2013 ENGINE

Engine Mechanical (VK50VE) - FX50

SYMPTOM DIAGNOSIS

NOISE, VIBRATION AND HARSHNESS (NVH) TROUBLESHOOTING

NVH Troubleshooting - Engine Noise

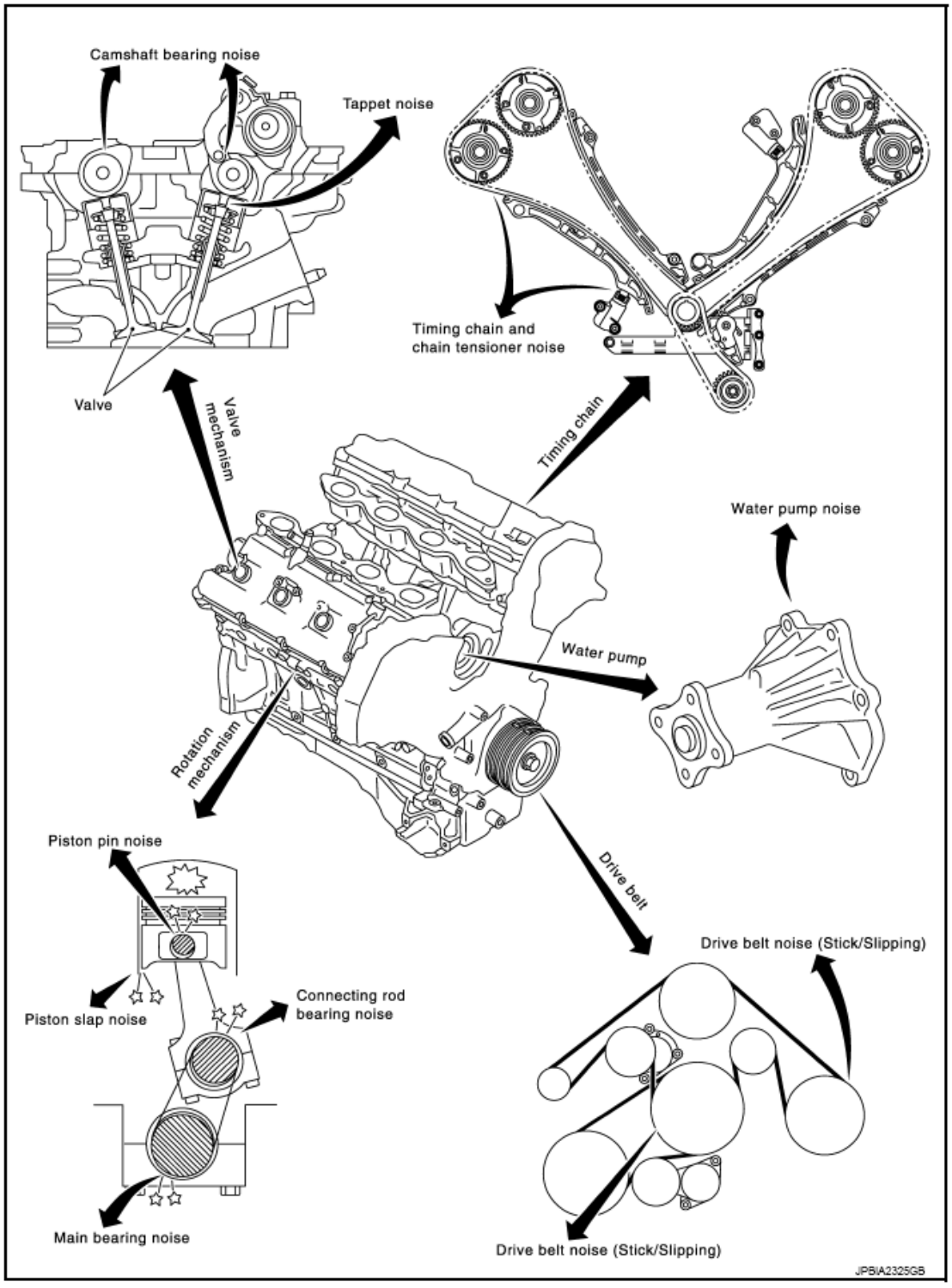


Fig. 1: Identifying Noise, Vibration And Harshness Troubleshooting Components
Courtesy of NISSAN NORTH AMERICA, INC.

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

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

If necessary, repair or replace these parts.

Location of noise	Type of noise	Operating condition of engine						Source of noise	Check item	Referen
		Before warm-up	After warm-up	When starting	When idling	When racing	While driving			
Top of engine Rocker cover Cylinder head	Ticking or clicking	C	A	-	A	B	-	Tappet noise	Valve clearance	CAMSHA VALVI CLEARAN
	Rattle	C	A	-	A	B	C	Camshaft bearing noise	Camshaft runout Camshaft journal oil clearance	CAMSHA (EXH) VA CLEARAN ADJUSTM
Crankshaft pulley Cylinder block (Side of engine) Oil pan	Slap or knock	-	A	-	B	B	-	Piston pin noise	Piston to piston pin oil clearance Connecting rod bushing oil clearance	CONNECT ROD SII CLEARAN
	Slap or rap	A	-	-	B	B	A	Piston slap noise	Piston to cylinder bore clearance Piston ring side clearance Piston ring end gap Connecting rod bend and torsion	CONNECT ROD SII CLEARAN
	Knock	A	B	C	B	B	B	Connecting rod bearing noise	Connecting rod bushing oil clearance Connecting rod bearing oil	CONNECT ROD SII CLEARAN

									clearance	
	Knock	A	B	-	A	B	C	Main bearing noise	Main bearing oil clearance Crankshaft runout	**CONNECT ROD SII CLEARAI**
Front of engine Timing chain case	Tapping or ticking	A	A	-	B	B	B	Timing chain and timing chain tensioner noise	Timing chain cracks and wears Timing chain tensioner operation	**TIMING CI**
Front of engine	Squeaking or fizzing	A	B	-	B	-	C	Drive belts (Sticking or slipping)	Drive belts deflection	**TENSIO ADJUSTM**
	Creaking	A	B	A	B	A	B	Drive belts (Slipping)	Idler pulley bearing operation	
	Squall Creak	A	B	-	B	A	B	Water pump noise	Water pump operation	**INSTALLA**

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

PRECAUTION

PRECAUTIONS

Precaution for Procedure without Cowl Top Cover

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

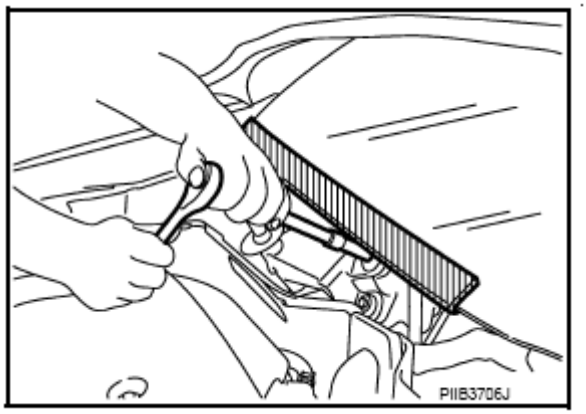


Fig. 2: Precaution For Preventing Damage To Windshield
Courtesy of NISSAN NORTH AMERICA, INC.

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

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

Information necessary to service the system safely is included in the "**SRS AIR BAG** " and "**SEAT BELTS** " articles of this Service Information.

WARNING: Always observe the following items for preventing accidental activation.

- **To avoid rendering the SRS inoperative, which could increase the risk of personal injury or death in the event of a collision that would result in air bag inflation, all maintenance must be performed by an authorized NISSAN/INFINITI dealer.**
- **Improper maintenance, including incorrect removal and installation of the SRS, can lead to personal injury caused by unintentional activation of the system. For removal of Spiral Cable and Air Bag Module, see "SRS AIR BAG ".**
- **Never use electrical test equipment on any circuit related to the SRS unless instructed to in this Service Information. SRS wiring harnesses can be identified by yellow and/or orange harnesses or harness connectors.**

PRECAUTIONS WHEN USING POWER TOOLS (AIR OR ELECTRIC) AND HAMMERS

WARNING: Always observe the following items for preventing accidental activation.

- **When working near the Air Bag Diagnosis Sensor Unit or other Air**

Bag System sensors with the ignition ON or engine running, never use air or electric power tools or strike near the sensor(s) with a hammer. Heavy vibration could activate the sensor(s) and deploy the air bag(s), possibly causing serious injury.

- **When using air or electric power tools or hammers, always switch the ignition OFF, disconnect the battery, and wait at least 3 minutes before performing any service.**

Precautions For Engine Service

DISCONNECTING FUEL PIPING

- Before starting work, check 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.

DRAINING ENGINE COOLANT

Drain engine coolant and engine oil when the engine is cooled.

INSPECTION, REPAIR AND REPLACEMENT

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

REMOVAL AND DISASSEMBLY

- When instructed to use SST, 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.
- Dowel pins are used for several parts alignment. When replacing and reassembling parts with dowel pins, check that dowel pins are installed in the original position.
- Must cover openings of engine system with a tape or equivalent, to seal out foreign materials.
- Mark and arrange disassembly parts in an organized way for easy troubleshooting and reassembly.
- When loosening nuts and bolts, as a basic rule, start with the one furthest outside, then the one diagonally opposite, and so on. If the order of loosening is specified, do exactly as specified. Power tools may be used in the step.

ASSEMBLY AND INSTALLATION

- Use torque wrench to tighten bolts or nuts to specification.
- When tightening nuts and bolts, as a basic rule, equally tighten in several different steps starting with the ones in center, then ones on inside and outside diagonally in this order. If the order of tightening is specified, do exactly as specified.
- Replace with new gasket, packing, oil seal or O-ring.

- Thoroughly wash, clean, and air-blow each part. Carefully check 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.
- After disassembling, or exposing any internal engine parts, change engine oil and replace oil filter with a new one.
- Release air within route when refilling after draining engine coolant.
- After repairing, start the engine and increase engine speed to check engine coolant, fuel, engine oil, and exhaust gases for leakage.

Parts Requiring Angle Tightening

- Use angle wrench [SST: KV10112100 (BT8653-A)] for the final tightening of the following engine parts:
  - Cylinder head bolts
  - Main bearing cap bolts
  - Main bearing cap sub bolts
  - Connecting rod cap bolts
  - Crankshaft pulley bolt (No angle wrench is required as the bolt flange is provided with notches for angle tightening)
- Ensure thread and seat surfaces are clean and coated with engine oil.

Precaution for Liquid Gasket

REMOVAL OF LIQUID GASKET SEALING

- After removing mounting nuts and bolts, separate the mating surface using the seal cutter [SST: KV10111100 (J-37228)] (A) and remove old liquid gasket sealing.

CAUTION: Be careful not to damage the mating surfaces.

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

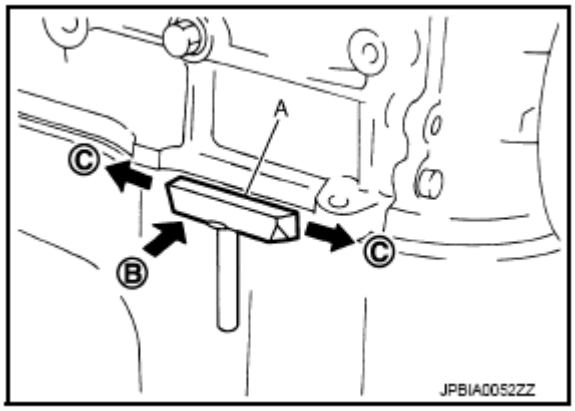


Fig. 3: Separating Mating Surface Using Seal Cutter
Courtesy of NISSAN NORTH AMERICA, INC.

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

LIQUID GASKET APPLICATION PROCEDURE

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

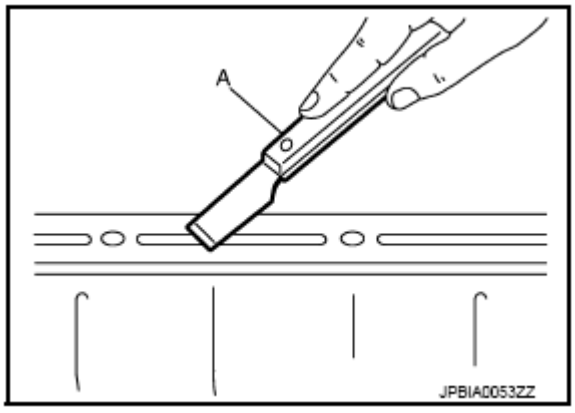


Fig. 4: Removing Liquid Gasket Using Scraper
Courtesy of NISSAN NORTH AMERICA, INC.

3. Attach liquid gasket tube to the tube presser (commercial service tool).

Use Genuine RTV Silicone Sealant or an equivalent. Refer to "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS ".

4. Apply liquid gasket without gaps to the specified location according to the specified dimensions.
   - If there is a groove for liquid gasket application, apply liquid gasket to the groove.

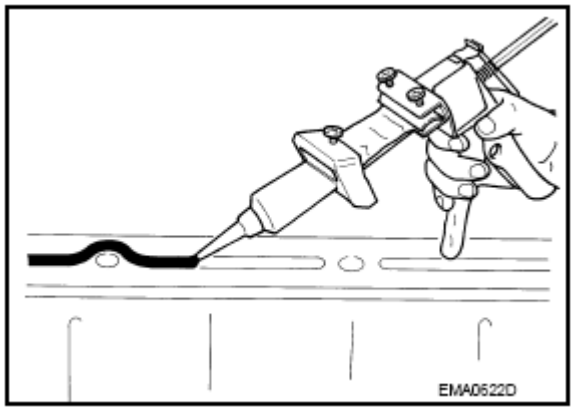


Fig. 5: Applying Liquid Gasket Without Gaps To Specified Location
Courtesy of NISSAN NORTH AMERICA, INC.

   - As for bolt holes (B), normally apply liquid gasket inside the holes. Occasionally, it should be applied outside the holes. Check to read the text of this information.

A : Groove
⇦ : Inside

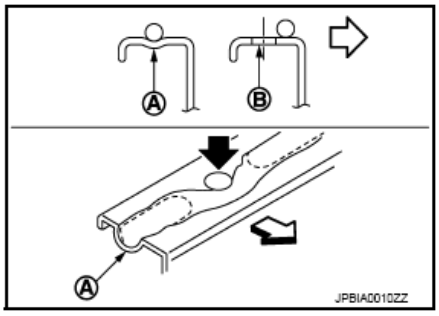


Fig. 6: Applying Liquid Gasket To Groove And Inside Bolt Holes
Courtesy of NISSAN NORTH AMERICA, INC.

   - Within 5 minutes of liquid gasket application, install the mating component.
   - If liquid gasket protrudes, wipe it off immediately.
   - Do not retighten mounting bolts or nuts after the installation.
   - After 30 minutes or more have passed from the installation, fill engine oil and engine coolant.

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

Definitions of Bank Names

- In this information, each bank name is defined as per the following:

A : Bank 2 (The conventional right bank)
B : Bank 1 (The conventional left bank)
⇦ : Engine front

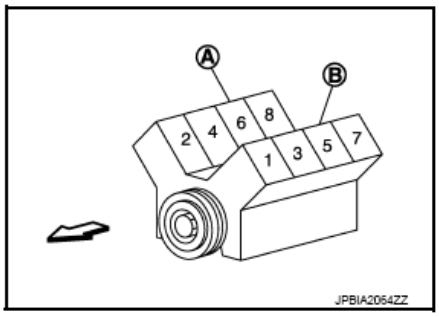


Fig. 7: Cylinder Number And Bank Layout
Courtesy of NISSAN NORTH AMERICA, INC.

