rear axle, refer to "LIFTING POINTS" in "GI" section.**

Removal

OUTLINE

Remove engine and transaxle assembly with front suspension member from vehicle downward. Separate front suspension member, and then separate engine and transaxle.

PREPARATION

1. Release fuel pressure. (Refer to "FUEL PRESSURE RELEASE")
2. Drain engine coolant from radiator. (Refer to "Changing Engine Coolant")
3. Remove the following parts.
   - Engine cover (Refer to "INTAKE MANIFOLD COLLECTOR")
   - Hood assembly (Refer to "HOOD")
   - Undercover and splash guards (RH and LH)
   - Front road wheel and tire (RH and LH) (Refer to "ROAD WHEEL TIRE")
   - Air duct (inlet), air cleaner case with mass air flow sensor and air duct assembly (Refer to "AIR CLEANER AND AIR DUCT")
   - Battery, battery tray and battery tray bracket (Refer to "BATTERY")
   - Drive belts (Refer to "DRIVE BELTS")
   - Radiator, reservoir of radiator (Refer to "RADIATOR")
   - Front wiper arm (Refer to "FRONT WIPER AND WASHER SYSTEM")
   - Cowl top cover (Refer to "COWL TOP")

VEHICLE INSIDE

4. Disconnect engine harness on ECCS control unit and temporarily secure it on engine side

⚠ CAUTION

After disengaging, cover the harness so that foreign material cannot be entered.

LEFT SIDE OF ENGINE ROOM

5. Disconnect heater hose.
   After disconnecting, install plug to heater hose to prevent engine coolant from draining.
6. Remove vacuum hose between canister purge control valve and canister.
7. Disconnect fuel feed hose. (Refer to "FUEL INJECTOR AND FUEL TUBE")

⚠ CAUTION

Disconnect fuel feed hose, and plug it to prevent fuel from draining.

8. Disconnect control cable from transaxle. (Refer to "A/T: SHIFT CONTROL SYSTEM")
9. Remove IPDM E/R and bracket. (Refer to "IPDM E/R (INTELLIGENT POWER DISTRIBUTION MODULE ENGINE ROOM")

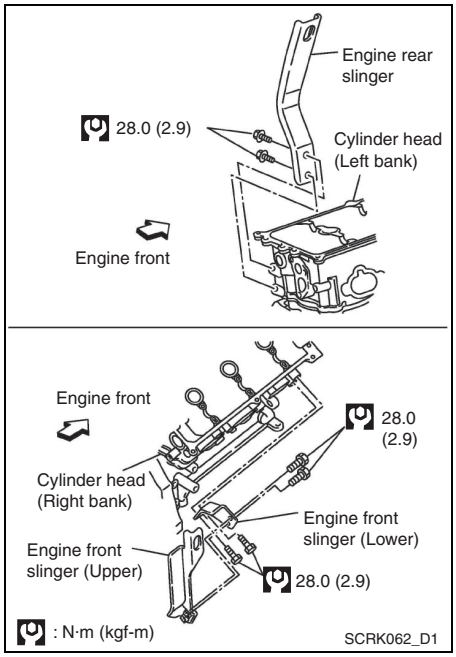
RIGHT SIDE OF ENGINE ROOM

10. Remove brake booster vacuum hose from vehicle.
11. Disconnect alternator. (Refer to "CHARGING SYSTEM")
12. Remove A/C compressor with piping connected from engine. Temporarily secure it on vehicle side with a rope to avoid putting load on it.
    (Refer to "Air Conditioner Cycle")
13. Disconnect suction hoses of power steering oil pump at reservoir tank side. (Refer to "HYDRAULIC LINE")

VEHICLE UNDERBODY

14. Remove front drive shafts (right and left sides). (Refer to "FRONT DRIVE SHAFT")
15. Remove front exhaust tube. (Refer to "EXHAUST SYSTEM")
16. Disconnect steering lower joint at power steering gear assembly side. (Refer to "STEERING COLUMN")
17. Disconnect front stabilizer connecting rod. (Refer to "FRONT SUSPENSION ASSEMBLY")
18. Disconnect power steering piping at a point between vehicle and engine. (Refer to "HYDRAULIC LINE")
    After disconnecting, Install plug to avoid leakage of power steering fluid.

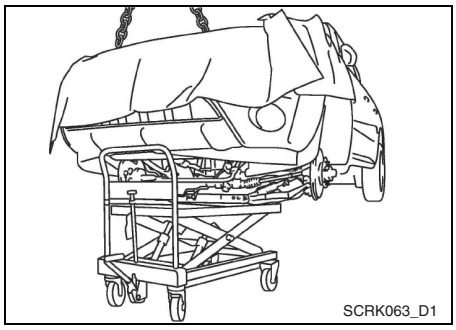
REMOVAL



19. Install engine slingers (service part) into front of cylinder head (right bank) and rear of cylinder head (left bank). Lift with hoist and secure engine in position.

CAUTION

- **For engine slingers and mounting bolt, use only genuine service part.**
- **Refer to service part.**



20. Use manual lift table caddy or equivalently rigid tool such as transmission jack. Securely support bottom of front suspension member.

CAUTION

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

21. Separate engine mounting insulator (RH) and engine mounting bracket (RH).
22. Pull engine mounting (LH) through-bolt out. £®VQ23DE£©
23. Remove front suspension member mounting nuts and bolts. Refer to "FRONT SUSPENSION ASSEMBLY".
24. Carefully lower engine, transaxle and front suspension member assembly.

CAUTION

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

25. Remove crankshaft position sensor (POS). Refer to "OIL PAN AND OIL STRAINER".

26. Remove power steering oil pump, power steering piping and power steering bracket from engine and transaxle assembly. Refer to "HYDRAULIC LINE".
27. Disconnect harness connector of engine mounting insulators (front and rear).
28. Remove engine mounting (front) and engine mounting (rear) through-bolts.
29. Remove each engine mounting insulator and each engine mounting bracket.
30. Separate engine and transaxle assembly from front suspension member.
31. Remove starter motor. Refer to "STARTING SYSTEM".
32. Separate engine and transaxle.
    (Refer to VQ23DE: TRANSAXLE ASSEMBLY. VQ35DE: TRANSAXLE ASSEMBLY.)

Installation

Note the following, and install in the reverse order of separation.
- Do not allow engine mounting insulator to be damage and careful no engine oil gets on it.
- For a path with a specified installation orientation, refer to "Component" figure.
- Make sure all engine mounting insulators are seated properly, then tighten nuts and bolts.

Inspection after Installation

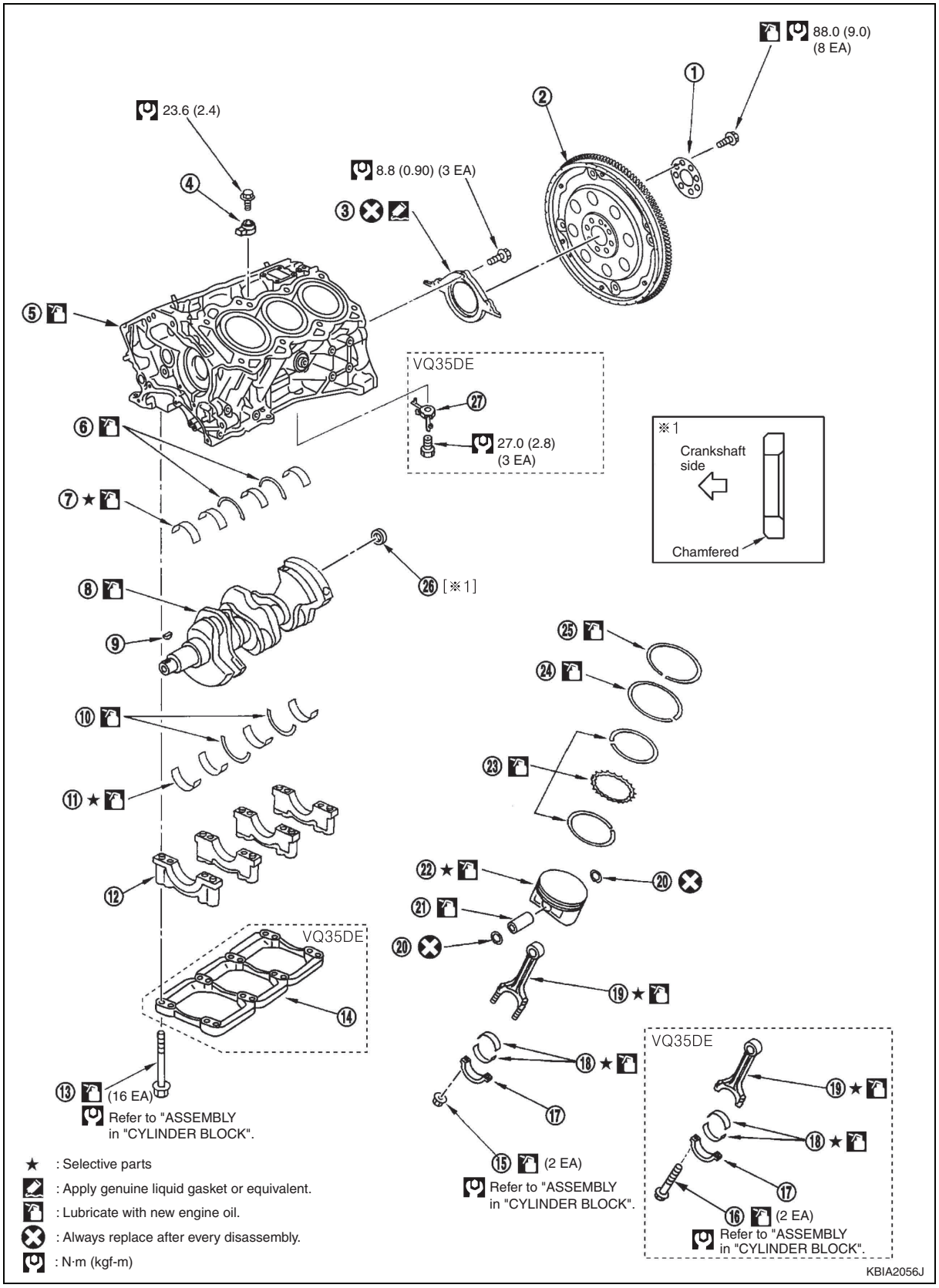
- Before starting engine, check the levels of engine coolant, engine oil and working fluid. If less than required quantity, fill to the specified level.
- Use procedure below to check for fuel leakage.
  - Turn ignition switch "ON" (with engine stopped). With fuel pressure applied to fuel piping, check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

INSPECTION ITEMS:

Item	Before Starting Engine	Engine Running	After Engine Stopped
Engine coolant	Level	Leakage	Level
Engine oil	Level	Leakage	Level
Working fluid	Level	Leakage	Level
Fuel	-	Leakage	-
Exhaust gases	-	Leakage	-

Cylinder Block

Components



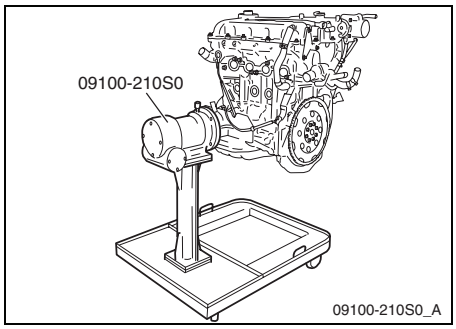
1. Reinforcement plate
2. Drive plate
3. Rear oil seal retainer (rear oil seal integrated type)
4. Knock sensor
5. Cylinder block
6. Thrust bearing
7. Main bearing
8. Crankshaft
9. Woodruff Key
10. Thrust bearing
11. Main bearing
12. Main bearing cap
13. Main bearing cap bolt
14. Main bearing beam
15. Connecting rod nut
16. Connecting rod bolt
17. Connecting rod bearing cap
18. Connecting rod bearing
19. Connecting rod
20. Snap ring
21. Piston pin
22. Piston
23. Oil ring
24. Second ring
25. Top ring
26. Pilot converter
27. Oil jet

Disassembly

REFERENCE

VQ35DE (with main bearing beam, connecting rod bearing cap is tighten by bolts) is shown as an example unless the figure includes specification.