- For cylinder numbers and bank layout, refer to the figure.

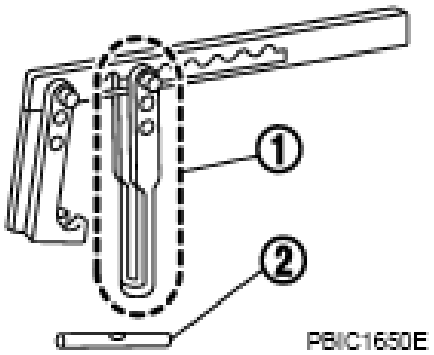
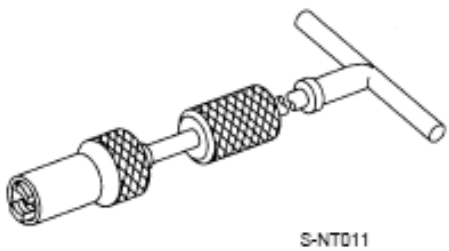
  Bank 1: The bank side including cylinder No. 1 (odd-numbered cylinder side)

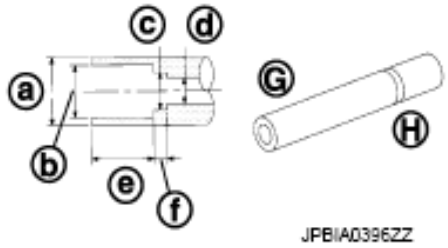
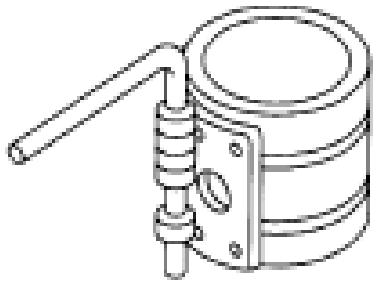
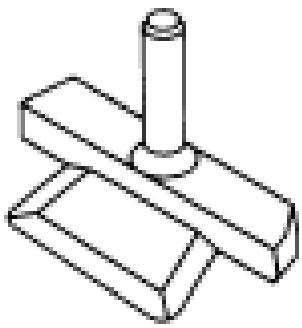
  Bank 2: The other bank side of the above (even-numbered cylinder side)

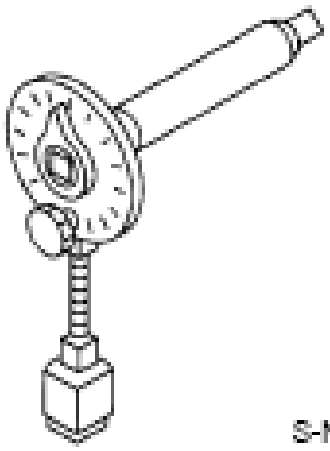
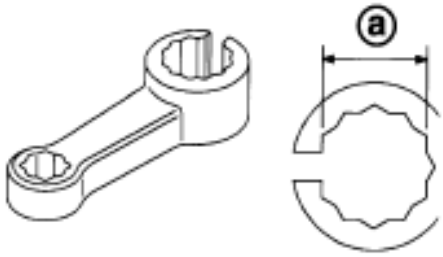
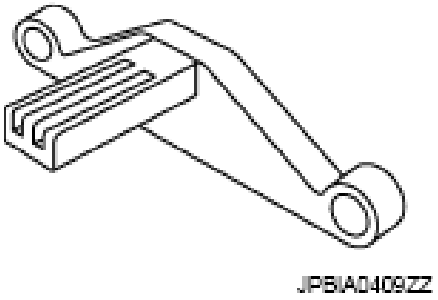
PREPARATION

PREPARATION

Special Service Tool

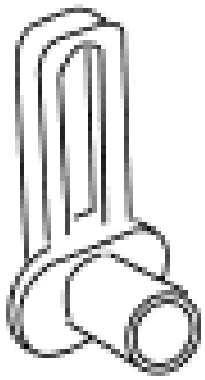
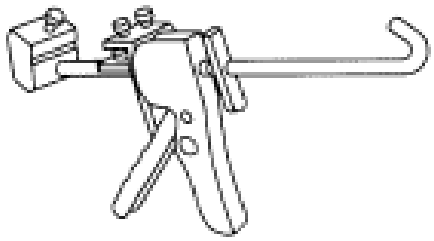
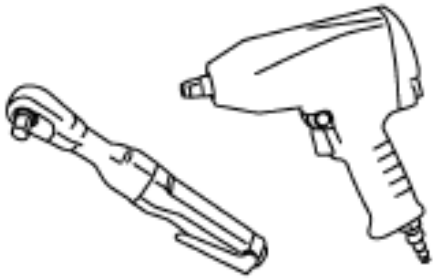
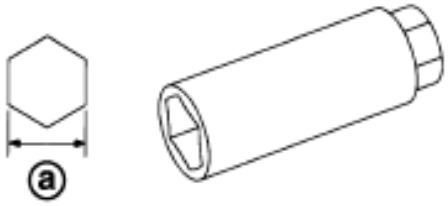
Tool number (Kent-Moore No.) Tool name	Description
KV10116200 (J-26336-A) Valve spring compressor 1. KV10115900 (J-26336-20) Attachment 2. KV10109220 (-) Adapter 	Disassembling valve mechanism Part (1) is a component of KV10116200 (J26336-A), but part (2) is not so.
KV10107902 (J-38959) Valve oil seal puller 	Removing valve oil seal

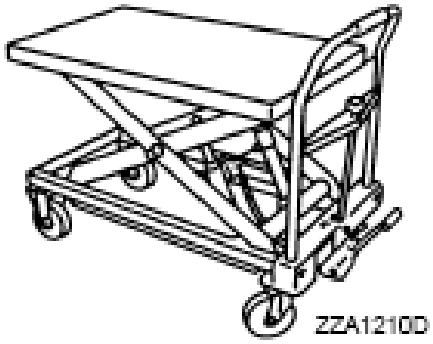
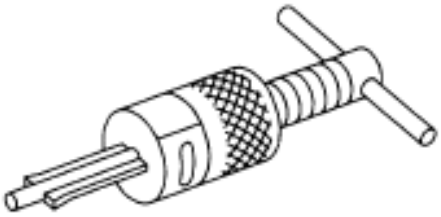
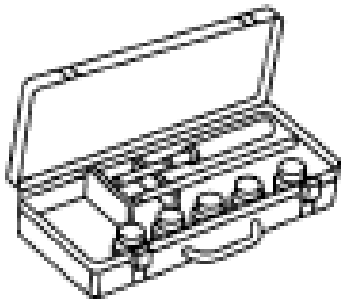
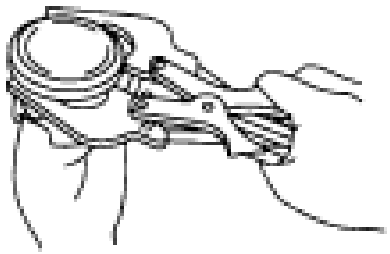
KV10115600 (J-38958) Valve oil seal drift	 JPBIA0396ZZ	Installing valve oil seal **Use side A (G)** a. **20 (0.79) dia.** b. **13 (0.51) dia.** c. **10.3 (0.406) dia.** d. **8 (0.31) dia.** e. **10.7 (0.421)** f. **5 (0.20)** **H: Side B** Unit: mm (in)
EM03470000 (J-8037) Piston ring compressor	 S-NT044	Installing piston assembly into cylinder bore
KV10111100 (J-37228) Seal cutter	 S-NT045	Removing steel oil pan and front cover
KV10112100 (BT8653-A) Angle wrench		Tightening bolts for bearing cap, cylinder head, etc.

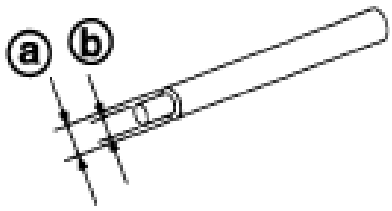
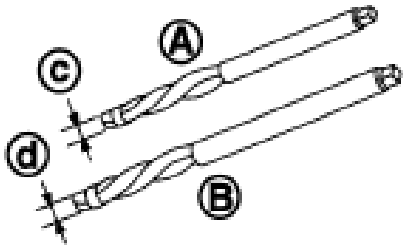
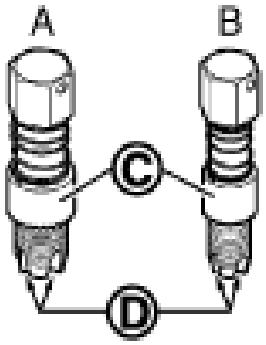
	 S-NT014	
KV10114400 (J-38365) Heated oxygen sensor wrench	 JPBIA0397ZZ	Loosening or tightening air fuel ratio sensor 1 and heated oxygen sensor 2 a. **22 mm (0.87 in)**
KV10119200 (J-49277) Ring gear stopper	 JPBIA0409ZZ	Removing and installing crankshaft pulley
KV10119300 (-) Adapter and torque wrench assembly		Tightening rocker cover mounting bolts. (specified torque)

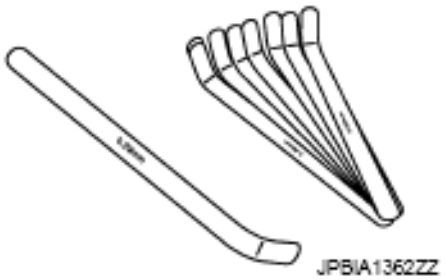
Commercial Service Tool

(Kent-Moore No.) Tool name	**Description**

(J-45488) Quick connector release	 PBIC0198E	Removing fuel tube quick connectors in engine room
(-) Tube presser	 S-NT052	Pressing the tube of liquid gasket
(-) Power tool	 PBIC0190E	Loosening nuts and bolts
(-) Spark plug wrench	 JPBIA0399ZZ	Removing and installing spark plug a. **14 mm (0.55 in)**

(-) Manual lift table caddy	 ZZA1210D	Removing and installing engine
(-) Pilot bushing puller	 NT045	Removing pilot converter
(-) Valve seat cutter set	 S-NT048	Finishing valve seat (EXH) dimensions
(-) Piston ring expander	 S-NT030	Removing and installing piston ring
(-)		Removing and installing valve guide (EXH)

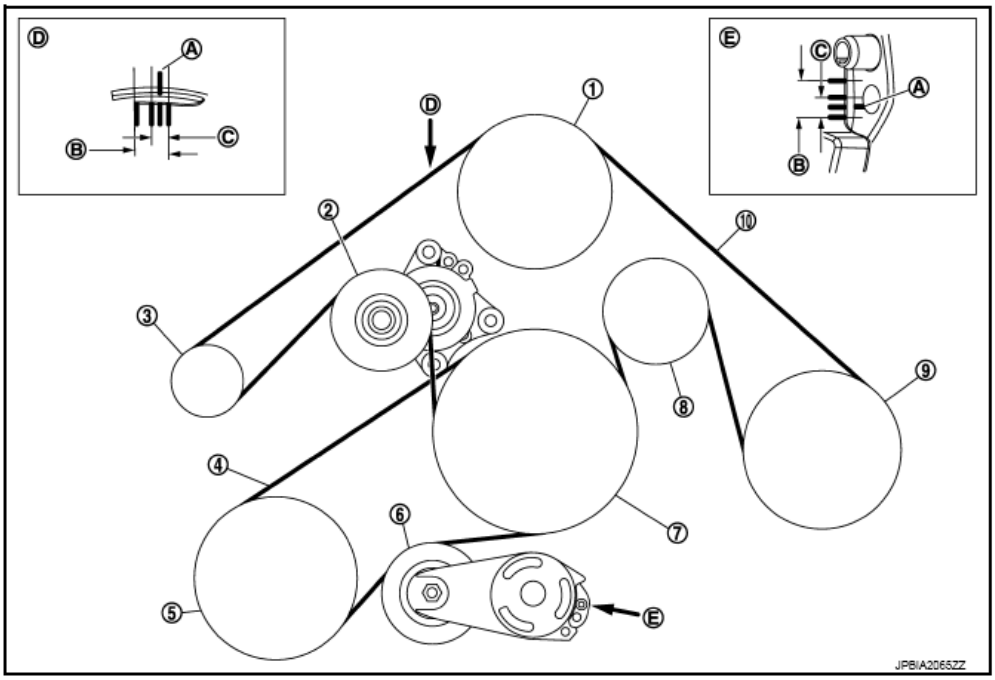
Valve guide drift	 JPBIA0400ZZ	a. **9.5 mm (0.374 in) dia.** b. **5.5 mm (0.217 in) dia.**
(-) Valve guide reamer	 JPBIA0401ZZ	1. Reaming valve guide (EXH) inner hole 2. Reaming hole for oversize valve guide (EXH) **c: 6.0 mm (0.236 in) dia.** **d: 10.2 mm (0.402 in) dia.**
(J-43897-18) (J-43897-12) Oxygen sensor thread cleaner	 JPBIA0238ZZ	Reconditioning the exhaust system threads before installing a new air fuel ratio sensor and heated oxygen sensor (Use with anti-seize lubricant shown below.) A. **J-43897-18 [18 mm (0.71 in) dia.] for zirconia heated oxygen sensor and air fuel ratio sensor** B. **J-43897-12 [12 mm (0.47 in) dia.] for titania heated oxygen sensor** C. Mating surface shave cylinder D. Flutes
(-) Anti-seize lubricant (Permatex 133AR or equivalent meeting MIL specification MIL-A-907)	 AEM489	Lubricating oxygen sensor thread cleaning tool when reconditioning exhaust system threads

(-) Feeler gauge 	Inspection valve clearance (use a curved-tip gauge)
(-) Compression gauge with flexible type adapter	Checking compression pressure

PERIODIC MAINTENANCE

DRIVE BELTS

Exploded View



1.	Water pump	2.	Auto-tensioner (for alternator, water pump and A/C compressor belt)	3.	Alternator
4.	Power steering oil pump belt	5.	Power steering oil pump	6.	Auto-tensioner (for power steering oil pump belt)
7.	Crankshaft pulley	8.	Idler pulley	9.	A/C compressor
10.	Alternator, water pump and A/C compressor belt				
A.	Indicator	B.	Possible use range	C.	Range when new drive belt is installed
D.	View D	E.	View E		

Fig. 8: Exploded View Of Drive Belts With Belt Routing
Courtesy of NISSAN NORTH AMERICA, INC.

Checking

WARNING: Be sure to perform the these steps when engine is stopped.

- **Remove air duct (inlet) when inspecting alternator, water pump and A/C compressor belt.**
- **Remove engine undercover with power tool when inspecting power steering oil pump belt.**
- **Check that the indicator (A) (notch on fixed side) of each auto-tensioner is within the possible use range (B).**

NOTE:

- **Check the each auto-tensioners indication when the engine is cold.**
- **When new drive belts is installed, the indicator (notch on fixed side) should be within the range (C) in the figure.**
- **Visually check all drive belts for wear, damage or cracks.**
- **If the indicator (notch on fixed side) is out of the possible use range or drive belts are damaged, replace drive belts.**

Tension Adjustment

Refer to "**DRIVE BELTS**".

Removal and Installation

REMOVAL

Alternator, Water Pump and A/C Compressor Belt

1. Remove air duct (inlet). Refer to "**EXPLODED VIEW**".
2. Remove reservoir tank. Refer to "**EXPLODED VIEW** ".
3. With box wrench, and while securely holding the hexagonal part in pulley center of auto tensioner (1), move wrench handle in the direction of arrow (loosening direction of belt).