1. Remove engine assembly from vehicle, and separate transaxle from engine. Refer to "Removal and Installation" in "ENGINE ASSEMBLY" section.
2. Remove engine mounting bracket. Refer to "Removal and Installation" in "ENGINE ASSEMBLY" section.
3. Remove exhaust manifolds. Refer to "EXHAUST MANIFOLD AND THREE WAY CATALYST".
4. Install engine sub-attachment (09100-210S0) to right side of cylinder block.



5. Lift engine and mount it onto engine stand.

REFERENCE

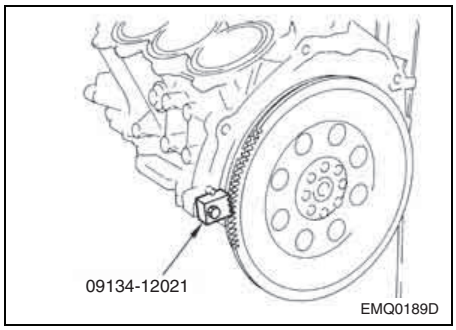
This example is engine stand for holding at transaxle mounting side with driver plate removed.

6. Drain engine coolant and engine oil. Refer to "ENGINE COOLANT" and "ENGINE OIL".
7. Remove cylinder head. Refer to "CYLINDER HEAD".
8. Remove knock sensor.

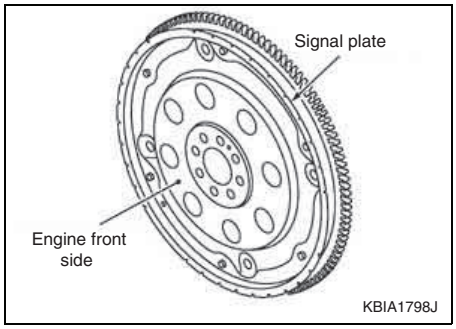
⚠ CAUTION

Carefully handle sensor avoiding shocks.

9. Remove drive plate as follows:
   a. Fix crankshaft with ring gear brake (09134-12021).



   b. Loosen mounting bolts in diagonal order and remove drive plate.

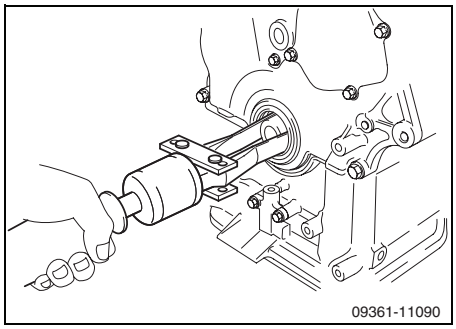


CAUTION

Do not disassemble signal plate. (disassembly prohibited parts)

- **Do not place drive plate with signal plate facing down.**
- **When handling signal plate, take care not to damage, deform or scratch it.**
- **Handle signal plate in a manner that prevents it from becoming magnetized.**

10. Remove pilot converter using pilot converter puller pilot (09134-12010) and puller E (09361-11090) as necessary.
11. Remove rear oil seal retainer.
    - Remove by inserting screwdriver between main bearing cap and rear oil seal retainer.



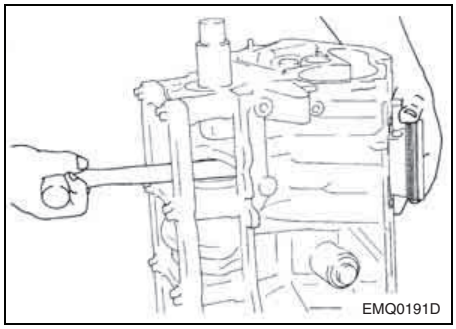
CAUTION

If rear oil seal retainer is removed, replace it with new one.

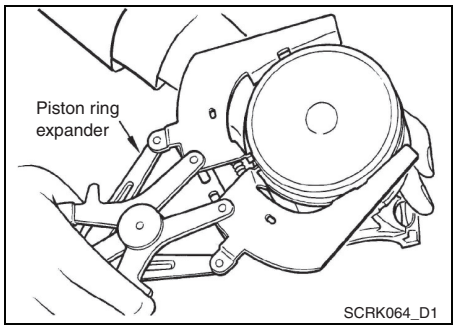
REFERENCE

Regard both rear oil seal and retainer as an assembly.

12. Remove piston and connecting rod assembly.
    - Before removing piston and connecting rod assembly, check the connecting rod side clearance. Refer to "CONNECTING ROD SIDE CLEARANCE".
    - Remove piston from connecting rod as follows:
      a. Position crankshaft pin corresponding to connecting rod to be removed onto the bottom dead center.
      b. Remove connecting rod cap.
      c. Using hammer handle or similar tool, push piston and connecting rod assembly out to the cylinder head side.



13. Remove connecting rod bearings from connecting rod and connecting rod bearing cap.
    - Identify installation position, and store them without mixing them up.

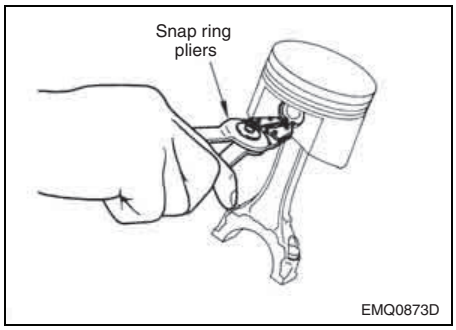


14. Remove piston rings form piston.
    - Use piston ring expander (commercial service tool).

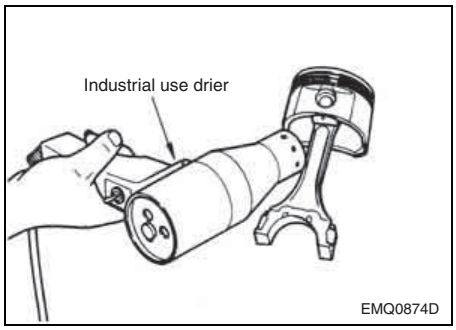
⚠ CAUTION

- **When removing piston rings, be careful not to damage piston.**
- **Be careful not to damage piston rings by expanding them excessively.**

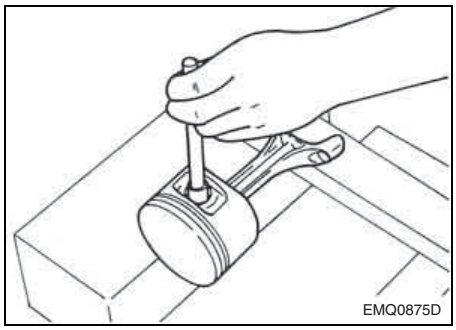
- Before removing piston rings, check the piston ring side clearance. (Refer to "PISTON RING SIDE CLEARANCE".



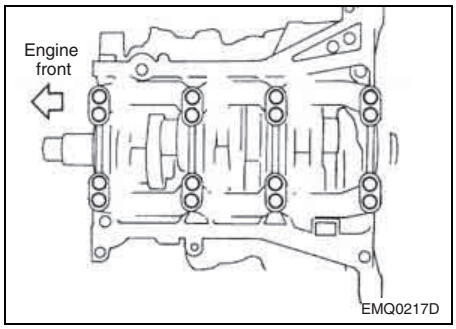
15. Remove piston from connecting rod as follows:
    a. Using snap ring pliers (commercial service tool), remove snap ring.



    b. Heat piston to 60 ~ 70°C (140 to 158°F) with industrial use drier or equivalent.



    c. Push out piston pin with stick of outer diameter approximately 20 mm (0.79 in).



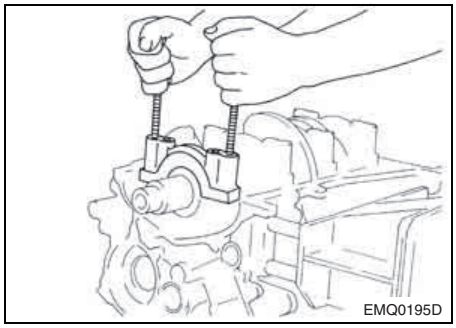
16. Remove main bearing cap bolts.

REFERENCE

Use TORX socket (size E-14).

- Before loosening main bearing cap bolts, measure crankshaft side clearance. Refer to "CRANKSHAFT SIDE CLEARANCE".
- Loosen bolts in reverse order as shown in the figure in several different steps.

17. Remove main bearing beam. (VQ35DE)



18. Remove main bearing caps.
    - Using main bearing cap bolts, remove main bearing cap while shaking it back-and-forth.
19. Remove crankshaft.
20. Remove main bearing and thrust bearing from cylinder block and main bearing cap.

⚠ CAUTION

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

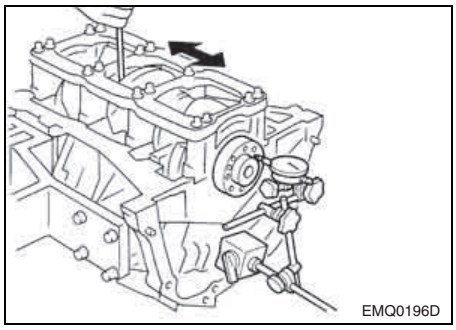
21. Remove oil jet. (VQ35DE)

Inspection after Disassembly

REFERENCE

VQ35DE (with main bearing beam) is shown as an example unless the figure includes specification.

CRANKSHAFT SIDE CLEARANCE

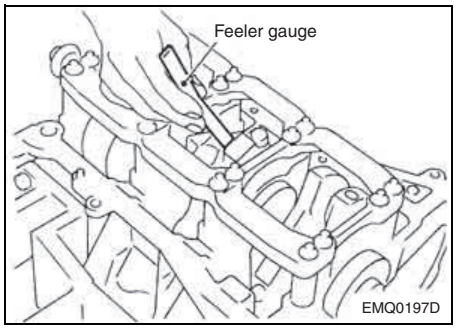

EMQ0196D

- Measure the clearance between thrust bearings and crankshaft arm when crankshaft is moved fully forward or backward with dial gauge.

  Standard: 0.10 ~ 0.25 mm
  Limit: 0.3 mm

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

CONNECTING ROD SIDE CLEARANCE



EMQ0197D

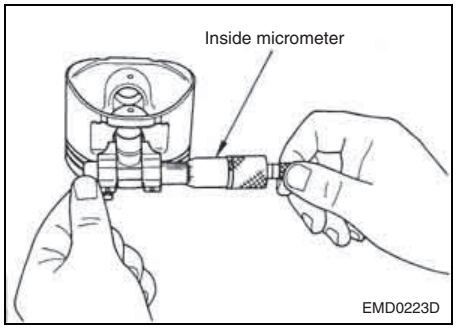
- Measure the side clearance between connecting rod and crankshaft arm with feeler gauge.

  Standard: 0.20 ~ 0.35 mm
  Limit: 0.4 mm

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

PISTON TO PISTON PIN OIL CLEARANCE

Piston Pin Hole Diameter

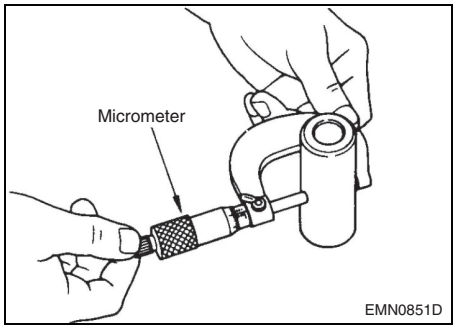


EMD0223D

- Measure the inner diameter of piston pin hole with inside micrometer.

  Standard: 21.991 ~ 21.995 mm

Piston Pin Outer Diameter



EMN0851D

- Measure the outer diameter of piston pin with micrometer.

  Standard: 21.989 ~ 21.993 mm

Piston to Piston Pin Oil Clearance

(Piston to piston pin oil clearance)
= (Piston pin hole diameter) - (Piston pin outer diameter)

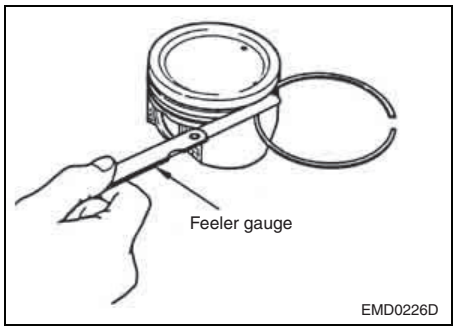
Standard: -0.002 ~ 0.006 mm

- If the calculated value is out of the standard, replace piston and piston pin assembly.
- When replacing piston and piston pin assembly, refer to "HOW TO SELECT PISTON".

REFERENCE

- **Piston is available together with piston pin as assembly.**
- **Piston pin (piston pin hole) grade is provided only for the parts installed at the plant. For service part, no piston pin grades can be selected. (Only "0" grade is available.)**

PISTON RING SIDE CLEARANCE



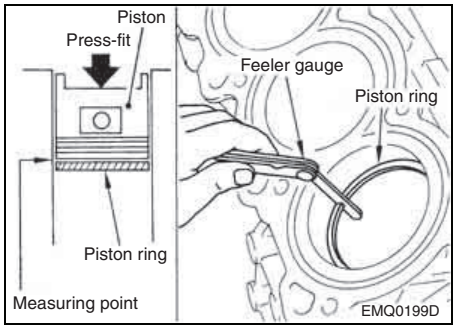
- Measure side clearance of piston ring and piston ring groove with feeler gauge.

Standard	VQ23DE	VQ35DE
Top ring	: 0.045 ~ 0.080 mm	0.045 ~ 0.080 mm
2nd ring	: 0.030 ~ 0.070 mm	0.030 ~ 0.070 mm
Oil ring	: 0.045 ~ .125 mm	0.065 ~ 0.135 mm

Limit	VQ23DE	VQ35DE
Top ring	: 0.11 mm	0.11 mm
2nd ring	: 0.10 mm	0.10 mm
Oil ring	: -	-

- If the measured value exceeds the limit (fro, oil ring, standard value), replace piston ring.
- Measure again. If it still exceeds the limit, replace piston also.

PISTON RING END GAP



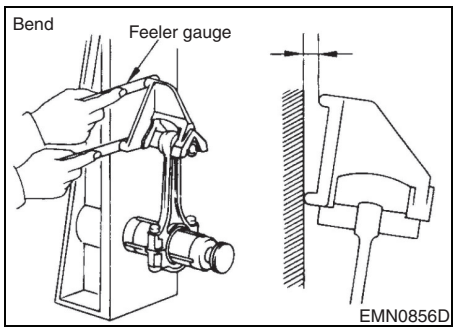
- Make sure that cylinder bore inner diameter is within the specification. Refer to "Cylinder Bore Inner Diameter".
- Lubricate with new engine oil to piston and piston ring, and then insert piston ring until middle of cylinder with piston, and measure piston ring end gap with feeler gauge.

Standard	VQ23DE	VQ35DE
Top ring	: 0.20 ~ 0.30 mm	0.23 ~ 0.33 mm
2nd ring	: 0.31 ~ 0.46 mm	0.33 ~ 0.48 mm
Oil ring	: 0.20 ~ 0.60 mm	0.20 ~ 0.50 mm

Limit	VQ23DE	VQ35DE
Top ring	: 0.54 mm	0.47 mm
2nd ring	: 0.67 mm	0.59 mm
Oil ring	: 0.95 mm	0.76 mm

- If the measured value exceeds the limit, replace piston ring.

CONNECTING ROD BEND AND TORSION

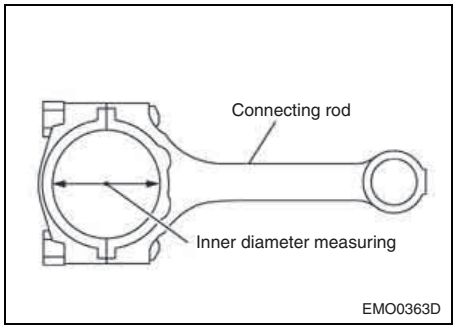


- Check with connecting rod aligner.

  Bend Limit: 0.15 mm per 100 mm length
  Torsion Limit: 0.3 mm per 100 mm length

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

CONNECTING ROD BIG END DIAMETER



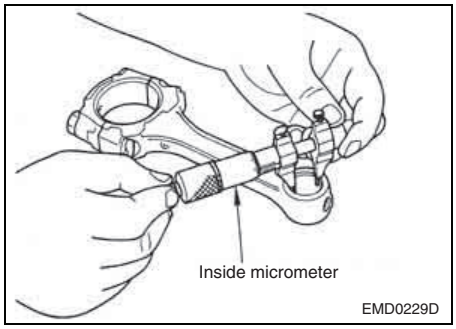
- Install connecting rod bearing cap without installing connecting rod bearing, and tightening connecting rod nuts (VQ23DE) or connecting rod bolts (VQ35DE) to the specified torque. Measure the inner diameter of connecting rod big end with inside micrometer.
- Refer to "ASSEMBLY" for the tightening procedure.

  Standard
  VQ23DE: ϕ 48.000 ~ 48.013 mm
  VQ35DE: ϕ 55.000 ~ 55.013 mm

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

CONNECTING ROD BUSHING OIL CLEARANCE (SMALL END)

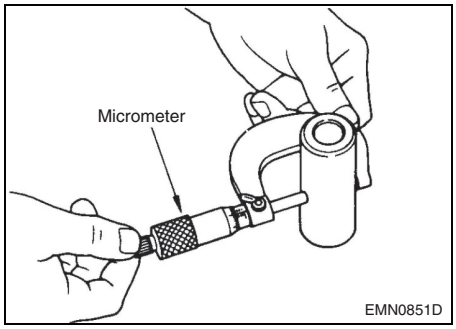
Connecting Rod Bushing Small End Inner Diameter



- Measure the inner diameter of connecting rod bushing (small end) with inside micrometer.

  Standard: ϕ 22.000 ~ 22.012 mm

PISTON PIN OUTER DIAMETER



- Measure the outer diameter of piston pin with micrometer.

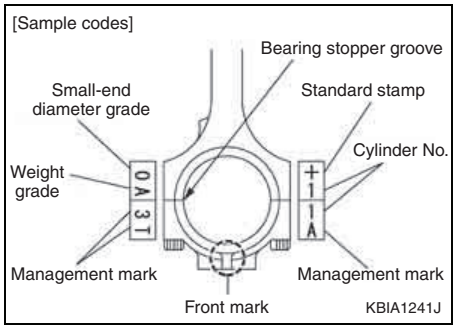
Standard: ϕ 21.989 ~ 21.993 mm

CONNECTING ROD BUSHING OIL CLEARANCE

(Connecting rod bushing small end oil clearance)
= (Connecting rod bushing small end inner diameter) - (Piston pin outer diameter)

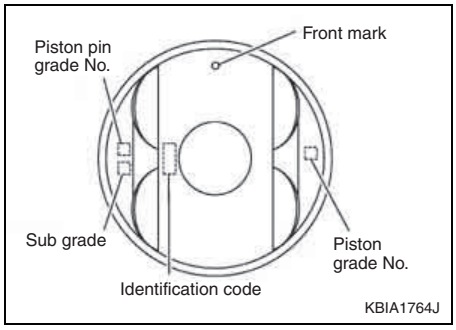
Standard: 0.005 ~ 0.017 mm
Limit: 0.030 mm

- If the calculated value exceeds the limit, replace connecting rod assembly and/or piston and piston pin assembly.
- If replacing piston and piston pin assembly, refer to "Cylinder Bore Inner Diameter".
- If replacing connecting rod assembly, refer to "CONNECTING ROD BEARING OIL CLEARANCE" to select the connecting rod bearing.