CAUTION:

- **Never place hand in a location where pinching may occur if the holding tool accidentally comes off.**
- **Never loosen the hexagonal part in center of auto tensioner pulley (Never turn it clockwise). If turned clockwise, the complete auto tensioner must be replaced as a unit, including the pulley.**

4. Under the above condition, insert a metallic bar (A) of approximately 6 mm (0.24 in) in diameter (hexagonal bar wrench shown as example in the figure) through the holding boss to lock auto tensioner pulley arm.
   - Leave auto tensioner pulley arm locked until belt is installed again.

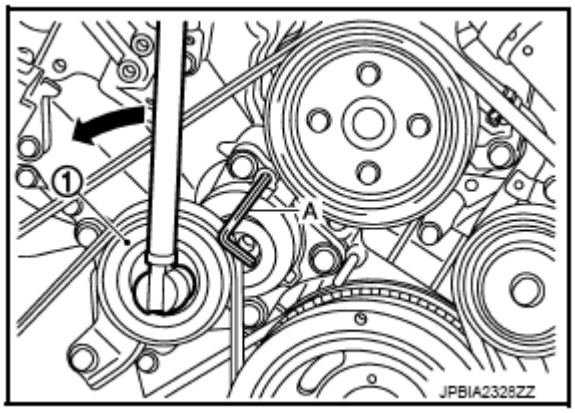


Fig. 9: Loosening Drive Belt Auto-Tensioner And Inserting Metal Bar
Courtesy of NISSAN NORTH AMERICA, INC.

5. Remove alternator, water pump and A/C compressor belt.

Power Steering Oil Pump Belt

1. Remove engine undercover with power tool.
2. Remove alternator, water pump and A/C compressor belt. Refer to "**Alternator, Water Pump and A/C Compressor Belt**".
3. With box wrench, and while securely holding the hexagonal part in pulley center of auto tensioner (1), move wrench handle in the direction of arrow (loosening direction of belt).

CAUTION:
- **Never place hand in a location where pinching may occur if the holding tool accidentally comes off.**
- **Never loosen the hexagonal part in center of auto tensioner pulley (Never turn it clockwise). If turned clockwise, the complete auto tensioner must be replaced as a unit, including the pulley.**

4. Under the above condition, insert a metallic bar (A) of approximately 6 mm (0.24 in) in diameter (hexagonal bar wrench shown as example in the figure) through the holding boss to lock auto tensioner pulley arm.
   - Leave auto tensioner pulley arm locked until belt is installed again.

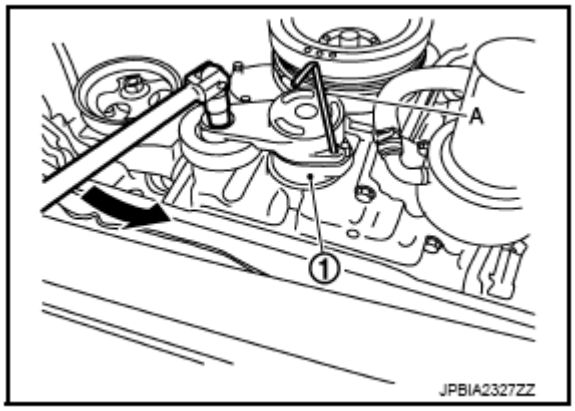


Fig. 10: Loosening Drive Belt Auto-Tensioner And Inserting Metal Bar
Courtesy of NISSAN NORTH AMERICA, INC.

5. Remove power steering oil pump belt.

INSTALLATION

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

CAUTION:
- **Check drive belts are securely installed around all pulleys.**
- **Check drive belts are correctly engaged with the pulley groove.**
- **Check for engine oil and engine coolant contacting drive belts and pulley groove.**

Inspection

INSPECTION AFTER INSTALLATION

- Turn crankshaft pulley clockwise several times to equalize tension between each pulley, and then confirm tension of drive belts at indicator (notch on fixed side) is within the possible use range. Refer to "**EXPLODED VIEW**".

AIR CLEANER FILTER

Removal and Installation

REMOVAL

1. Unhook clips (A).

1 : Holder
2 : Air cleaner case

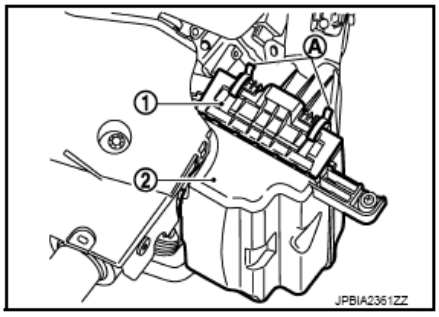


Fig. 11: Locating Air Cleaner Case, Holder And Clips
Courtesy of NISSAN NORTH AMERICA, INC.

2. Remove air cleaner filter (2) from air cleaner case (3).

1 : Holder

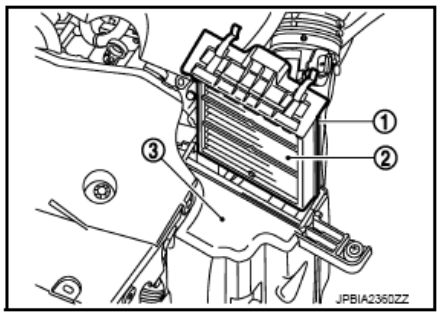


Fig. 12: Removing Air Cleaner Filter
Courtesy of NISSAN NORTH AMERICA, INC.

INSTALLATION

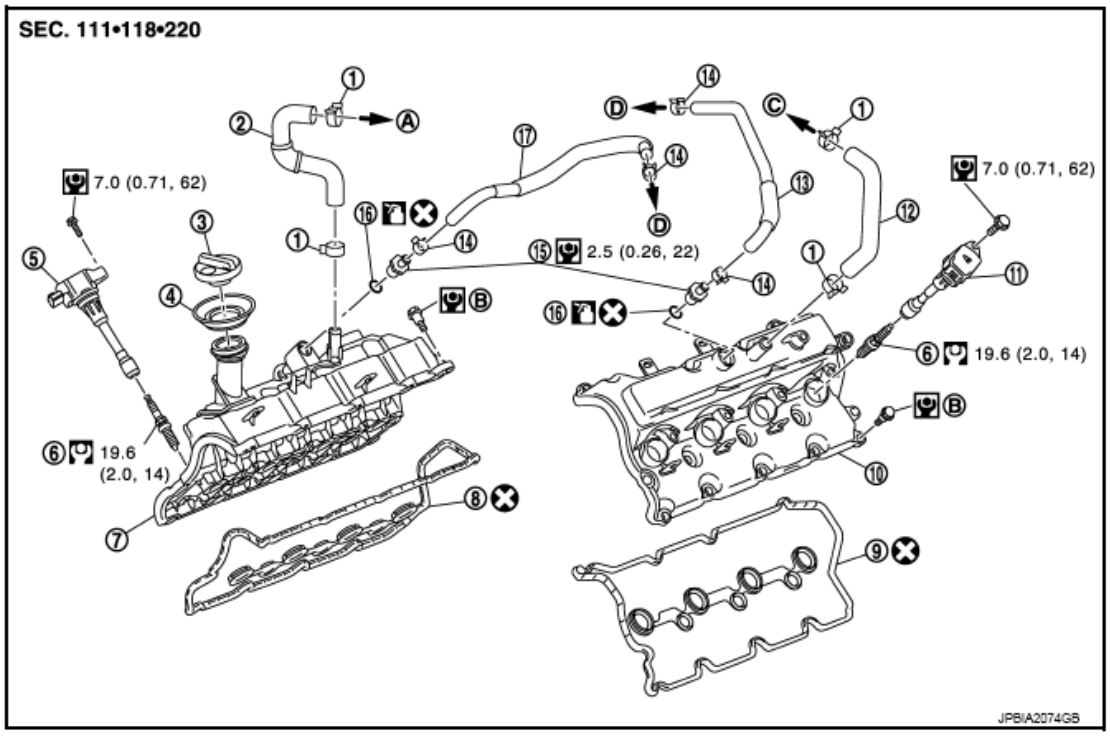
Note the following item, and install in the reverse order of removal.

- Install the air cleaner filter by aligning the seal with the notch of air cleaner case.

SPARK PLUG

Exploded View

Symbol	Description
	N·m (kg-m, ft-lb)
	N·m (kg-m, in-lb)
	Always replace after disassembly.



1. Clamp	2. PCV hose	3. Oil filler cap
4. Oil catcher	5. Ignition coil (No. 1 - 6)	6. Spark plug
7. Rocker cover (bank 2)	8. Rocker cover gasket (bank 2)	9. Rocker cover gasket (bank 1)
10. Rocker cover (bank 1)	11. Ignition coil (No. 7, 8)	12. PCV hose
13. PCV hose	14. Clamp	15. PCV valve
16. O-ring	17. PCV hose	
A. To air duct (bank 2)	B. Comply with the installation procedure when tightening.	C. To air duct (bank 1)
D. To intake manifold		

Fig. 13: Exploded View Of Spark Plug With Torque Specifications
Courtesy of NISSAN NORTH AMERICA, INC.

Removal and Installation

REMOVAL

1. Remove engine cover. Refer to "**EXPLODED VIEW**".
2. Remove ignition coil. Refer to "**EXPLODED VIEW**".
3. Remove spark plug with a spark plug wrench (commercial service tool).

a : 14 mm (0.55 in)

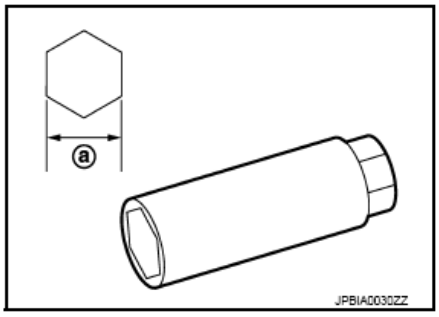


Fig. 14: Identifying Spark Plug Wrench Dimension
Courtesy of NISSAN NORTH AMERICA, INC.

INSTALLATION

Installation is the reverse order of removal.

Inspection

INSPECTION AFTER REMOVAL

Use the standard type spark plug for normal condition.

Spark plug (Standard type): Refer to "SPARK PLUG".

CAUTION:

- **Never drop or impact spark plug.**
- **Never use a wire brush for cleaning.**
- **If plug tip is covered with carbon, use spark plug cleaner to clean.**

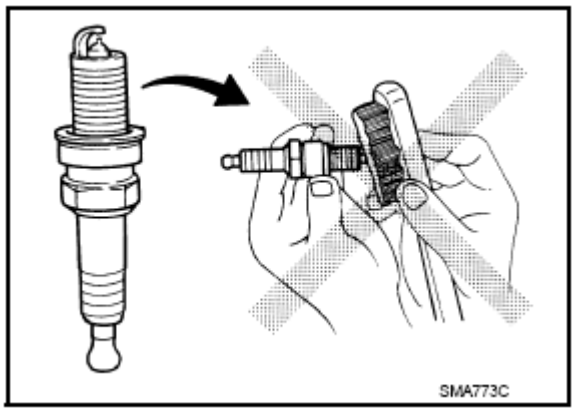


Fig. 15: Caution For Cleaning Spark Plug
Courtesy of NISSAN NORTH AMERICA, INC.

Cleaner air pressure

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

Cleaning time

: Less than 20 seconds

- **Measure spark plug gap. When it exceeds the limit, replace spark plug even if it is within the specified replacement mileage. Refer to "SPARK PLUG".**
- **Spark plug gap adjustment is not required between replacement intervals.**

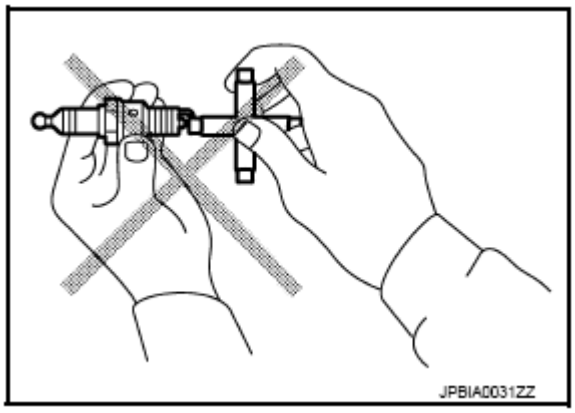


Fig. 16: Caution For Adjusting Spark Plug Gap
Courtesy of NISSAN NORTH AMERICA, INC.

CAMSHAFT VALVE CLEARANCE

Inspection

INSPECTION

Check valve clearance if applicable to the following cases:

Intake side:

- At the removal and installation of VVEL ladder assembly or valve-related parts, or at the occurrence of malfunction (poor starting, idle malfunction, unusual noise) due to aged deterioration in valve clearance.

CAUTION: Valve clearance check on the intake side is not required after replacing the VVEL ladder assembly & cylinder head assembly with a new one. (Install new VVEL ladder assembly & cylinder head assembly in factory-shipped condition because it is factory-adjusted and inspected.)

NOTE: VVEL ladder assembly cannot be replaced as a single part, because it is

machined together with cylinder head assembly.

Exhaust side:

- At the removal, installation, and replacement of camshaft (EXH) or valve-related parts, or at the occurrence of malfunction (poor starting, idle malfunction, unusual noise) due to aged deterioration in valve clearance.

1. Remove rocker covers (bank 1 and bank 2). Refer to "**REMOVAL AND INSTALLATION**".
2. Measure the valve clearance as per the following:
   - Use the feeler gauge (commercial service tool) of curved-tip. This allows the feeler gauge to access the clearance between camshaft (drive shaft) nose and valve lifter with ease.

     Valve clearance: Refer to "CAMSHAFT".

   NOTE: Be sure to note the following points when measuring valve clearance on the intake side.

   - Before measuring, check that the position of drive shaft nose is within the angle shown in the figure below.

A : Bank 2
B : Feeler gauge (commercial service tool)
c : 45 degrees (drive shaft nose angle)
D : View D
⇦ : Insertion direction of feeler gauge on the bank 2
⬅ : Insertion direction of feeler gauge on the bank 1

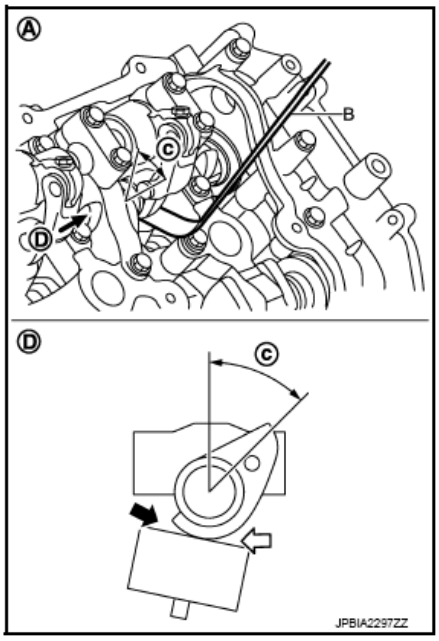


Fig. 17: Locating Feeler Gauge Insertion Direction
Courtesy of NISSAN NORTH AMERICA, INC.

   - Refer to the figure for the insertion direction of the feeler gauge since the direction depends on the bank.

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

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

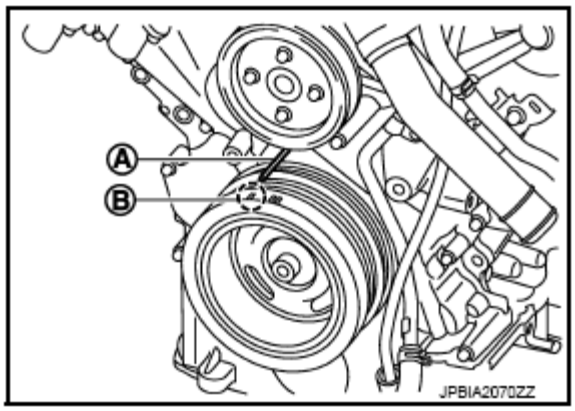


Fig. 18: Locating Crankshaft Pulley Timing Indicator And Timing Mark
Courtesy of NISSAN NORTH AMERICA, INC.

- Check that exhaust cam nose on No. 1 cylinder (engine front side of bank 1) is located as shown in the figure below.

1 : Camshaft (EXH) (bank 1)
⇦ : Engine front

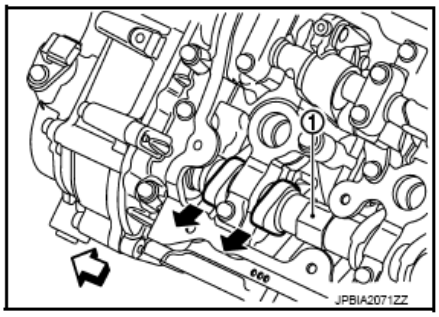


Fig. 19: Locating Exhaust Camshaft Nose
Courtesy of NISSAN NORTH AMERICA, INC.

- If not, turn crankshaft one revolution (360 degrees) and align as shown in the figure below.
- By referring to the figure, measure the valve clearances at locations marked "x" as shown in the table below (locations indicated in the figure).

⇦ : Engine front

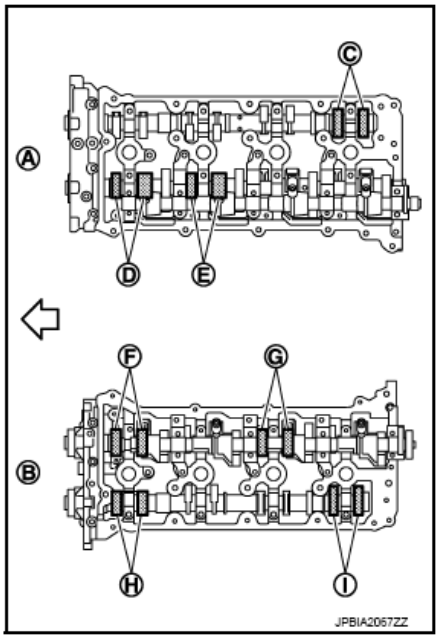


Fig. 20: Locating Valve Clearances Measurement Locations
Courtesy of NISSAN NORTH AMERICA, INC.

- No. 1 cylinder at compression TDC

Measuring position [bank 2 (A)]		No. 2 CYL.	No. 4 CYL.	No. 6 CYL.	No. 8 CYL.
No. 1 cylinder at compression TDC	EXH				x (C)
	INT	x (D)	x (E)		
Measuring position [bank 1 (B)]		No. 1 CYL.	No. 3 CYL.	No. 5 CYL.	No. 7 CYL.
No. 1 cylinder at compression TDC	INT	x (F)		x (G)	
	EXH	x (H)			x (I)

NOTE: **To measure valve clearance of No. 1 cylinder INT valve (front side), insert feeler gauge (commercial service tool) from the front side (A) of the control shaft bracket or camshaft (EXH) side (B).**

1 : Valve lifter

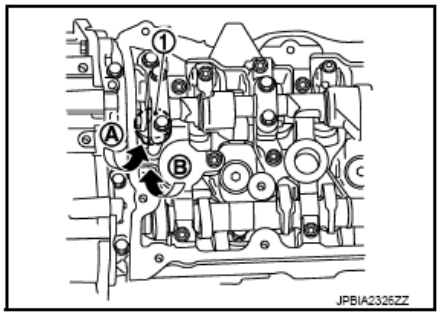


Fig. 21: Measuring Cylinder Intake Valve Clearances Using Feeler Gauge

Courtesy of NISSAN NORTH AMERICA, INC.

b. Rotate crankshaft 270 degrees clockwise (when viewed from engine front) to align No. 3 cylinder at TDC its compression stroke.

NOTE: Crankshaft pulley mounting bolt flange has an angle mark (B) every 90 degrees (c). They can be used as a guide to rotation angle.

A : Paint mark

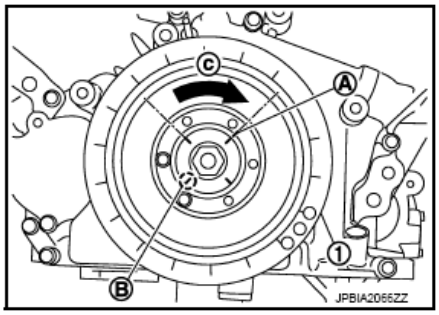


Fig. 22: Rotating Crankshaft 270 Degrees Clockwise
Courtesy of NISSAN NORTH AMERICA, INC.

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

⇦ : Engine front

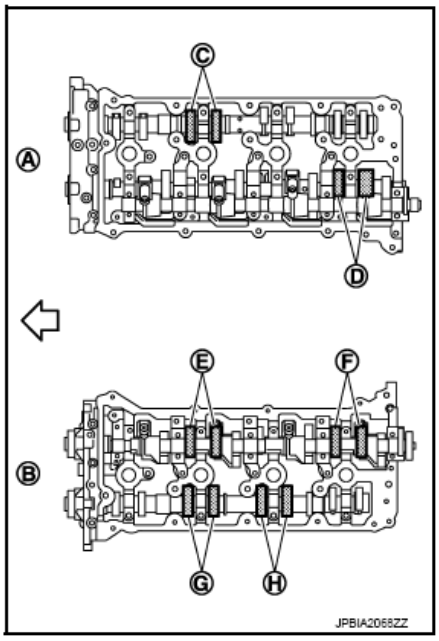


Fig. 23: Locating Valve Clearances Measurement Locations
Courtesy of NISSAN NORTH AMERICA, INC.

- No. 3 cylinder at compression TDC

Measuring position [bank 2 (A)]		No. 2 CYL.	No. 4 CYL.	No. 6 CYL.	No. 8 CYL.
No. 3 cylinder at compression TDC	EXH		x (C)		
	INT				x (D)
Measuring position [bank 1 (B)]		No. 1 CYL.	No. 3 CYL.	No. 5 CYL.	No. 7 CYL.
No. 3 cylinder at compression TDC	INT		x (E)		x (F)
	EXH		x (G)	x (H)	

c. Rotate crankshaft 90 degrees clockwise (when viewed from engine front) to align No. 6 cylinder at TDC of compression stroke.

NOTE: Crankshaft pulley mounting bolt flange has an angle mark (B) every 90 degrees (c). They can be used as a guide to rotation angle.

A : Paint mark

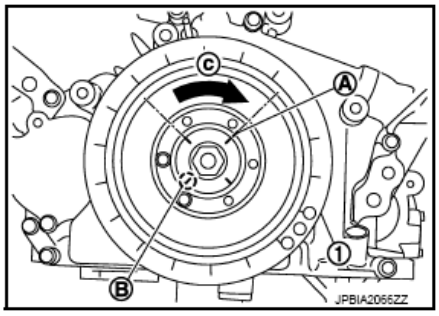


Fig. 24: Rotating Crankshaft 90 Degrees Clockwise
Courtesy of NISSAN NORTH AMERICA, INC.

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

⇦ : Engine front

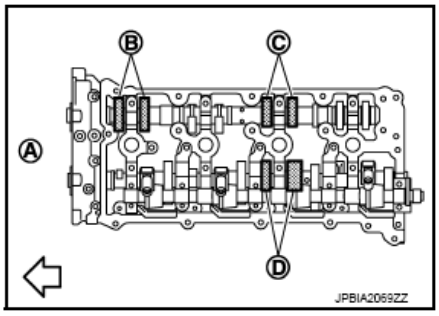


Fig. 25: Locating Valve Clearances Measurement Locations
Courtesy of NISSAN NORTH AMERICA, INC.

- No. 6 cylinder at compression TDC

Measuring position [bank 2 (A)]		No. 2 CYL.	No. 4 CYL.	No. 6 CYL.	No. 8 CYL.
No. 6 cylinder at compression TDC	EXH	x (B)		x (C)	

	INT			x (D)	

3. Perform adjustment or replacement if the measured value is out of the standard.
   - If a valve clearance on the exhaust side is out of specification, adjust the valve clearance. Refer to "**INSPECTION**".
   - If a valve clearance on the intake side is out of specification, replace VVEL ladder assembly & cylinder head assembly. Refer to "**EXPLODED VIEW**".

CAUTION: Never adjust valve clearance on the intake side.

NOTE: Since the valve lifter (INT) cannot be replaced by the piece, VVEL ladder assembly & cylinder head assembly replacement are required.

COMPRESSION PRESSURE

Inspection

1. Warm up engine thoroughly. Then, stop it.
2. Release fuel pressure. Refer to "**INSPECTION** ".
3. Disconnect fuel pump fuse (1) from IPDM E/R (2) to avoid fuel injection during measurement.

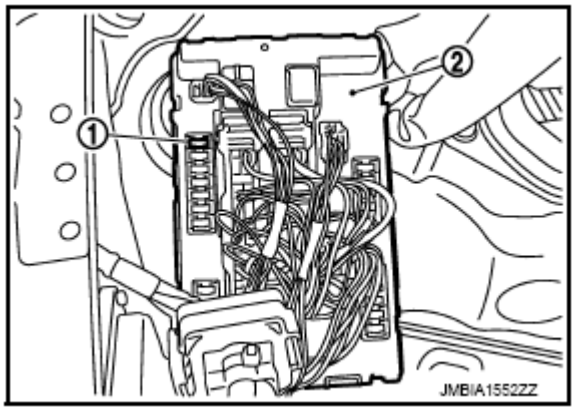


Fig. 26: Locating IPDM E/R And Fuel Pump Fuse
Courtesy of NISSAN NORTH AMERICA, INC.

4. Remove engine cover. Refer to "**EXPLODED VIEW**".
5. Remove ignition coil and spark plug from each cylinder. Refer to "**EXPLODED VIEW**".
6. Connect engine tachometer (not required in use of CONSULT).
7. Measure compression pressure using compression gauge connected with flexible type adapter (commercial service tool).
8. With accelerator pedal fully depressed, turn ignition switch to "START" for cranking. When the gauge pointer stabilizes, read the compression pressure and the engine RPM. Perform these steps to check each

cylinder.

Compression pressure: Refer to "GENERAL SPECIFICATION".

CAUTION:

- **Measure a six-cylinder under the same conditions since a measurement depends on measurement conditions (engine water temperature, etc.).**
- **Always use a fully charged battery to obtain the specified engine speed.**

- If the engine speed is out of the specified range, check battery liquid for proper gravity. Check the engine speed again with normal battery gravity. Refer to "**HOW TO HANDLE BATTERY** ".
- If compression pressure is below the minimum value, check valve clearances and parts associated with combustion chamber (valve, valve seat, piston, piston ring, cylinder bore, cylinder head, and cylinder head gasket). After checking, measure compression pressure again.
- If a cylinder has low compression pressure, pour a small amount of engine oil into the spark plug hole of the cylinder to recheck it for compression.
  - If the added engine oil improves the compression, piston rings may be worn out or damaged. Check piston rings and replace if necessary. Refer to "**DISASSEMBLY AND ASSEMBLY**".
  - 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. Refer to "**DISASSEMBLY AND ASSEMBLY**".
- If two adjacent cylinders have respectively low compression pressure and their compression remains low even after the addition of engine oil, cylinder head gaskets are leaking. In such a case, replace cylinder head gaskets. Refer to "**DISASSEMBLY AND ASSEMBLY**".

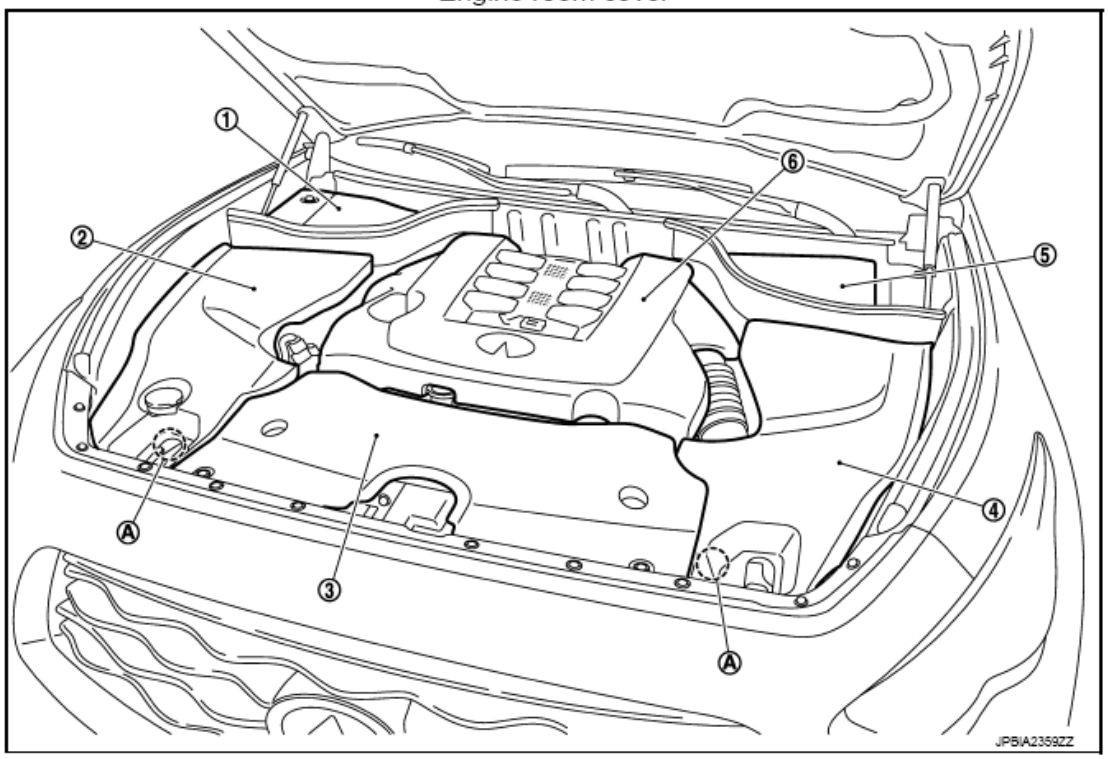
9. After inspection is completed, install removed parts.
10. Start the engine, and check that the engine runs smoothly.
11. Perform trouble diagnosis. If DTC appears, erase it. Refer to "**DESCRIPTION** ".