REFERENCE

- **The following parts are for factory installed parts grading.**
- **Service parts apply only to grade ì0î.**



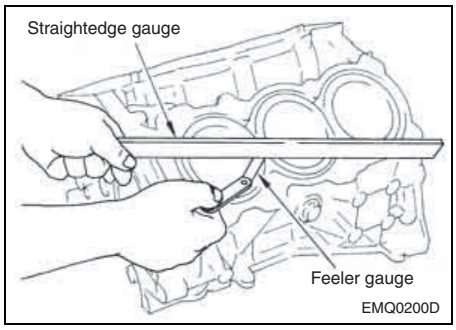
(mm)

Grade	0	1
Connecting rod bushing small end inner diameter	22.006/22.000	22.012/22.006
Piston pin hole diameter	21.999/21.993	22.005/21.999
Piston pin outer diameter	21.995/21.989	22.001/21.995

REFERENCE

For the service parts, the weight grade for connecting rod cannot be selected.

CYLINDER BLOCK DISTORTION



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

CAUTION

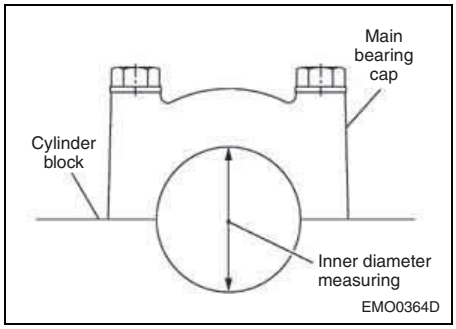
Be careful not to allow gasket flakes to enter engine oil or engine coolant passages.

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

  Limit: 0.1 mm

- If it exceeds the limit, replace cylinder block.

MAIN BEARING HOUSING INNER DIAMETER



- Install main bearing caps and main bearing beam without installing main bearings, and tighten main bearing cap bolts to the specified torque.
- Refer to "ASSEMBLY" for the tightening procedure.
- Measure the inner diameter of main bearing housing with bore gauge.

  Standard: ϕ 63.993 ~ 64.017 mm

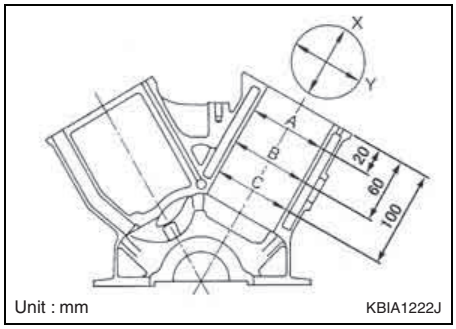
- If out of the standard, replace cylinder block.

REFERENCE

Cylinder block cannot be replaced as a single part, because it is machined together with main bearing caps.

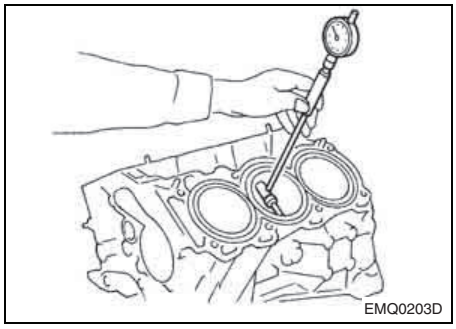
PISTON TO CYLINDER BORE CLEARANCE

Cylinder Bore Inner Diameter

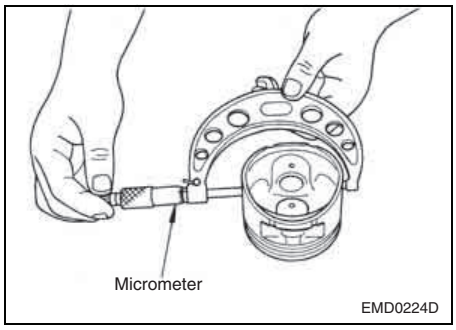


- Using bore gauge, measure cylinder bore for wear, out-of-round and taper at six different points on each cylinder. ("X" and "Y" directions at "A", "B" and "C").

  Standard inner diameter
  VQ23DE: ϕ 85.000 ~ 85.030 mm
  VQ35DE: ϕ 95.500 ~ 95.530 mm
  Out-of-round limit (Difference between "X" and "Y"): 0.015 mm
  Taper limit (Difference between "A" and "C"): 0.010 mm



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



Piston Skirt Diameter

- Measure outer diameter of piston skirt with micrometer.

Measuring point
VQ23DE: Distance from the top 45.4 mm
VQ35DE: Distance from the top 41.0 mm
Standard
VQ23DE: ϕ84.980 ~ 85.010 mm
VQ35DE: ϕ95.480 ~ 5.510 mm

PISTON TO CYLINDER BORE CLEARANCE

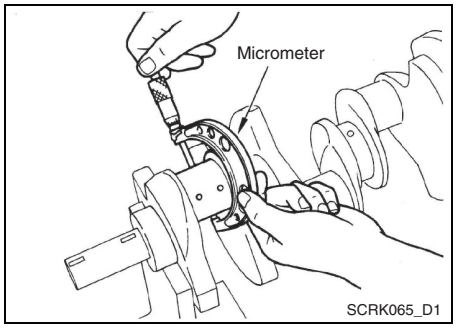
- Calculate by piston skirt diameter and cylinder bore inner diameter (direction "X", position "B").
  (Clearance)=(Cylinder bore inner diameter) - (Piston skirt diameter)

Standard: 0.010 ~ 0.030 mm
Limit: 0.08 mm

- If calculated value exceeds the limit, replace piston and piston pin assembly. (Refer to "HOW TO SELECT PISTON".
- Use the oversize piston if the clearance cannot be corrected with standard piston.
- When using oversize piston, rebore cylinder so that the clearance of the piston-to-cylinder bore satisfies the standard. Also, use oversize piston rings when using oversize piston.

CAUTION
When using oversize piston, use over size pistons for all cylinders.

Piston oversize (OS): 0.2 mm



CRANKSHAFT MAIN JOURNAL DIAMETER

- Measure outer diameter of crankshaft main journals with micrometer.

  Standard: ϕ 59.951 ~ 59.975 mm

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

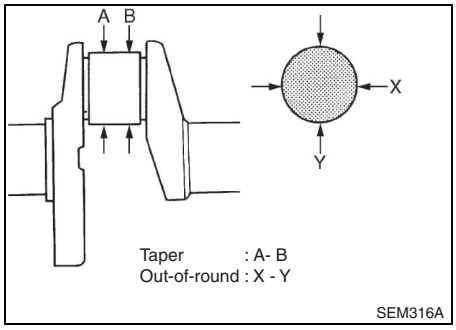
CRANKSHAFT PIN JOURNAL DIAMETER

- Measure outer diameter of crankshaft pin journal with micrometer.

  Standard
  VQ23DE: ϕ 44.956 ~ 44.974 mm
  VQ35DE: ϕ 51.956 ~ 51.974 mm

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

CRANKSHAFT OUT-OF-ROUND AND TAPER

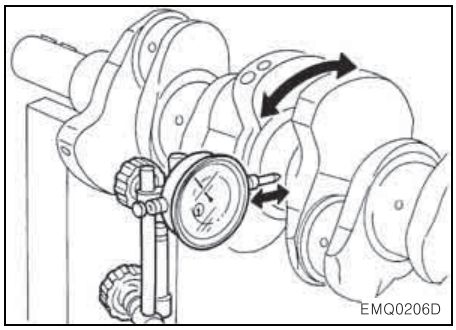


- Measure the dimensions at four different points as shown in the figure on each main journal and pin journal with micrometer.
- Out-of-round is indicated by the difference in the dimensions between "1" and "2" at "A" and "B".
- Taper is indicated by the difference in the dimensions between "A" and "B" at "1" and "2".

  Out-of-round: 0.002 mm
  Taper: 0.002 mm

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

Crankshaft Runout



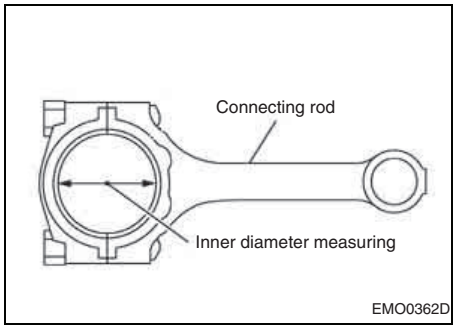
- Place V-block on precise flat table, and support the journals on the both end of crankshaft.
- Place dial gauge straight up on the No. 3 journal.
- While rotating crankshaft, read the movement of the pointer on dial indicator.
- Crankshaft runout is half of total indicator reading.

Standard: 0.025 mm or less
Limit: 0.1 mm

- If it exceeds the limit, replace crankshaft.

Connecting Rod Bearing Oil Clearance

METHOD BY CALCULATION

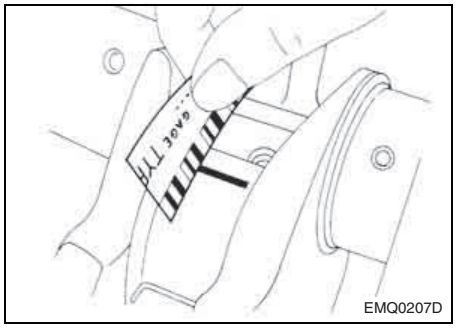


- Install connecting rod bearings to connecting rod and connecting rod bearing cap, and tighten connecting rod nuts (VQ23DE) or connecting rod bolts (VQ35DE) to the specified torque. Measure the inner diameter of connecting rod bearing with inside micrometer.
- Refer to "ASSEMBLY" for the tightening procedure.
  (Bearing oil clearance) =
  (Connecting rod bearing inner diameter) - (Crankshaft pin journal diameter)

Standard: 0.034 ~ 0.059 mm (actual clearance)
Limit: 0.07 mm

- If calculated value exceeds the limit, select proper connecting rod bearing according to connecting rod big end diameter and crankshaft pin journal diameter to obtain the specified bearing oil clearance. Refer to "HOW TO SELECT CONNECTING ROD BEARING".

METHOD OF USING PLASTIGAGE



- Remove oil and dust on crankshaft pin journal and the surfaces of each bearing completely.
- Cut plastigage slightly shorter than the bearing width, and place it in crankshaft axial direction, avoiding oil holes.
- Install connecting rod bearings to connecting rod bearing cap, and tighten connecting rod nuts (VQ23DE) or connecting rod bolts (VQ35DE) to the specified torque.

Refer to "ASSEMBLY" for the tightening procedure.

⚠ CAUTION

Do not rotate crankshaft.