REMOVAL AND INSTALLATION

ENGINE ROOM COVER

Exploded View

Engine room cover



1. Battery cover
2. Engine room cover (RH)
3. Air duct (inlet)
4. Engine room cover (LH)
5. Brake master cylinder cover
6. Engine cover

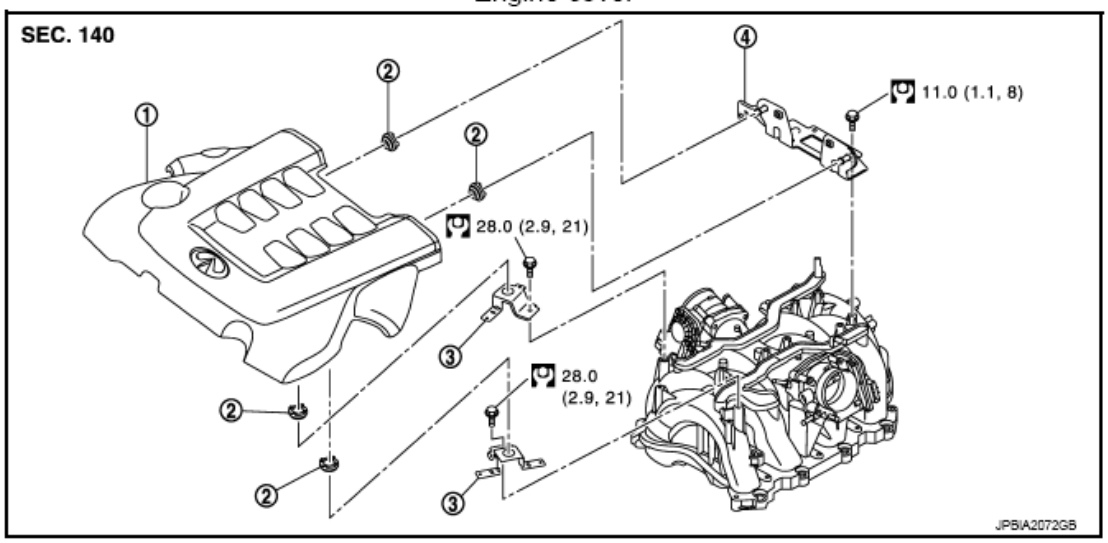
A. Clip

Fig. 27: Exploded View Of Engine Room Cover
Courtesy of NISSAN NORTH AMERICA, INC.

Refer to "**SYMBOLS** " for symbols in the figure.

Symbol	Description
	N·m (kg-m, ft-lb)
	N·m (kg-m, in-lb)
	Always replace after disassembly.

Engine cover



1. Engine cover
2. Grommet
3. Bracket
4. Bracket (rear)

Fig. 28: Exploded View Of Engine Cover With Torque Specifications
Courtesy of NISSAN NORTH AMERICA, INC.

Refer to "**SYMBOLS** " for symbols in the figure.

Removal and Installation

REMOVAL

CAUTION: Never damage or scratch engine cover when installing or removing.

1. Remove clip, and remove engine room cover (RH and LH).
2. Remove engine cover as per the following:
   - Front side: Lift and remove fit.
   - Rear side: Pull out to forward and remove fit.
3. Remove battery cover and brake master cylinder cover, if necessary.
4. Remove air duct (inlet). Refer to "**EXPLODED VIEW**".

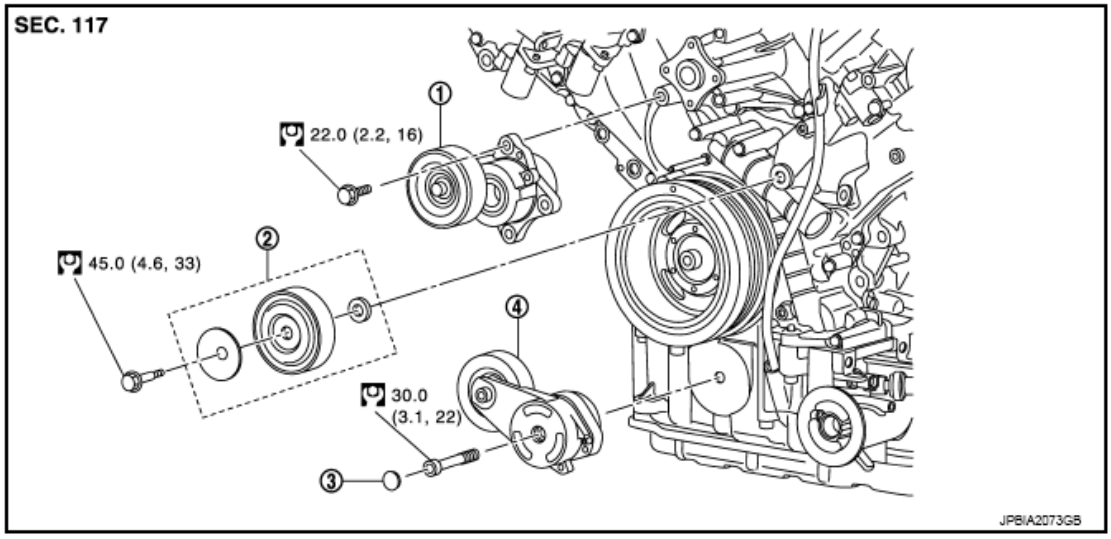
INSTALLATION

Installation is the reverse order of removal.

DRIVE BELT AUTO TENSIONER AND IDLER PULLEY

Exploded View

Symbol	Description
	N·m (kg-m, ft-lb)
	N·m (kg-m, in-lb)
	Always replace after disassembly.



1. Auto-tensioner (for alternator, water pump and A/C compressor belt)
2. Idler pulley
3. Cover
4. Auto-tensioner (for power steering oil pump belt)

Fig. 29: Exploded View Of Drive Belt Auto Tensioner And Idler Pulley With Torque Specifications
Courtesy of NISSAN NORTH AMERICA, INC.

Refer to "**SYMBOLS** " for symbols in the figure.

Removal and Installation

Removal

CAUTION: The complete drive belt auto-tensioner must be replaced as a unit, including the pulley.

1. Remove drive belts. Refer to "**EXPLODED VIEW**".
   - Keep auto-tensioner pulley arm locked after drive belt is removed.
2. Remove drive belt auto-tensioners.
   - Keep auto-tensioner pulley arm locked to install or remove auto-tensioner.

CAUTION: Never loosen the hexagonal part in center of drive belt auto

tensioner pulley (Never turn it clockwise). If turned clockwise, the complete drive belt auto tensioner must be replaced as a unit, including the pulley.

3. Remove idler pulley.

Installation

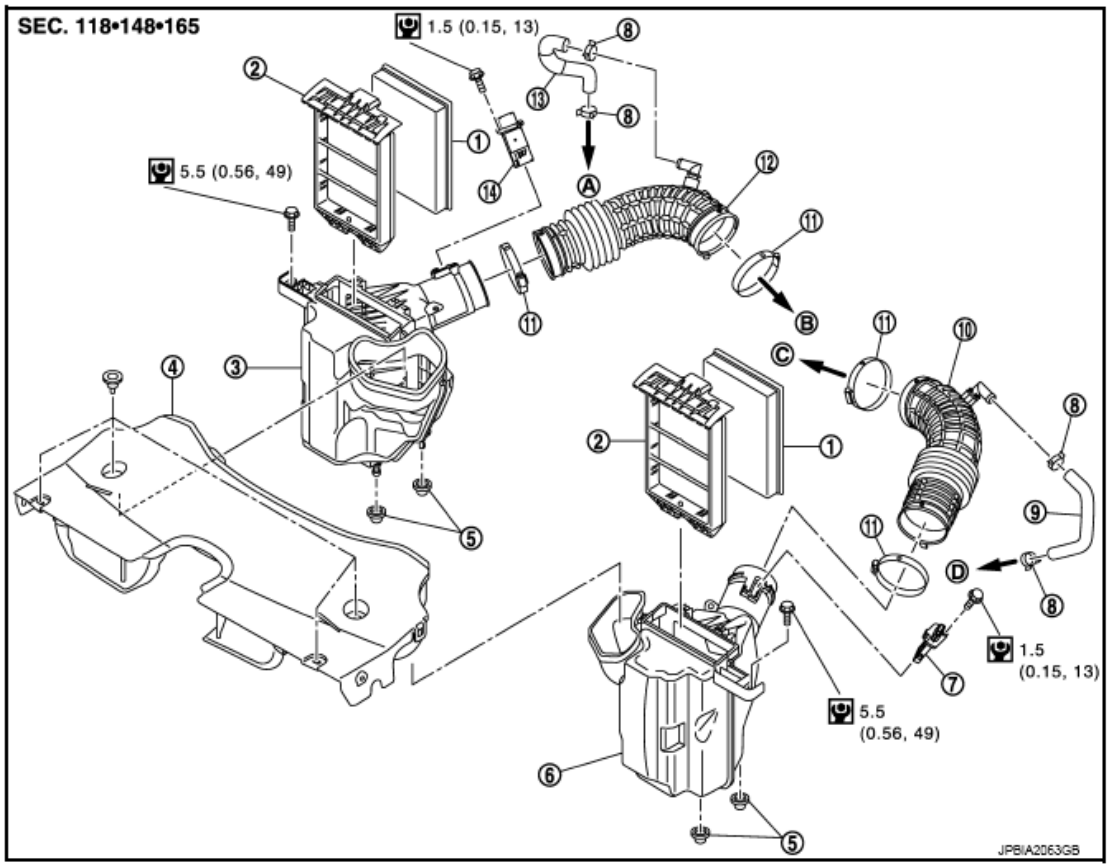
Installation is the reverse order of removal.

CAUTION: Never swap the pulley between new and old drive belt auto tensioner.

AIR CLEANER AND AIR DUCT

Exploded View

Symbol	Description
	N·m (kg-m, ft-lb)
	N·m (kg-m, in-lb)
	Always replace after disassembly.



1.	Air cleaner filter	2.	Holder	3.	Air cleaner case (bank 2)
4.	Air duct (inlet)	5.	Grommet	6.	Air cleaner case (bank 1)
7.	Mass air flow sensor (bank 1)	8.	Clamp	9.	PCV hose
10.	Air duct (bank 1)	11.	Clamp	12.	Air duct (bank 2)
13.	PCV hose	14.	Mass air flow sensor (bank 2)		
A.	To rocker cover (bank 2)	B.	To electric throttle control actuator (bank 2)	C.	To electric throttle control actuator (bank 1)
D.	To rocker cover (bank 1)				

Fig. 30: Exploded View Of Air Cleaner And Air Duct With Torque Specifications
Courtesy of NISSAN NORTH AMERICA, INC.

Refer to "**SYMBOLS** " for symbols in the figure.

Removal and Installation

REMOVAL

1. Remove engine cover and engine room cover (RH and LH). Refer to "**EXPLODED VIEW**".

2. Remove air duct (inlet).
3. Disconnect mass air flow sensor harness connector.
4. Disconnect PCV hose.
5. Remove air cleaner case & mass air flow sensor assembly and air duct by disconnecting their joints.
   - Add matching marks, if necessary for easier installation.
6. Remove mass air flow sensor from air cleaner case, if necessary.

CAUTION: Handle mass air flow sensor according to the following instructions.

- **Never impact mass air flow sensor.**
- **Never disassemble mass air flow sensor.**
- **Never touch mass air flow sensor.**

INSTALLATION

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

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

Clamp tightening torque :4.5 N.m (0.46 kg-m, 40 in-lb)

Inspection

INSPECTION AFTER REMOVAL

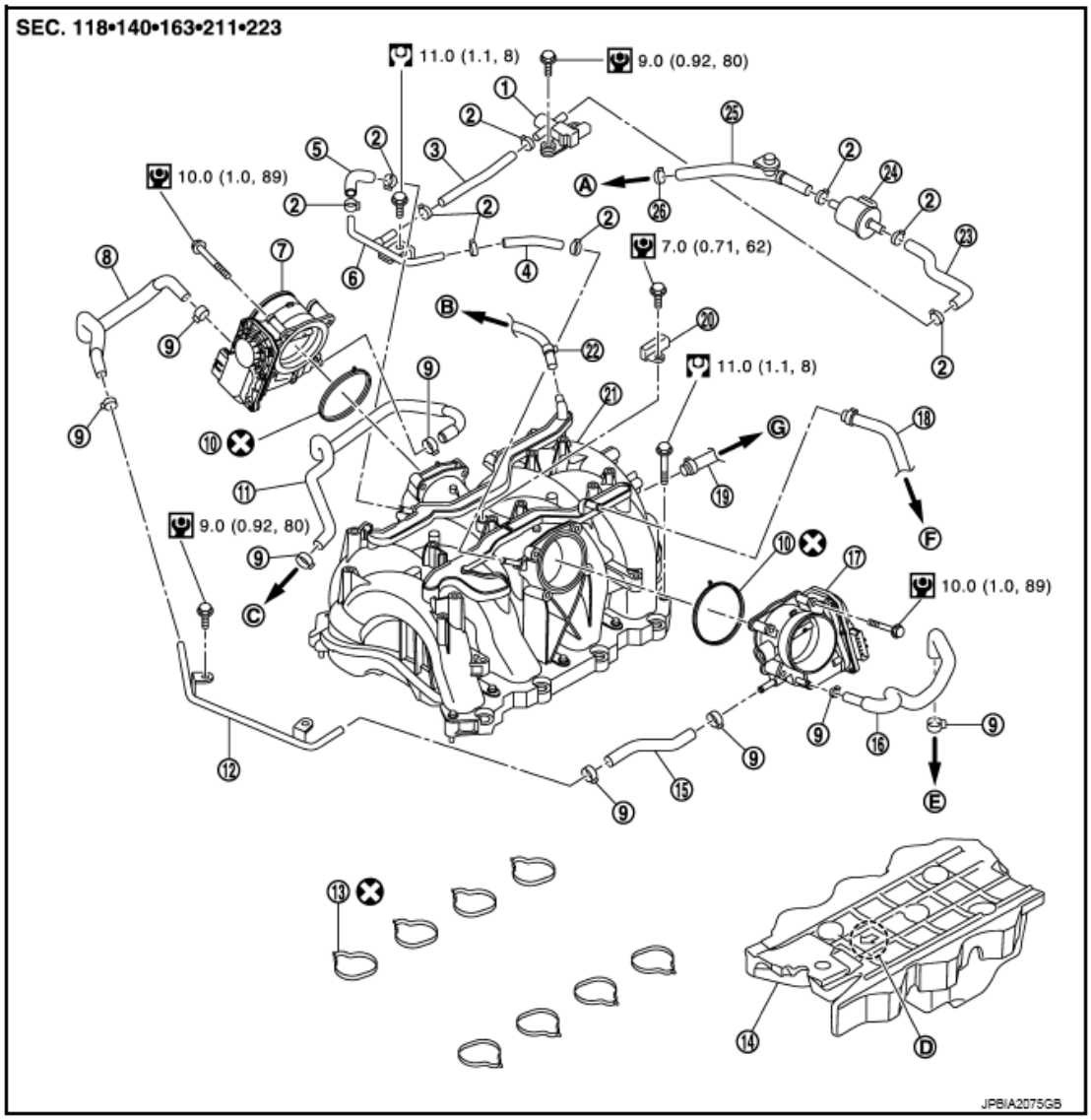
Inspect air duct assembly for crack or tear.

- If damage is found, replace air duct assembly

INTAKE MANIFOLD

Exploded View

Symbol	Description
	N·m (kg-m, ft-lb)
	N·m (kg-m, in-lb)
	Always replace after disassembly.



1.	EVAP canister purge control solenoid valve	2.	Clamp	3.	EVAP hose
4.	EVAP hose	5.	EVAP hose	6.	EVAP tube
7.	Electric throttle control actuator (bank 2)	8.	Water hose	9.	Clamp
10.	Gasket	11.	Water hose	12.	Water pipe
13.	Gasket	14.	Acoustic absorbent	15.	Water hose
16.	Water hose	17.	Electric throttle control actuator (bank 1)	18.	PCV hose
19.	Vacuum hose	20.	Manifold absolute pressure (MAP) sensor	21.	Intake manifold
22.	PCV hose	23.	EVAP hose	24.	Vacuum tank
25.	EVAP service port hose	26.	Clamp		

Fig. 31: Exploded View Of Intake Manifold With Torque Specifications
Courtesy of NISSAN NORTH AMERICA, INC.

Refer to "**SYMBOLS** " for symbols in the figure.

Removal and Installation

REMOVAL

WARNING: To avoid the danger of being scalded, never drain the engine coolant when the engine is hot.

1. Remove engine cover and engine room cover (RH and LH). Refer to "**EXPLODED VIEW**".
2. Release fuel pressure. Refer to "**INSPECTION** ".
3. Remove air duct (inlet) and air duct. Refer to "**EXPLODED VIEW**".
4. Remove quick connector cap (1) and disconnect fuel feed hose (2) on engine side. Refer to "**EXPLODED VIEW**".

⇦ : Engine front

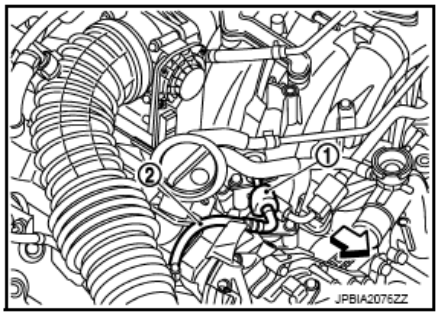


Fig. 32: Locating Quick Connector Cap And Fuel Feed Hose
Courtesy of NISSAN NORTH AMERICA, INC.

5. Remove engine cover bracket. Refer to "**EXPLODED VIEW**".
6. Remove fuel injector and fuel tube assembly. Refer to "**EXPLODED VIEW**".
7. Disconnect manifold absolute pressure (MAP) sensor and air fuel ratio sensor 1 (bank 1) harness connector.
8. Remove vacuum tank, EVAP service port hose and EVAP canister purge control solenoid valve.
9. Disconnect PCV hoses and vacuum hose from intake manifold.
   - Add matching marks as necessary for easier installation.
10. Drain engine coolant from radiator. Refer to "**DRAINING** ".

CAUTION:
- **Perform this step when the engine is cold.**
- **Never spill engine coolant on drive belts.**

NOTE: When removing only intake manifold, move electric throttle control

actuator without disconnecting the water hoses.

11. Remove electric throttle control actuator.
    - Loosen mounting bolts in reverse order as shown in the figure below.

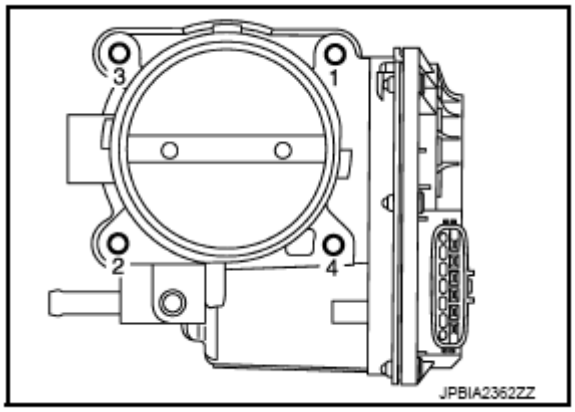


Fig. 33: Electric Throttle Control Actuator Mounting Bolts Tightening Sequence
Courtesy of NISSAN NORTH AMERICA, INC.

NOTE:
- **The figure shows the electric throttle control actuator (bank 1) viewed from the air duct side.**
- **Viewed from the air duct side, the order of loosening mounting bolts of electric throttle control actuator (bank 1) is the same as that of the electric throttle control actuator (bank 2).**

CAUTION:
- **Handle carefully to avoid any impact to electric throttle control actuator.**
- **Never disassemble.**

12. Remove intake manifold with power tool.
    - Loosen mounting bolts in reverse order as shown in the figure below.

⇦ : Engine front

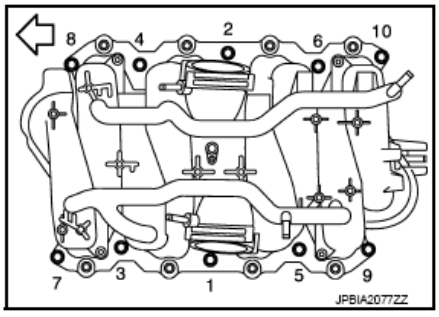


Fig. 34: Intake Manifold Mounting Bolts Tightening Sequence
Courtesy of NISSAN NORTH AMERICA, INC.

13. Remove intake manifold gaskets.

CAUTION: Cover engine openings to avoid entry of foreign materials.

14. Remove manifold absolute pressure (MAP) sensor, if necessary.

CAUTION: Handle carefully to avoid any impact to manifold absolute pressure (MAP) sensor.

15. Remove acoustic absorbent.

INSTALLATION

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

Intake Manifold

Tighten in numerical order as shown in the figure below.

⇦ : Engine front

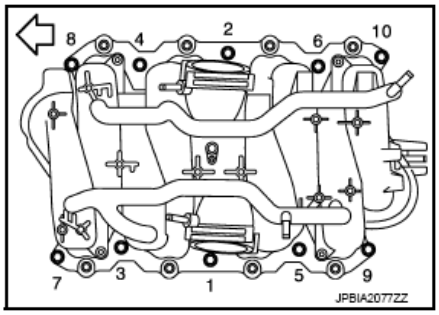


Fig. 35: Intake Manifold Mounting Bolts Tightening Sequence
Courtesy of NISSAN NORTH AMERICA, INC.

Electric Throttle Control Actuator

- Tighten in numerical order as shown in the figure below.

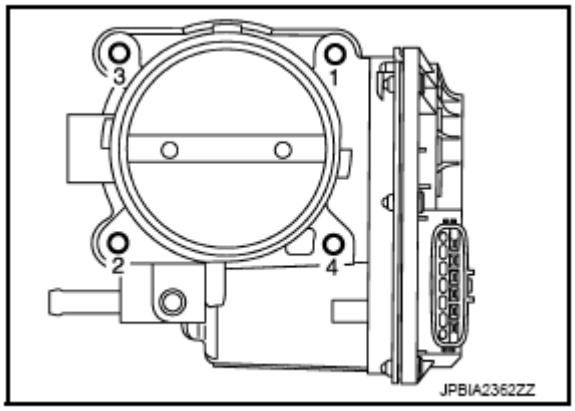


Fig. 36: Electric Throttle Control Actuator Mounting Bolts Tightening Sequence
Courtesy of NISSAN NORTH AMERICA, INC.

NOTE:

- **The figure shows the electric throttle control actuator (bank 1) viewed from the air duct side.**
- **Viewed from the air duct side, the order of tightening mounting bolts of electric throttle control actuator (bank 1) is the same as that of the electric throttle control actuator (bank 2).**

- Perform the "Throttle Valve Closed Position Learning" when harness connector of electric throttle control actuator is disconnected. Refer to "**THROTTLE VALVE CLOSED POSITION LEARNING: DESCRIPTION** ".
- Perform the "Idle Air Volume Learning" and "Throttle Valve Closed Position Learning" when electric throttle control actuator is replaced. Refer to "**IDLE AIR VOLUME LEARNING: DESCRIPTION** " and "**THROTTLE VALVE CLOSED POSITION LEARNING: DESCRIPTION** ".

Water Hose

Insert hose by 27 to 32 mm (1.06 to 1.26 in) from connector end.

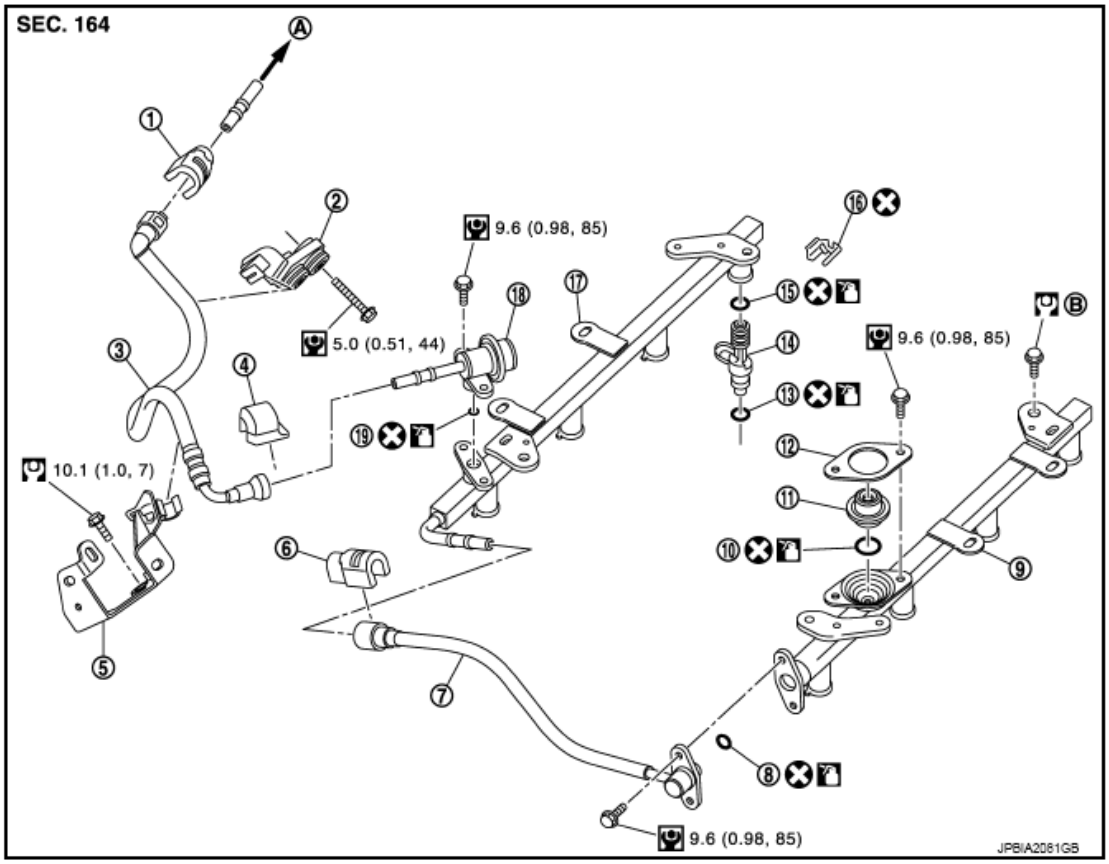
Vacuum Hose

Refer to "**EXCEPT FOR MEXICO: INSPECTION** ".

FUEL INJECTOR AND FUEL TUBE

Exploded View

Symbol	Description
	N·m (kg-m, ft-lb)
	N·m (kg-m, in-lb)
	Always replace after disassembly.



1. Quick connector cap
2. Fuel hose bracket
3. Fuel feed hose
4. Quick connector cap
5. Fuel hose bracket
6. Quick connector cap
7. Fuel hose (center)
8. O-ring
9. Fuel tube (bank 1)
10. O-ring
11. Fuel damper
12. Fuel damper cap
13. O-ring (green)
14. Fuel injector
15. O-ring (black)
16. Clip
17. Fuel tube (bank 2)
18. Fuel feed damper
19. O-ring

A. To centralized under-floor piping
B. Comply with the installation procedure when tightening.

Fig. 37: Exploded View Of Fuel Injector And Fuel Tube With Torque Specifications
Courtesy of NISSAN NORTH AMERICA, INC.

Refer to "**SYMBOLS** " for symbols in the figure.

CAUTION: Never remove or disassemble parts unless instructed as shown in the figure below.

Removal and Installation

REMOVAL

WARNING:

- **Put a "CAUTION FLAMMABLE" sign in the workshop.**
- **Be sure to work in a well ventilated area and furnish workshop with a CO_2 fire extinguisher.**
- **Never smoke while servicing fuel system. Keep open flames and sparks away from the work area.**
- **To avoid the danger of being scalded, never drain engine coolant when engine is hot.**

1. Remove engine cover and engine room cover (RH and LH). Refer to "**EXPLODED VIEW**".
2. Release fuel pressure. Refer to "**INSPECTION** ".
3. Remove the fuel feed hose (2) on the fuel feed damper side with quick connector release (commercial service tool: J-45488) as per the followings steps.

1. : Quick connector cap
⇦ : Engine front

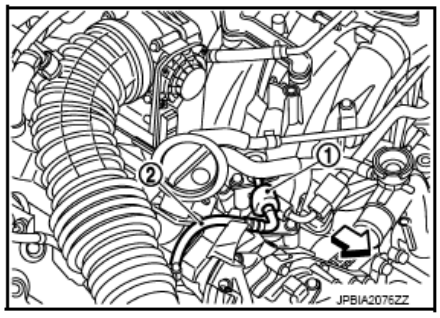


Fig. 38: Locating Quick Connector Cap And Fuel Feed Hose
Courtesy of NISSAN NORTH AMERICA, INC.

CAUTION: Use the quick connector release for removing the fuel feed hose on the centralized under-floor piping side as well as the fuel feed damper side although the shape of the quick connector is different.

a. Remove quick connector cap from quick connector connection.
b. With the sleeve side (B) of quick connector release (A) facing to quick connector (D), install quick connector release onto fuel feed hose.

1 : Fuel feed damper
C : Insert and retain

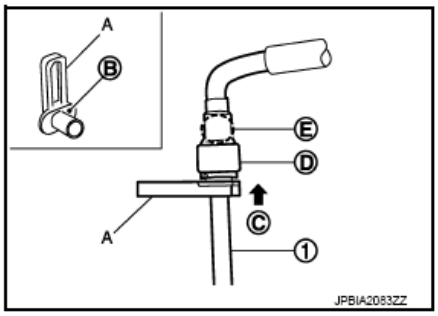


Fig. 39: Installing Quick Connector Release Onto Fuel Feed Hose
Courtesy of NISSAN NORTH AMERICA, INC.

c. Insert quick connector release into quick connector until sleeve contacts and goes no further. Hold quick connector release on that position.

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

d. Pull out quick connector straight from fuel feed damper.

CAUTION:

- **Pull quick connector holding position (E) as shown in the figure below.**
- **Never pull with lateral force applied. O-ring inside quick connector may be damaged.**
- **Prepare container and cloth beforehand as fuel will leak out.**
- **Avoid fire and sparks.**
- **Keep parts away from heat source. Especially, be careful when welding is performed around them.**
- **Never expose parts to battery electrolyte or other acids.**
- **Never bend or twist connection between quick connector and fuel feed hose during installation/removal.**
- **To keep the connecting portion clean and to avoid damage and foreign materials, cover them completely with plastic bags (A) or something similar.**

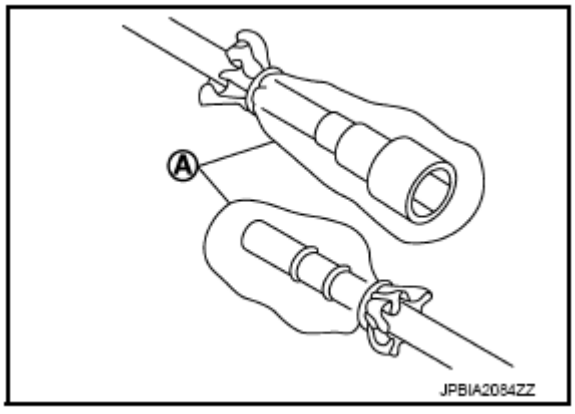


Fig. 40: Securing Quick Connector Using Plastic Bags
Courtesy of NISSAN NORTH AMERICA, INC.