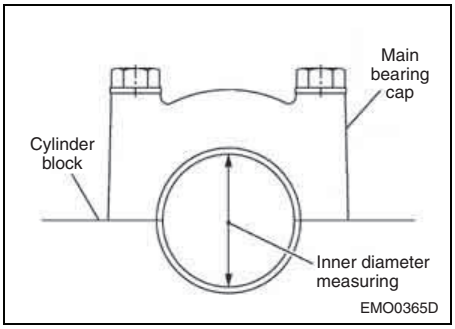
- Remove connecting rod bearing cap and bearing, and using scale on plastigage bag, measure the plastigage width.

REFERENCE

The procedure when the measured value exceeds the limit is same as that described in the "Method by Calculation".

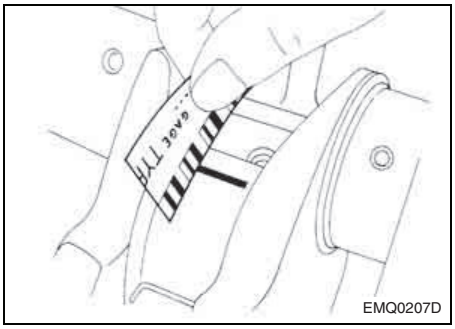
Main Bearing Oil Clearance

METHOD BY CALCULATION



- Install main bearings to cylinder block and main bearing caps, and tighten main bearing cap bolts to the specified torque. Measure the inner diameter of main bearing.
- Refer to "ASSEMBLY" for the tightening procedure.
  (Bearing oil clearance) =
  (Main bearing inner diameter) - (Crankshaft main journal diameter)
  Standard: 0.035 ~ 0.045 mm (actual clearance)
  Limit: 0.065 mm
- If calculated value exceeds the limit, select proper main bearing according to main bearing housing inner diameter and crankshaft main journal diameter to obtain the specified bearing oil clearance. Refer to "HOW TO SELECT MAIN BEARING".

METHOD OF USING PLASTIGAGE



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

⚠ CAUTION

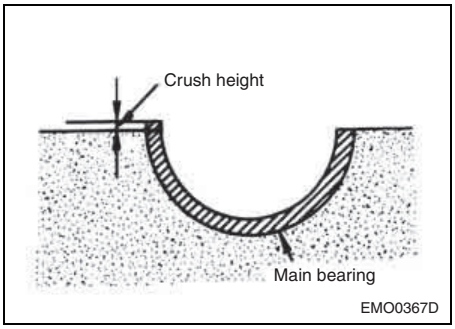
Do not rotate crankshaft.

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

REFERENCE

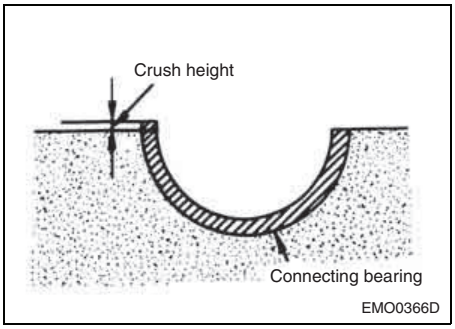
- The procedure when the measured value exceeds the limit is same as that described in the ìMethod by Calculationî.

CRUSH HEIGHT OF MAIN BEARING

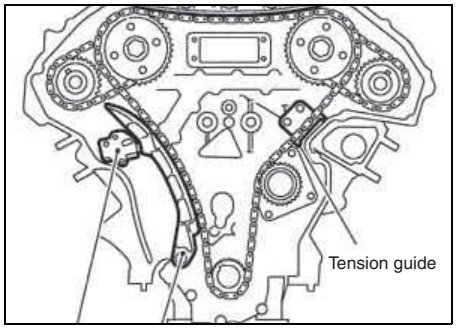


- When main bearing cap is removed after being tightened to the specified torque with main bearings installed, the tip end of bearing must protrude.
- Refer to "ASSEMBLY" for the tightening procedure.
  Standard: There must be crush height.
- If the standard is not met, replace main bearings.

CRUSH HEIGHT OF CONNECTING ROD BEARING



- When connecting rod bearing cap is removed after being tightening to the specified torque with connecting rod bearings installed, the tip end of bearing must protrude. (VQ23DE: with nuts, VQ35DE: with bolts).
- Refer to "ASSEMBLY" for the tightening procedure.
  Standard: There must be crush height.
- If it exceeds the limit, replace connecting rod bearing.

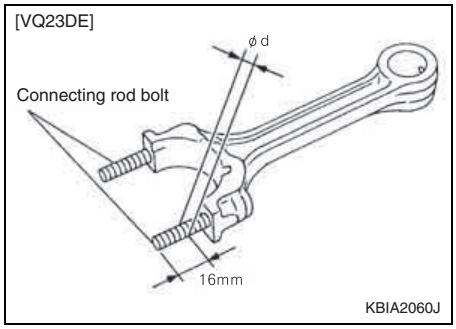


MAIN BEARING CAP BOLT OUTER DIAMETER

1. Measure outer diameters ("ϕd1" and "ϕd2") at two positions as shown in the figure.
   - If reduction appears in "A" range, regard it as "d2".
2. Calculate the difference between ϕd1 and ϕd2.

Limit: 0.11 mm

- If it exceeds the limit (when becomes thinner), replace main bearing cap bolt with new one.



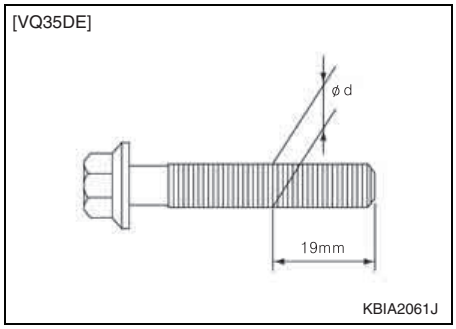
CONNECTING ROD BOLT OUTER DIAMETER

VQ23DE

- Install nut to connecting rod bolt, and make sure if the nut can smoothly tighten until the end of screw thread by hands.
- Measure outer diameter "ϕd" at position as shown in the figure.
- If reduction appears in a position other than "d", regard it as "d".

Standard: ϕ7.90 ~ ϕ8.00 mm
Limit: ϕ7.75 mm

If it exceeds the limit, replace connecting rod bolt and nut.

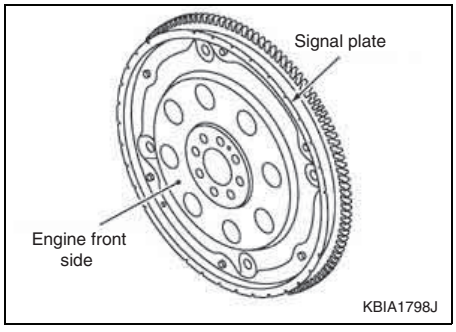


VQ35DE

- Measure outer diameter "ϕd" at position as shown in the figure.
- If reduction appears in a position other than "d", regard it as "d".

Standard: ϕ7.90 ~ 8.00 mm
Limit: ϕ7.75 mm

- If it exceeds the limit (when it becomes thinner), replace connecting rod bolt with new one.

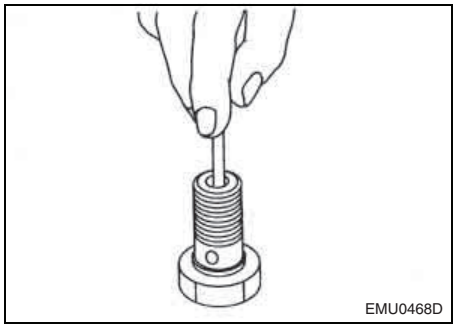


SIGNAL PLATE

- Visually check signal plate for deformation or cracks.
- If anything above is found, replace drive plate.

OIL JET (VQ35DE)

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



OIL JET RELIEF VALVE (VQ35DE)

- Using clean plastic stick, press check valve in oil jet relief valve. Make sure that valve moves smoothly with proper reaction force.
- If it is not satisfied, replace oil jet eye bolt.

How to Select Piston and Bearing

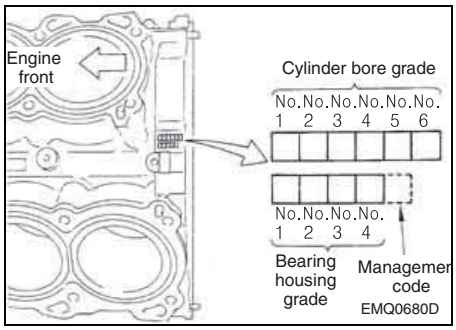
DESCRIPTION

Selection Points	Selection Parts	Selection Items	Selection Methods
Between cylinder block and crankshaft	Main bearing	Main bearing grade (Bearing thickness)	Determined by match of cylinder block bearing housing grade (inner diameter of housing) and crankshaft journal grade (outer diameter of journal).
Between crankshaft and connecting rod	Connecting rod bearing	Connecting rod bearing grade (Bearing thickness)	Determined by crankshaft pin grade (pin outer diameter)
Between cylinder block and piston	Piston and piston pin assembly NOTE: Piston is available together with piston pin as assembly.	Piston grade (Piston skirt diameter)	Piston grade = Cylinder bore grade (inner diameter of bore)
※ Between piston pin and connecting rod	-	-	-

※ For the service parts, the grade for fitting cannot be selected between piston pin and connecting rod. (Only "0" grade)
Information at the shipment from the plant is described as a reference.

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

How to Select Piston

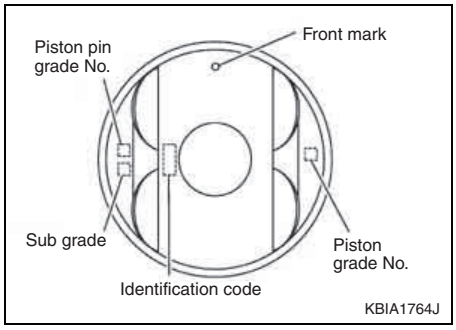


WHEN NEW CYLINDER BLOCK IS USED

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

REFERENCE

Piston is available with piston pin as assembly for the service part. (Only "0" grade piston pin is available.)



WHEN CYLINDER BLOCK IS REUSED

1. Measure the cylinder bore inner diameter.

2. Determine the bore grade by comparing the measurement with the values under the cylinder bore inner diameter of the "Piston Selection Table". Select piston of the same grade.