4. Remove air duct. Refer to "**EXPLODED VIEW**".

5. Remove electric throttle control actuator. Refer to "**EXPLODED VIEW**".
6. Remove fuel hose (center).
   - The procedure for removing the quick connector is the same as for removing the fuel feed damper.

CAUTION: Disconnect quick connector by using quick connector release (commercial service tool: J-45488), not by picking out retainer tabs.

7. Remove fuel tube and fuel injector assembly.
   - Loosen mounting bolts (b) first. Then loosen mounting bolts (a) shown in the figure below.

1 : Fuel tube (bank 2)
2 : Fuel tube (bank 1)
⇦ : Engine front

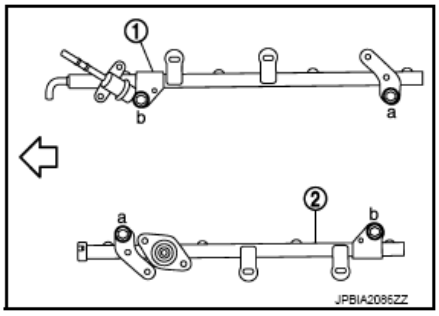


Fig. 41: Fuel Tube And Fuel Injector Assembly Mounting Bolts Loosening Sequence
Courtesy of NISSAN NORTH AMERICA, INC.

CAUTION: Never tilt it, or remaining fuel in pipes may flow out from pipes.

8. Remove fuel injector (1) from fuel tube (3) as per the following:

Symbol	Description
	N·m (kg-m, ft-lb)
	N·m (kg-m, in-lb)
	Always replace after disassembly.

A : Installed condition
B : Clip mounting groove
C : Protrusion

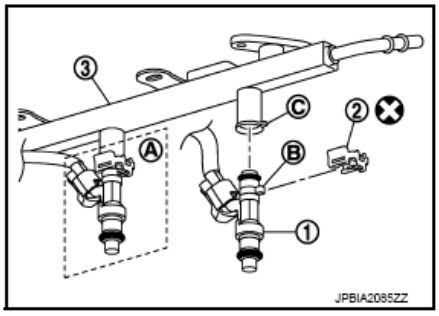


Fig. 42: Locating Fuel Injector, Fuel Tube, Protrusion And Clip Mounting Groove
Courtesy of NISSAN NORTH AMERICA, INC.

a. Open and remove clip (2).
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 nozzles during removal.**
- **Never bump or drop fuel injector.**
- **Never disassemble fuel injector.**

9. Disconnect sub harness connector from fuel injectors.
10. Remove fuel damper and fuel feed damper, if necessary.

INSTALLATION

CAUTION: Do not reuse O-rings.

1. Install fuel damper (4) as per the following:

Symbol	Description
	N·m (kg-m, ft-lb)
	N·m (kg-m, in-lb)
	Always replace after disassembly.

1 : Fuel damper cap

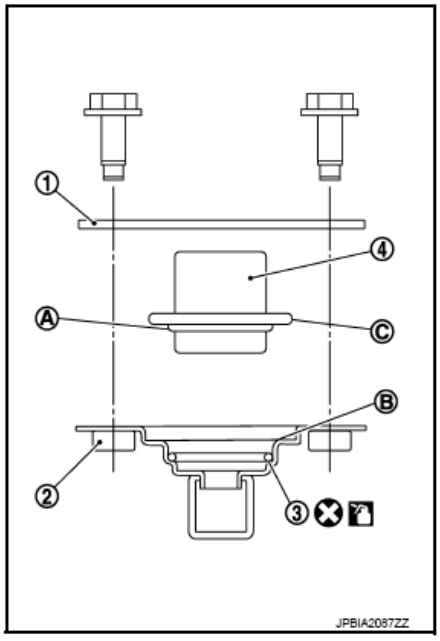


Fig. 43: Locating Fuel Damper Related Components
Courtesy of NISSAN NORTH AMERICA, INC.

a. Install new O-ring (3) to fuel tube (bank 1) (2) as shown. When handling new O-ring, pay attention to the following caution items:

CAUTION:
- **Do not reuse O-ring.**
- **Handle O-ring with bare hands. Never wear gloves.**
- **Lubricate O-ring with new engine oil.**
- **Never clean O-ring with solvent.**
- **Check 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, never insert it quickly into fuel tube.**
- **Insert new O-ring straight into fuel tube. Never de-center or twist it.**

b. Install spacer (A) to fuel damper. Insert fuel damper straight into fuel tube (bank 1).

CAUTION:
- **Insert straight, check that the axis is lined up.**
- **Insert fuel damper at 130 N (13.3 kg, 29.2 lb) or less to prevent damage to the parts**
- **Insert fuel damper until the rim (C) reaches the cap flange (B).**

c. Tighten mounting bolts evenly in turn.
   - After tightening mounting bolts, check that there is no gap between flange and fuel tube (bank 1).

2. Install fuel feed damper.
   - Handling procedure of O-ring is the same as that of fuel damper.
   - Insert fuel feed damper straight into fuel tube (bank 2).

CAUTION: Insert fuel feed damper at 147 N (15 kg, 33.1 lb) or less to prevent damage to the parts

   - Tighten mounting bolts evenly in turn.
   - After tightening mounting bolts, check that there is no gap between flange and fuel tube (bank 2).
3. Install new O-rings to fuel injector paying attention to the following caution.

CAUTION:
- **Do not reuse O-rings.**
- **Upper and lower O-ring are different. Be careful not to confuse them.**

Fuel tube side: Black

Nozzle side: Green

- **Handle O-ring with bare hands. Never wear gloves.**
- **Lubricate O-ring with new engine oil.**
- **Never clean O-ring with solvent.**
- **Check 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, never insert it quickly into fuel tube.**
- **Insert O-ring straight into fuel injector. Never de-center or twist it.**

4. Install fuel injector (3) to fuel tube (1) as per the following:

Symbol	Description
	N·m (kg-m, ft-lb)
	N·m (kg-m, in-lb)
	Always replace after disassembly.

2 : O-ring (black)
4 : O-ring (green)

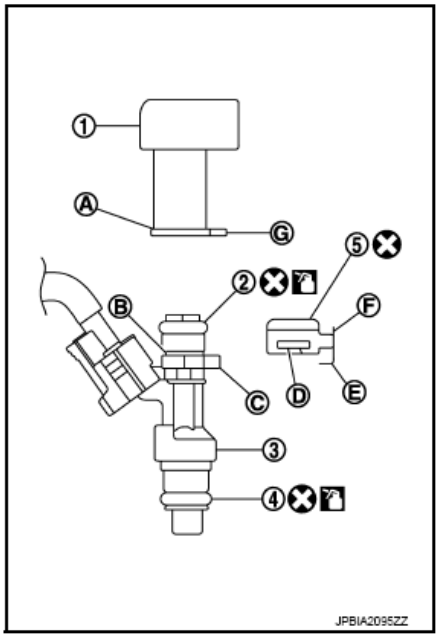


Fig. 44: Locating Fuel Injector And Fuel Tube Components
Courtesy of NISSAN NORTH AMERICA, INC.

a. Insert clip (5) into clip mounting groove (B) on fuel injector.

- Insert clip so that protrusion (C) of fuel injector matches cutout (E) of clip.

CAUTION:
- **Never reuse clip. Replace it with a new one.**
- **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 (G) of fuel tube matches cutout (F) of clip.
- Check that fuel tube flange (A) is securely fixed in flange fixing groove (D) on clip.

CAUTION: Insert fuel injector at 147 N (15 kg, 33.1 lb) or less to prevent damage to the parts

c. Check that installation is complete by checking that fuel injector does not rotate or come off.
- Check that protrusions of fuel injectors and fuel tube are aligned with cutouts of clips after installation.

5. Install fuel tube and fuel injector assembly.
- Tighten mounting bolts (a) first. Then tighten mounting bolts (b) shown in the figure below.

1 : Fuel tube (bank 2)
2 : Fuel tube (bank 1)
⇦ : Engine front

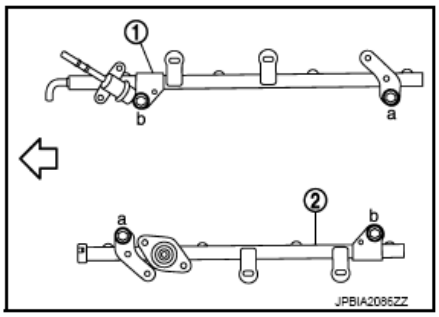


Fig. 45: Fuel Tube And Fuel Injector Assembly Mounting Bolts Tightening Sequence
Courtesy of NISSAN NORTH AMERICA, INC.

Torque Value: 1st step: 10.1 N.m (1.0 kg-m, 7 ft-lb)

Torque Value: 2nd step: 23.6 N.m (2.4 kg-m, 17 ft-lb)

CAUTION:
- **Be careful not to let tip of injector nozzle come in contact with other parts.**
- **Insert fuel injector at 147 N (15 kg, 33.1 lb) or less to prevent damage to the parts**

6. Install quick connectors as per the following:

- Unless otherwise indicated, the installation to the engine side and centralized under-floor piping side is exactly alike.

a. Check no foreign substances are deposited in and around fuel piping and quick connector, and no damage on them.
b. Thinly apply new engine oil around fuel piping from tip end to spool end.
c. Align center to insert quick connector straightly into fuel piping.

Fuel hose (center) and centralized under-floor piping side:

- Visually confirm that the two retainer tabs (A) are connected to the quick connector (B).

CAUTION:

- **Carefully align center to avoid inclined insertion to prevent damage to O-ring inside quick connector.**
- **Insert until you hear a "click" sound and actually feel the engagement.**
- **To avoid misidentification of engagement with a similar sound, be sure to perform the next step.**

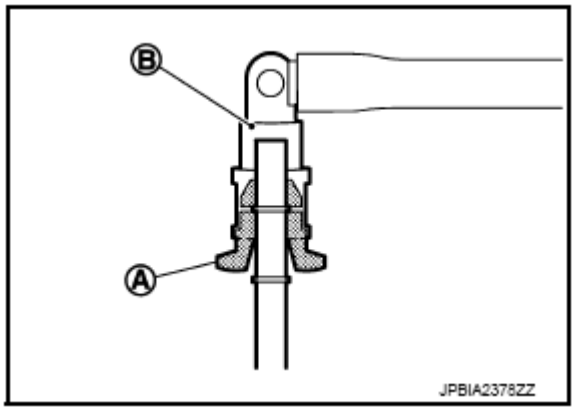


Fig. 46: Locating Quick Connector And Retainer Tabs
Courtesy of NISSAN NORTH AMERICA, INC.

Fuel feed damper side:

- Insert quick connector to fuel feed damper piping until top spool (2) is completely inside quick connector and 2nd level spool (3) exposes just below quick connector.

B : Fitted condition
⇦ : Upright insertion

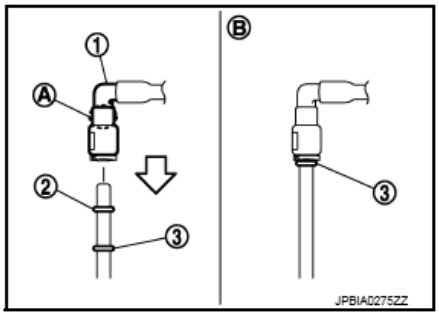


Fig. 47: Inserting Quick Connector To Fuel Feed Damper Piping
Courtesy of NISSAN NORTH AMERICA, INC.

CAUTION:

- **Hold (A) position as shown in the figure below, when inserting fuel feed hose (1) into quick connector.**
- **Carefully align center to avoid inclined insertion to prevent damage to O-ring inside quick connector.**
- **Insert until you hear a "click" sound and actually feel the engagement.**
- **To avoid misidentification of engagement with a similar sound, be sure to perform the next step.**

d. Pull quick connector by hand holding position (A). Check it is completely engaged (connected) so that it does not come out from fuel piping (1).

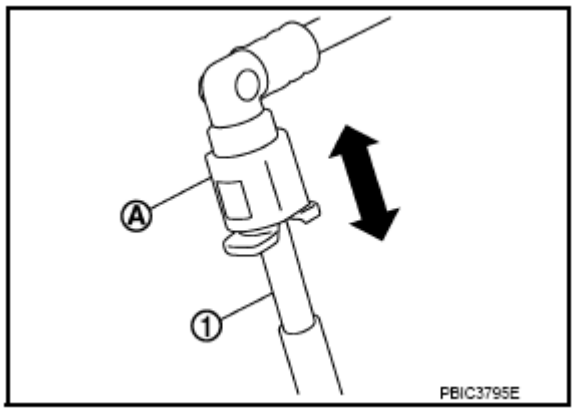


Fig. 48: Checking Quick Connector In Fuel Piping
Courtesy of NISSAN NORTH AMERICA, INC.

e. Install quick connector cap (3) to quick connector connection.

1 : Fuel tube (bank 1)
2 : Fuel hose (center)

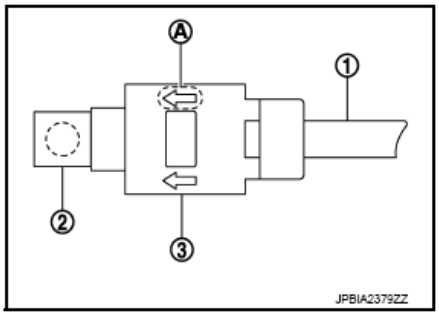


Fig. 49: Installing Quick Connector Cap
Courtesy of NISSAN NORTH AMERICA, INC.

- Install quick connector cap with arrow (A) on surface facing the direction of quick connector.

CAUTION: If cap cannot be installed smoothly, quick connector may have not be installed correctly. Check connection again.

NOTE: Figure shows an example fuel feed damper side.

7. Install in the reverse order of removal.

Inspection

INSPECTION AFTER INSTALLATION

Check for Fuel Leakage

1. Turn ignition switch "ON" (with the engine stopped). With fuel pressure applied to fuel piping, check that there is no fuel leakage at connection points.

NOTE: Use mirrors for checking at points out of clear sight.