PISTON SELECTION TABLE

VQ23DE

(mm) Grade No.(Mark)	1	2 (or no mark: Note)	3
Cylinder bore inner diameter	85.010/85.000	85.020/85.010	85.030/85.020
Piston skirt diameter	84.990/84.980	85.000/84.990	85.010/85.000

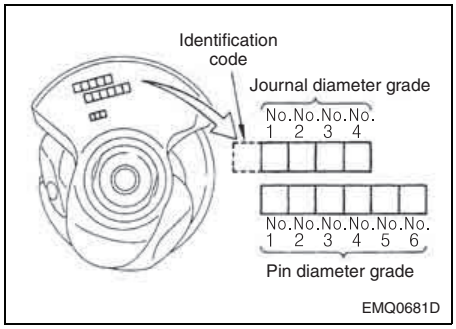
VQ35DE

(mm) Grade No.(Mark)	1	2 (or no mark: Note)	3
Cylinder bore inner diameter	95.510/95.500	95.520/95.510	95.530/95.520
Piston skirt diameter	84.990/84.980	95.500/95.490	95.510/95.500

Note: "No mark" is only available for piston side.

How to Select Connecting Rod Bearing

WHEN NEW CONNECTING ROD AND CRANKSHAFT ARE USED



- Check pin diameter grade ("0", "1" or "2") on front of crankshaft, and select connecting rod bearing of the same grade.

REFERENCE

There is no grading for connecting rod big end diameter.

WHEN CRANKSHAFT AND CONNECTING ROD ARE REUSED

1. Measure the connecting rod big end diameter. Make sure that the connecting rod big end diameter is within the standard value.
2. Measure the crankshaft pin journal diameter.
3. Determine the grade of crankshaft pin diameter grade by corresponding to the measured dimension in "Crankshaft pin journal diameter" column of "Connecting Rod Bearing Selection Table". Select connecting rod bearing of the same grade.

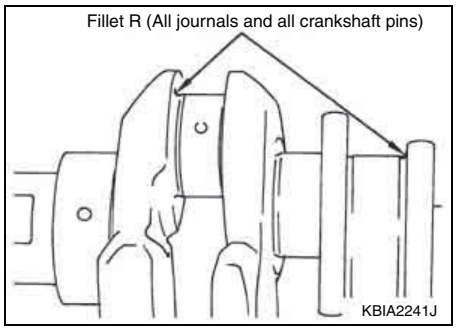
CONNECTING ROD BEARING SELECTION TABLE

VQ23DE

Connecting rod big end diameter (mm)		48.013/48.000	
Crankshaft pin journal diameter (mm)	Grade (Mark)	0 (No mark)	
44.974/44.968	0	• Bearing grade No. • Bearing thickness (mm) • Identification color	STD 0 1.503/1.500 Black
44.968/44.962	1	• Bearing grade No. • Bearing thickness(mm) • Color	STD 1 1.506/1.503 Brown
44.962/44.956	2	• Bearing grade No. • Bearing thickness(mm) • Color	STD 2 1.509/1.506 Green

VQ35DE

Connecting rod big end diameter (mm)		55.013/55.000	
Crankshaft pin journal diameter (mm)	Grade (Mark)	0 (No mark)	
51.974/51.968	0	• Bearing grade No. • Bearing thickness (mm) • Color	STD 0 1.503/1.500 Black
51.968/51.962	1	• Bearing grade No. • Bearing thickness (mm) • Color	STD 1 1.506/1.503 Brown
51.962/51.956	2	• Bearing grade No. • Bearing thickness (mm) • Color	STD 2 1.509/1.506 Green



UNDERSIZE BEARINGS USAGE GUIDE

- When the specified connecting rod bearing oil clearance is not obtained with standard size connecting rod bearings, use undersize (US) bearings.
- When using undersize (US) bearing, measure the connecting rod bearing inner diameter with bearing installed, and grind crankshaft pin so that the connecting rod bearing oil clearance satisfies the standard.

CAUTION

In grinding crankshaft pin journal to use undersize bearings, keep the fillet R [1.5 mm (0.059 in)].

BEARING UNDERSIZE TABLE

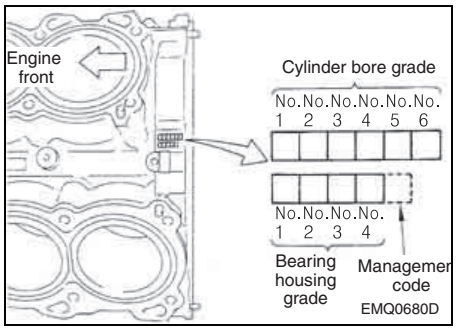
Size	Thickness (mm)
US 0.25	1.634/1.626

REFERENCE

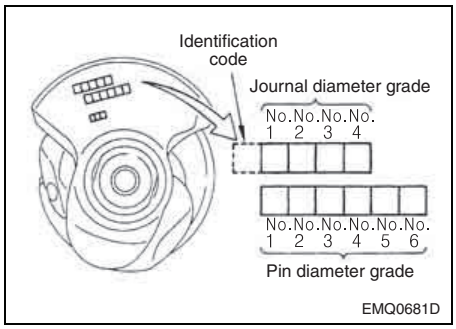
Both VQ23DE and VQ35DE thickness of undersize bearing is the same.

HOW TO SELECT MAIN BEARING

When New Cylinder Block and Crankshaft are Used



1. "Main Bearing Selection Table" rows correspond to bearing housing grade on rear left side of cylinder block.



2. "Main Bearing Selection Table" columns correspond to journal diameter grade on front side of crankshaft.
3. Select main bearing grade at the point where selected row and column meet in "Main Bearing Selection Table".

WHEN CYLINDER BLOCK AND CRANKSHAFT ARE REUSED

1. Measure cylinder block main bearing housing inner diameter.
2. Correspond the measured dimension in "Cylinder block main bearing housing inner diameter" row of "Main Bearing Selection Table".
3. Measure the crankshaft main journal diameter.
4. Correspond the measured dimension in "Crankshaft main journal diameter" column of "Main Bearing Selection Table".
5. Select main bearing grade at the point where selected row and column meet in following selection table.

MAIN BEARING SELECTION TABLE

Outer diameter of crankshaft journal	Inner diametter of main bearing housing in cylinder block																							
	A	B	C	D	E	F	G	H	J	K	L	M	N	P	R	S	T	U	Y	W	X	Y	4	7
A	0	0	0	01	01	01	1	1	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34
B	0	0	01	01	01	1	1	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4
C	0	01	01	01	1	1	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4
D	01	01	01	1	1	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4
E	01	01	1	1	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45
F	01	1	1	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45
G	1	1	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45
H	1	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45	5
J	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45	5	5
K	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45	5	5	5
L	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45	5	5	5	56
M	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45	5	5	5	56	56
N	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45	5	5	5	56	56	56
P	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45	5	5	5	56	56	56	6
R	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45	5	5	5	56	56	56	6	6
S	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45	5	5	5	56	56	56	6	6	6
T	23	23	3	3	3	34	34	34	4	4	4	45	45	45	5	5	5	56	56	56	6	6	6	67
U	23	3	3	3	34	34	34	4	4	4	45	45	45	5	5	5	56	56	56	6	6	6	67	67
V	3	3	3	34	34	34	4	4	4	45	45	45	5	5	5	56	56	56	6	6	6	67	67	67
W	3	3	34	34	34	4	4	4	45	45	45	5	5	5	56	56	56	6	6	6	67	67	67	7
X	3	34	34	34	4	4	4	45	45	45	5	5	5	56	56	56	6	6	6	67	67	67	7	7
Y	34	34	34	4	4	4	45	45	45	5	5	5	56	56	56	6	6	6	67	67	67	7	7	7
4	34	34	4	4	4	45	45	45	5	5	5	56	56	56	6	6	6	67	67	67	7	7	7	×
7	34	4	4	4	45	45	45	5	5	5	56	56	56	6	6	6	67	67	67	7	7	7	×	×

KBIA0589J

- If the selection is "X" (right botton on the table), use grade 7.
- The grade numbers in table mean the dimensions as below:

Inner Diameter of Main Bearing Housing in Cylinder Block (ϕ63.993 mm plus designated number)

Difference from standard value (Unit: 1/1000 mm)	Symbol	A	B	C	D	E	F	G	H	J	K	L
	Lower value	1	2	3	4	5	6	7	8	9	10	11
	Upper value	0	1	2	3	4	5	6	7	8	9	10

Symbol	M	N	P	R	S	T	U	V	W	X	Y	4	7
Lower value	12	13	14	15	16	17	18	19	20	21	22	23	24
Upper value	11	12	13	14	15	16	17	18	19	20	21	22	23

Ex: For symbol "M", the inner diameter is ϕ64.004 ~ 64.005 mm.

Outer Diameter of Crankshaft Journal (ϕ60.000 mm minus designated number)

Difference from standard value (Unit: 1/1000 mm)	Symbol	A	B	C	D	E	F	G	H	J	K	L
	Lower value	25	26	27	28	29	30	31	32	33	34	35
	Upper value	26	27	28	29	30	31	32	33	34	35	36

Symbol	M	N	P	R	S	T	U	V	W	X	Y	4	7
Lower value	36	37	38	39	40	41	42	43	44	45	46	47	48
Upper value	37	38	39	40	41	42	43	44	45	46	47	48	49

Ex: For symbol "M", the outer diameter is ϕ59.963 ~ ϕ59.964 mm.

- The selection (cross point) means the main bearing grade.

REFERENCE

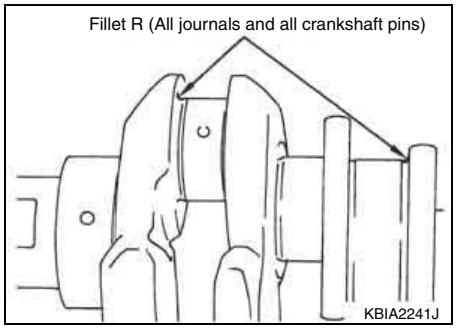
Set of upper and lower bearings is provided as a service part.

In case of 0, 1, 2, 3, 4, 5, 6 and 7

Grade (Cross point)	0	1	2	3	4	5	6	7
Part No.	13341-21900 13342-21900	13341-21910 13342-21910	13341-21920 13342-21920	13341-21930 13342-21930	13341-21940 13342-21940	13341-21950 13342-21950	13341-21960 13342-21960	13341-21970 13342-21970
Thickness (upper) (mm)	2.003/2.000	2.006/2.003	2.009/2.006	2.012/2.009	2.015/2.012	2.018/2.015	2.021/2.018	2.024/2.021
Thickness (lower) (mm)	2.003/2.000	2.006/2.003	2.009/2.006	2.012/2.009	2.015/2.012	2.018/2.015	2.021/2.018	2.024/2.021
Identification color/lower	Black/Black	Brown/Brown	Green/Green	Yellow/Yellow	Blue/Blue	Pink/Pink	Purple/Purple	White/White

In case of 01, 12, 23, 34, 45, 56 and 67

Grade (Cross point)	01	12	23	34	45	56	67
Part No.	13341-21910 13342-21900	13341-21920 13342-21910	13341-21930 13342-21920	13341-21940 13342-21930	13341-21950 13342-21940	13341-21960 13342-21950	13341-21970 13342-21960
Thickness (upper) (mm)	2.006/2.003	2.009/2.006	2.012/2.009	2.015/2.012	2.018/2.015	2.021/2.018	2.024/2.021
Thickness (lower) (mm)	2.003/2.000	2.006/2.003	2.009/2.006	2.012/2.009	2.015/2.012	2.018/2.015	2.021/2.018
Identification color/lower	Brown/Black	Green/Brown	Yellow/Green	Blue/Yellow	Pink/Blue	Purple/Pink	White/Violet



UNDERSIZE BEARINGS USAGE GUIDE

- When the specified connecting rod bearing oil clearance is not obtained with standard size connecting rod bearings, use undersize (US) bearings.
- When using undersize bearing, measure the connecting rod bearing inner diameter with bearing installed, and grind journal so that the connecting rod bearing oil clearance satisfies the standard.

Bearing undersize table

Size	Thickness (mm)
US 0.25	2.140/2.132

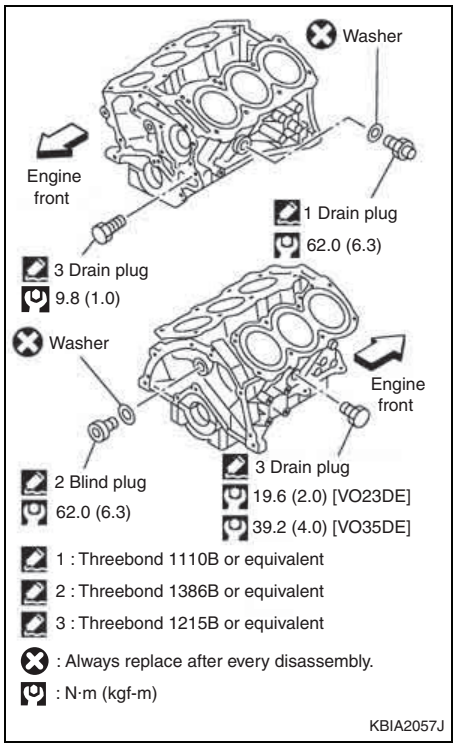
CAUTION

In grinding crankshaft main journal to use undersize bearings, keep the fillet R [1.5 mm (0.059 in)].

Assembly

REFERENCE

VQ35DE (with main bearing beam, connecting rod bearing cap is tighten by bolts) is shown as an example unless the figure includes specification.

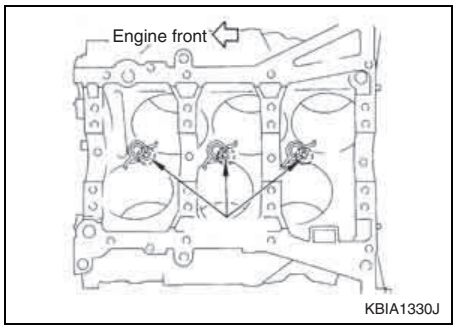


1. Fully air-blow engine coolant and engine oil passages in cylinder block, cylinder bore and crankcase to remove any foreign material.

2. Install each plug to cylinder block.(screw type plugs only)
   - Apply liquid gasket to the thread of water drain plug.
   - Replace washers with new ones.

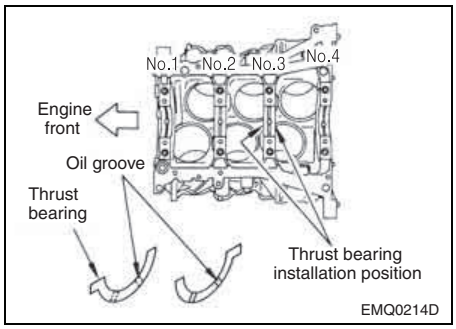
REFERENCE

Water drain plug at the right bank side for VQ35DE is also used as a connector of water pipe for oil cooler. Refer to "OIL COOLER (VQ35DE)".

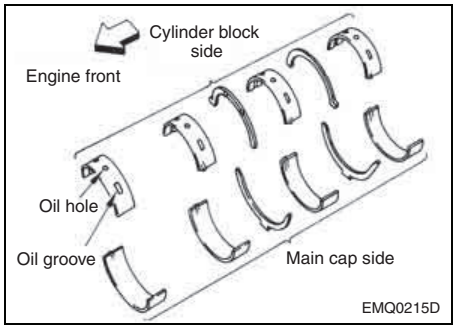


3. Install oil jet. (VQ35DE)
   - Insert oil jet dowel pin into cylinder block dowel pin hole, and tighten mounting bolts.

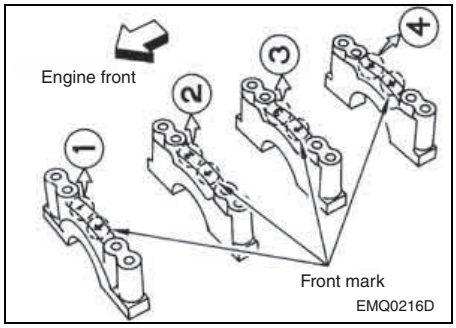
     Tightening torque : 27 N·m (2.75kgf-m)



4. Install main bearings and thrust bearings.
   a. Remove dust, dirt, and engine oil on bearing mating surfaces of cylinder block and main bearing caps.
   b. Install thrust bearings to the both sides of the No. 3 journal housing on cylinder block and main bearing cap.
      - Install thrust bearings with the oil groove facing crankshaft arm (outside).
      - Install thrust bearing with a protrusion on one end on cylinder block, and thrust bearing with a protrusion at center on main bearing cap. Align each protrusion with mating notch.



   c. Install main bearings paying attention to the direction..
      - Main bearing with oil hole and groove goes on cylinder block. The one without them goes on main bearing cap.
      - Before installing main bearings, apply engine oil to the bearing surface (inside). Do not apply engine oil to the back surface, but thoroughly clean it.
      - When installing, align main bearing stopper protrusion to cutout of cylinder block and main bearing caps.
      - Ensure the oil holes on cylinder block and those on the corresponding bearing are aligned.

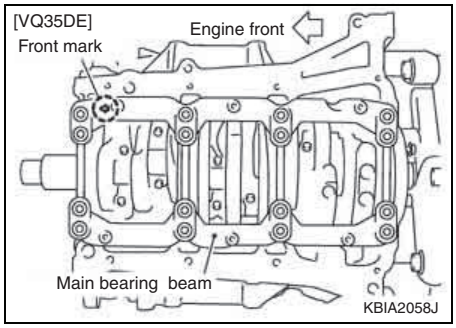


5. Install crankshaft to cylinder block.
   - While turning crankshaft by hand, check that it turns smoothly.

6. Install main bearing cap.
   - Main bearing caps are identified by identification mark cast on them. For installation, face front mark to front side.

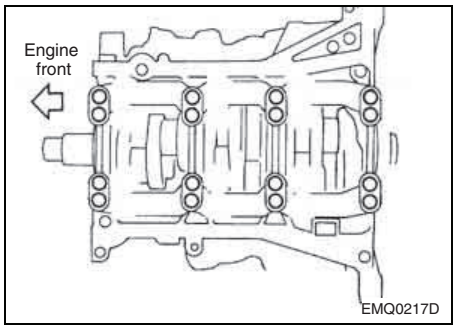
REFERENCE

Main bearing cap cannot be replaced as a single part, because it is machined together with cylinder block.



7. Install main bearing beam. (VQ35DE)
   - Install main bearing beam with front mark facing downward (oil pan side).
   - Install main bearing beam with front mark facing front of engine.

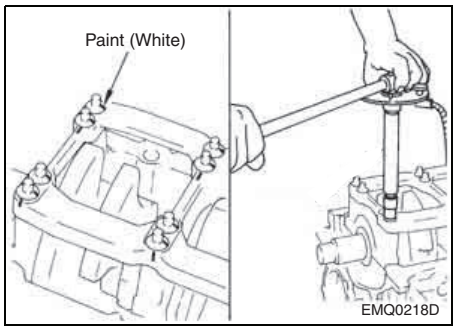
8. Inspect outer diameter of main bearing cap bolts. Refer to "MAIN BEARING CAP BOLT OUTER DIAMETER" in "INSPECTION AFTER DISASSEMBLY".



9. Tighten main bearing cap bolts in numerical order as shown in the figure as follows:
   a. Apply new engine oil to threads and seat surfaces of main bearing cap bolts.
   b. Tighten main bearing cap bolts in numerical order as shown in the figure.

      Tightening torque : 35 N·m (3.35 kgf-m)

   c. Make alignment marks (ex, paint mark) on the bolts and main bearing caps with same direction (in case of using protractor).
   d. Turn all cylinder head bolts 90 ~ 95 degrees clockwise again. (Angle tightening)

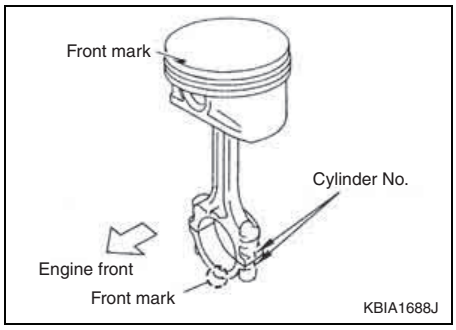


CAUTION

Check the tightening angle by using protractor or angle wrench. Avoid judgment by visual inspection without tool.

- After installing main bearing cap bolts, make sure that crankshaft can be rotated smoothly by hand.
- Check crankshaft side clearance. Refer to "CRANKSHAFT SIDE CLEARANCE".

10. Inspect outer diameter of connecting rod bolts. Refer to "CONNECTING ROD BOLT OUTER DIAMETE" in "INSPECTION AFTER DISASSEMBLY".

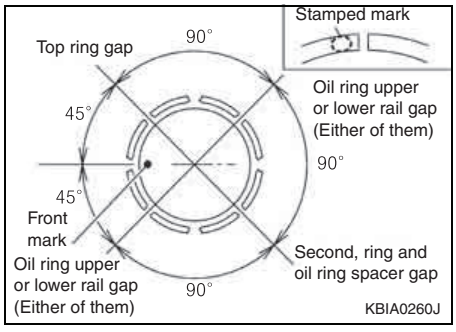


11. Install piston to connecting rod as follows:
   a. Using snap ring pliers(commercial service tool), install new snap ring to the groove of piston rear side.

CAUTION

Insert it fully into groove to install.

   b. Install piston to connecting rod.
      - Using industrial use drier or similar tool, heat piston until piston pin can be pushed in by hand without excess force [approx. 60 to 70°C (140 to 158°F)]. From the front to the rear, insert piston pin into piston and connecting rod.
      - Assemble so that the front mark on the piston head and the cylinder number on connecting rod are positioned as shown in the figure.
   c. Install new snap ring to the groove of the piston front side.
      - After installing, make sure that connecting rod moves smoothly.

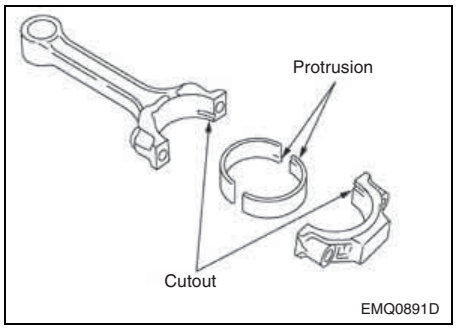


12. Using piston ring expander (commercial service tool), install piston rings.

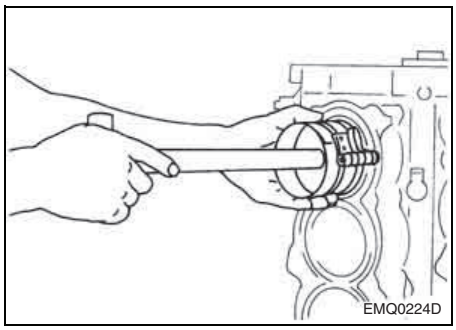
CAUTION

When installing piston rings, be careful not to damage piston.

- Position each ring with the gap as shown in the figure referring to the piston front mark.
- Install top ring and second ring with the stamped surface (top ring: "R", second ring: "R2") facing upward. (VQ23DE)
- Install second ring with the stamped surface ("R") facing upward. (VQ35DE)



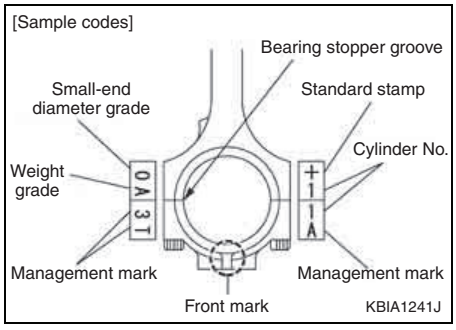
13. Install connecting rod bearing in connecting rods and connecting rod caps.
    - Before installing connecting rod bearings, apply engine oil to the bearing surface (inside). Do not apply engine oil to the back surface, but thoroughly clean it.
    - When installing, align connecting rod bearing stopper protrusion with notch of connecting rod to install.
    - Ensure the oil hole on connecting rod and that on the corresponding bearing are aligned.



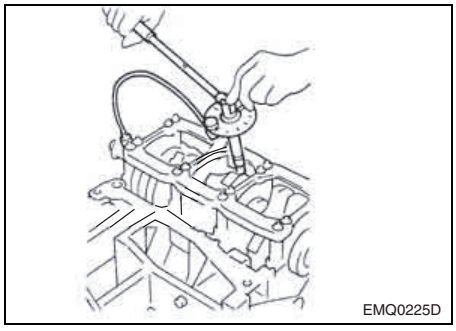
14. Install piston and connecting rod assembly to crankshaft.
    - Position crankshaft pin corresponding to connecting rod to be installed onto the bottom dead center.
    - Apply engine oil sufficiently to the cylinder bore, piston and crankshaft pin.
    - Match the cylinder position with the cylinder number on connecting rod to install.
    - Using piston ring compressor (commercial service tool), install piston with the front mark on the piston head facing the front of engine.

⚠ CAUTION

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



15. Install connecting rod bearing caps.
    - Match the stamped cylinder number marks on connecting rod with those on connecting rod bearing cap to install.
    - Be sure that front mark on connecting rod bearing cap is facing front of engine.

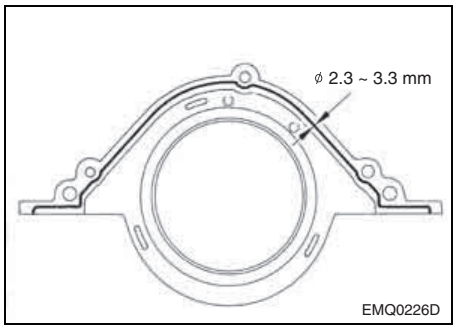


16. Tighten connecting rod nuts (VQ23DE) or connecting rod bolts (VQ35DE) as follows:
    a. Apply engine oil to the threads and seats of connecting rod nuts or bolts.
    b. Tighten them to 20 N·m (2 kgf-m).
    c. Make alignment marks (ex, paint mark) on the connecting rod nuts, bolts and connecting rod caps with same direction (in case of using protractor).
    d. Turn all cylinder head bolts 90~95 degrees clockwise again. (Angle tightening)

⚠ CAUTION

Check the tightening angle by using protractor or angle wrench. Avoid judgment by visual inspection without tool.

- After tightening connecting rod nuts or bolts, make sure that crankshaft rotates smoothly.
- Check connecting rod side clearance. Refer to "CONNECTING ROD SIDE CLEARANCE".



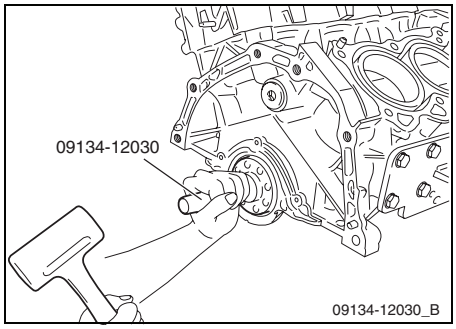
17. Install rear oil seal retainer.
    - Apply a continuous bead of liquid gasket (Threebond 1217 H or equivalent) to front timing chain case as shown in the figure. Refer to "LIQUID GASKET APPLICATION PROCEDURE".

⚠ CAUTION

Replace with a new part.

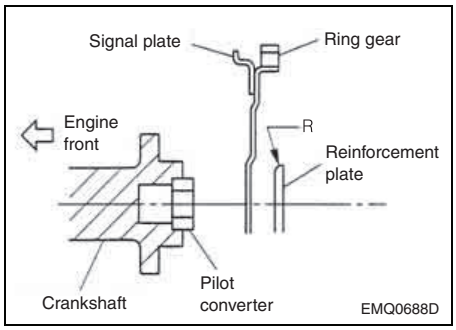
REFERENCE

Regard both rear oil seal and retainer as an assembly.



18. Install pilot converter. With drift B(09134-12030), press-fit as far as it will go.
    - Press-fit pilot converter with its chamfer facing crankshaft.

Refer to Disassembly and Assembly in "COMPONENT".



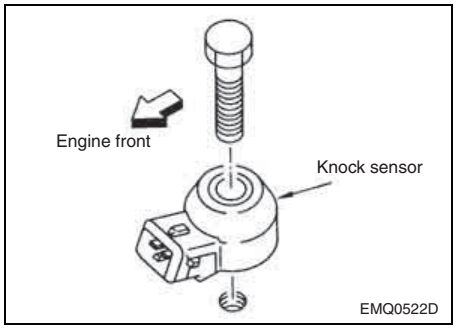
19. Install drive plate.
    a. Install drive plate and reinforcement plate as follows:
        - Install drive plate and reinforcement plate as shown in the figure.

⚠ CAUTION

Be careful not to install with wrong direction.

- Align the pin hole of drive plate and reinforcement plate with the knock pin in the rear end of crankshaft.

    b. Tighten mounting bolts as follows.
        - Fix crankshaft using ring gear brake (09134-12021).
        - Tighten mounting bolts crosswise over several times.



20. Install knock sensor.
    - Make sure that there is no foreign material on the cylinder block mating surface and the back surface of knock sensor.
    - Install connector faces front of engine.
    - For mounting bolt, use genuine parts.
    - Do not tighten mounting bolt while holding connector.
    - Make sure that knock sensor does not interfere with other parts.

Note: If any impact by dropping is applied to knock sensor, replace it with new one.

- After installing knock sensor, connect harness connector, and lay it out to rear of engine.

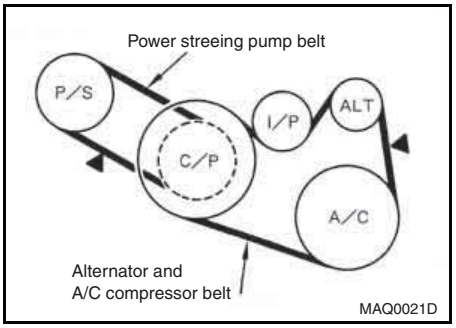
21. Assemble in the reverse order of disassembly after this step.

Service Data and Specifications (SDS)

Standard and Limit

Changing Interval of Air Cleaner Element	Every 60,000 km
Changing Interval of Spark Plugs (platinum-tipped type)	Every 100,000 km

Drive Belt Tension and Deflection		Tension [N (kg)]			Belt Deflection(mm) [Applied pushing force 98 N (10 kg, 22 lb)]		
Position	Drive belts specification	New belt	After adjustment	Limit	New belt	After adjustment	Limit
Alternator and A/C compressor belt	Poly V-belt (6 pitches)	838 ~ 926 (85.5 ~ 94.5)	730 ~ 818 (74.5 ~ 83.5)	294 (30)	3.7 ~ 4.1	4.2 ~ 4.6	7
Power steering oil pump belt	Poly V-belt (4 pitches)	603 ~ 691 (61.5 ~ 70.5)	495 ~ 583 (50.5 ~ 59.5)	196 (20)	6.5 ~ 7.2	7.3 ~ 8.0	11



Tightening Torque

*: Parts with tightening order
1), 2)...: Parts to be tightened with several steps

Unit: N·m (kgf-m)

Idler pulley lock nut (For alternator and A/C compressor belt)		34.8 (3.5)
Adjusting bolt [Note: Locking after adjustment] (Parts installed on idler pulley for alternator and A/C compressor belt)		5.4 (0.55)
Idler pulley lock nut (Power steering oil pump belt)		34.8 (3.5)
* Intake manifold	1) 2) 3) After then,	7.4 (0.75) 29.0 (3.0) 29.0 (3.0)
* Exhaust manifold		30.9 (3.2)
Exhaust Manifold Cover		5.8 (0.59)
Heated oxygen sensor 1		50.0 (5.1)
Heated oxygen sensor 2		50.0 (5.1)
Three way catalyst (under exhaust manifold£½ right bank side)		70.1 (7.2)
Three way catalyst (under exhaust manifold£½ left bank side)		31.9 (3.3)
Oil pan drain plug		34.3 (3.5)
Ignition coil		9.0 (0.92)
Spark plug		24.5 (2.5)