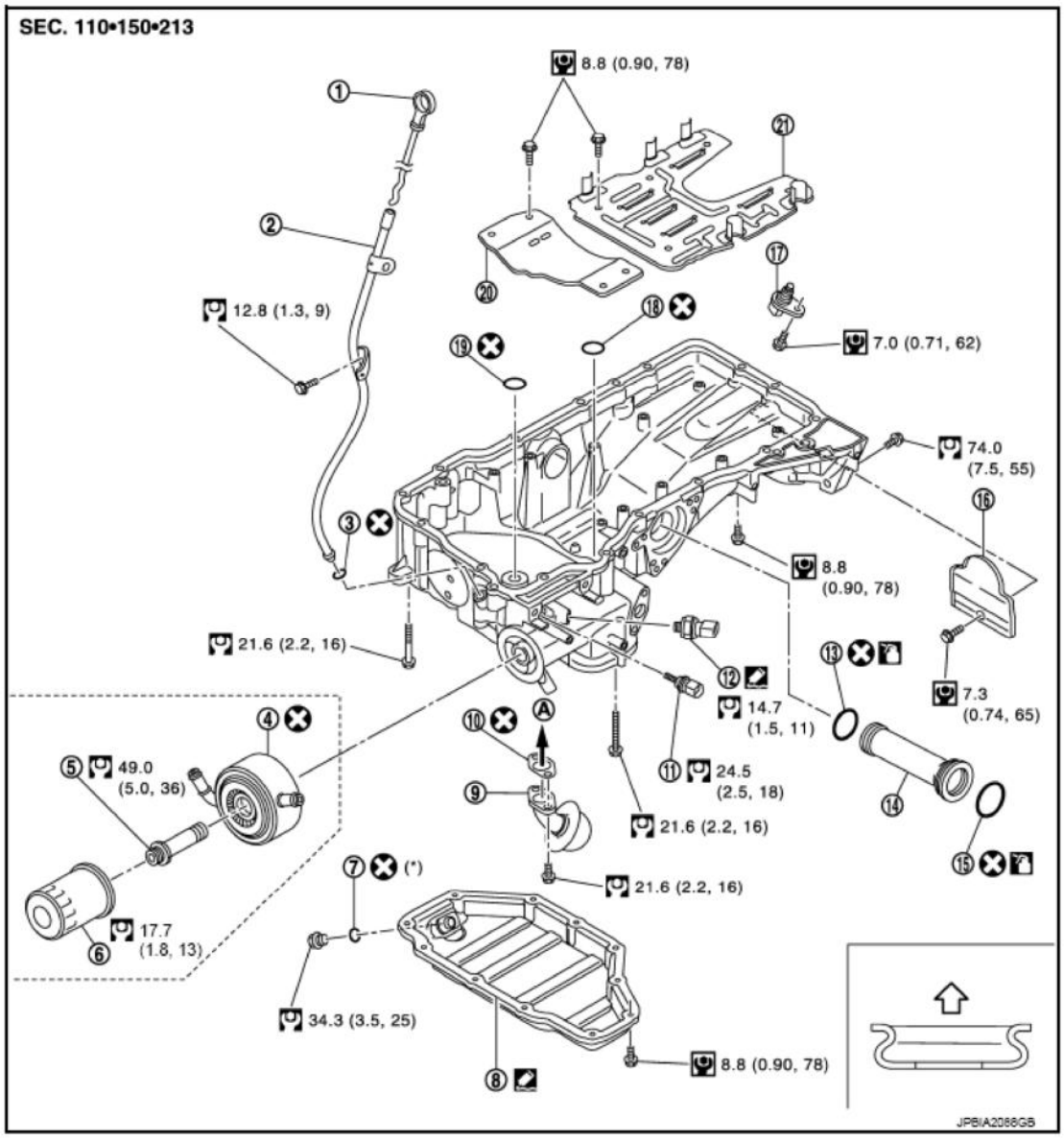
2. Start the engine. With engine speed increased, check again that there is no fuel leakage at connection points.

CAUTION: Never touch the engine immediately after it is stopped because the engine is extremely hot.

OIL PAN (LOWER) AND OIL STRAINER

Exploded View

Symbol	Description
	N·m (kg-m, ft-lb)
	N·m (kg-m, in-lb)
	Always replace after disassembly.



1. Oil level gauge
2. Oil level gauge guide
3. O-ring
4. Oil cooler
5. Connector bolt
6. Oil filter
7. Drain plug washer
8. Oil pan (lower)
9. Oil strainer
10. Gasket
11. Oil temperature sensor
12. Oil pressure switch
13. O-ring
14. Axle pipe
15. O-ring
16. Rear plate cover
17. Crankshaft position sensor (POS)
18. O-ring
19. O-ring
20. Baffle plate
21. Baffle plate

A. Oil pump side

⇦ : Oil pan side

Fig. 50: Exploded View Of Oil Pan (Lower) And Oil Strainer With Torque Specifications

Courtesy of NISSAN NORTH AMERICA, INC.

Refer to "**SYMBOLS** " for symbols in the figure.

Removal and Installation

REMOVAL

WARNING: To avoid the danger of being scalded, never drain engine oil when engine is hot.

1. Drain engine oil. Refer to "**DRAINING** ".
2. Remove oil pan (lower) as per the following:
   a. Loosen mounting bolts in reverse order as shown in the figure below, to remove.

⇦ : Engine front

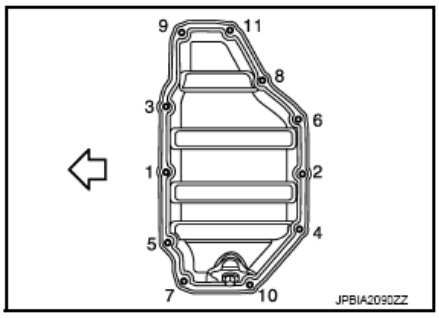


Fig. 51: Oil Pan (Lower) Mounting Bolts Tightening Sequence
Courtesy of NISSAN NORTH AMERICA, INC.

   b. Insert the seal cutter [SST: KV10111100 (J-37228)] (A) between oil pan (upper) and oil pan (lower).

CAUTION:
- **Be careful not to damage the mating surfaces.**
- **Never insert a screwdriver. This damages the mating surfaces.**

   c. Slide the seal cutter by tapping on the side of tool with a hammer. Remove oil pan (lower).

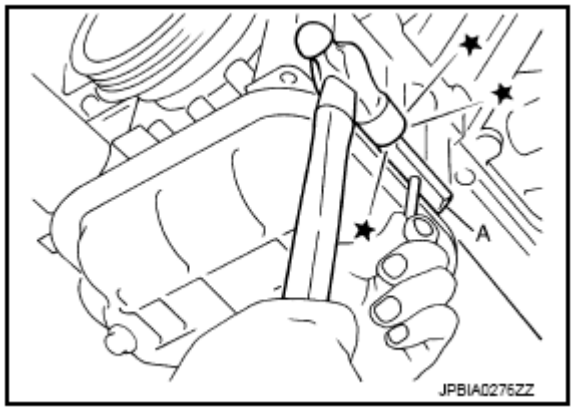


Fig. 52: Inserting Seal Cutter Between Oil Pan (Upper) And Oil Pan (Lower)
Courtesy of NISSAN NORTH AMERICA, INC.

3. Remove oil strainer.

INSTALLATION

CAUTION: Do not reuse drain plug washer.

1. Install oil strainer.
2. Install oil pan (lower) as per the following:
   a. Use scraper (A) to remove old liquid gasket from mating surfaces.
      - Remove old liquid gasket from the bolt holes and thread.

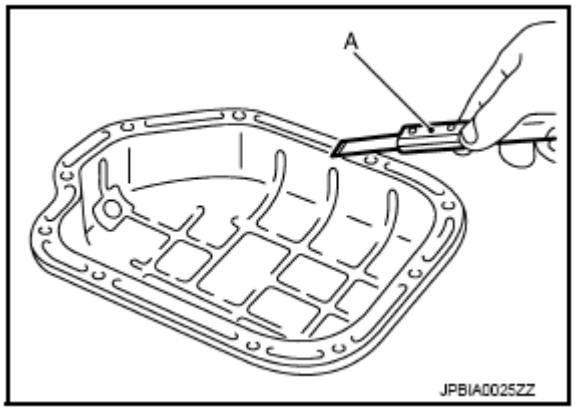


Fig. 53: Removing Liquid Gasket From Mating Surfaces Using Scraper
Courtesy of NISSAN NORTH AMERICA, INC.

CAUTION: Never scratch or damage the mating surfaces when cleaning off old liquid gasket.

b. Apply a continuous bead of liquid gasket with the tube presser (commercial service tool) to the oil pan (lower) as shown in the figure below.

a : 7.5 - 9.5 mm (0.295 - 0.374 in)
b : ϕ4.0 - 5.0 mm (0.157 - 0.197 in)
⇦ : Engine front

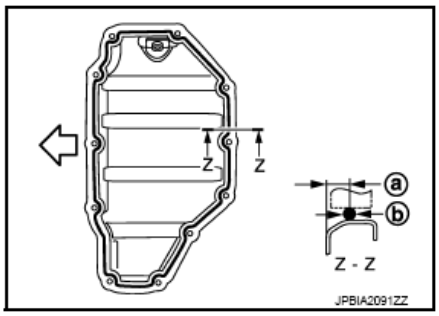


Fig. 54: Locating Liquid Gasket Application Area
Courtesy of NISSAN NORTH AMERICA, INC.

Use Genuine RTV Silicone Sealant or an equivalent. Refer to "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS ".

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

c. Install oil pan (lower).
- Tighten mounting bolts in numerical order as shown in the figure below.

⇦ : Engine front

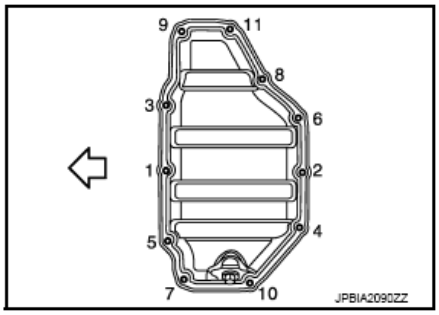


Fig. 55: Oil Pan (Lower) Mounting Bolts Tightening Sequence
Courtesy of NISSAN NORTH AMERICA, INC.

3. Install oil pan drain plug.

CAUTION: Do not reuse drain plug washer.

- Refer to the previous figure of the components for installation direction of drain plug washer. Refer to "**EXPLODED VIEW**".

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

NOTE: Wait at least 30 minutes after oil pan is installed before pouring engine oil.

Inspection

INSPECTION AFTER REMOVAL

Clean oil strainer if any object is attached.

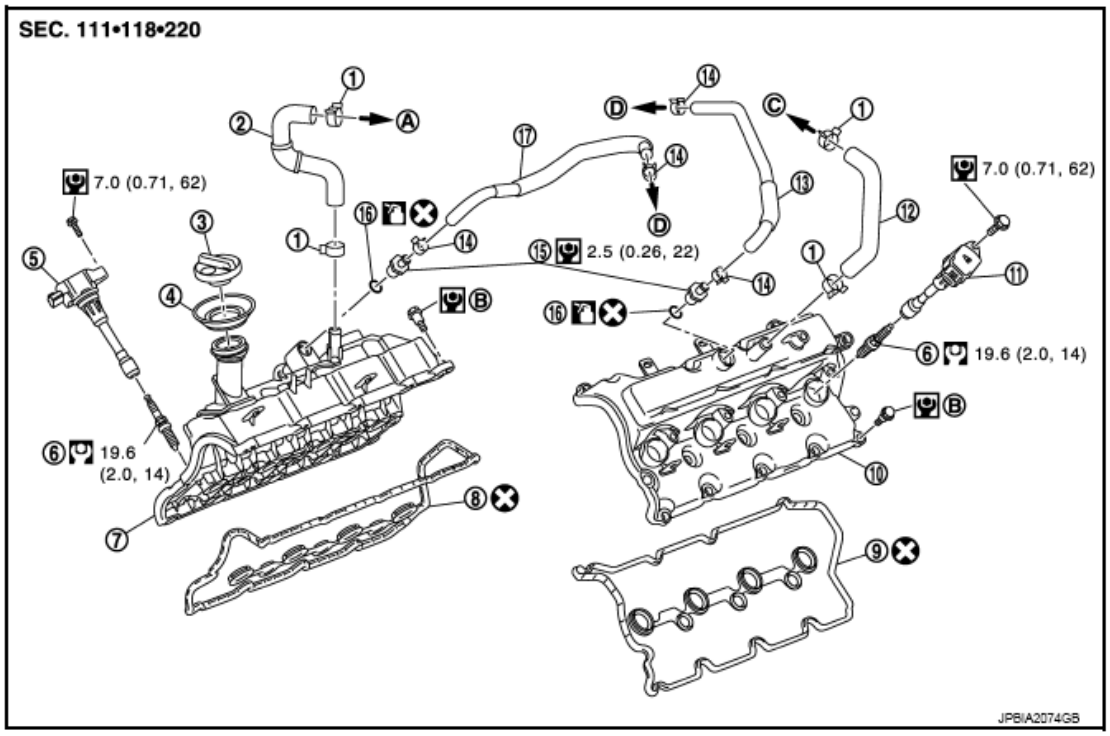
INSPECTION AFTER INSTALLATION

1. Check the engine oil level and adjust engine oil. Refer to "**INSPECTION** ".
2. Start engine, and check there is no leakage of engine oil.
3. Stop engine and wait for 15 minutes.
4. Check the engine oil level again. Refer to "**INSPECTION** ".

IGNITION COIL, SPARK PLUG AND ROCKER COVER

Exploded View

Symbol	Description
	N·m (kg-m, ft-lb)
	N·m (kg-m, in-lb)
	Always replace after disassembly.



1. Clamp
2. PCV hose
3. Oil filler cap
4. Oil catcher
5. Ignition coil (No. 1 - 6)
6. Spark plug
7. Rocker cover (bank 2)
8. Rocker cover gasket (bank 2)
9. Rocker cover gasket (bank 1)
10. Rocker cover (bank 1)
11. Ignition coil (No. 7, 8)
12. PCV hose
13. PCV hose
14. Clamp
15. PCV valve
16. O-ring
17. PCV hose
- A. To air duct (bank 2)
- B. Comply with the installation procedure when tightening.
- C. To air duct (bank 1)
- D. To intake manifold

Fig. 56: Exploded View Of Ignition Coil, Spark Plug And Rocker Cover With Torque Specifications
Courtesy of NISSAN NORTH AMERICA, INC.

Refer to "**SYMBOLS** " for symbols in the figure.

Removal and Installation

REMOVAL

1. Remove the following parts:
   - Engine cover and engine room cover (RH and LH): Refer to "**EXPLODED VIEW**".
   - Air cleaner case and air duct: Refer to "**EXPLODED VIEW**".
   - Fuel feed hose: Refer to "**EXPLODED VIEW**".

2. Disconnect PCV hose from rocker cover.
3. Remove ignition coil.

CAUTION: Never impact it.

NOTE: Installation position of Ignition coil depends on cylinder position.

4. Remove spark plugs. Refer to "**REMOVAL AND INSTALLATION**".

CAUTION: Never impact it.

5. Remove rocker cover.
   - Loosen bolts in reverse order shown in the figure below.

A : Bank 2
B : Bank 1
⇦ : Engine front

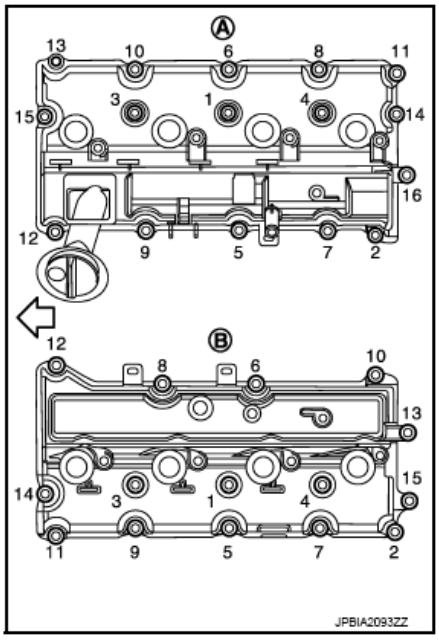


Fig. 57: Rocker Cover Mounting Bolts Tightening Sequence
Courtesy of NISSAN NORTH AMERICA, INC.

6. Remove rocker cover gasket from rocker cover.
7. Use scraper to remove all traces of liquid gasket from cylinder head & VVEL ladder assembly.

CAUTION: Never scratch or damage the mating surface when cleaning off old liquid gasket.

8. Remove PCV valve from rocker cover, if necessary.
9. Remove oil filler cap and oil catcher from rocker cover, if necessary.

INSTALLATION

CAUTION: Do not reuse O-rings.

1. Apply liquid gasket with the tube presser (commercial service tool) to VVEL ladder assembly (1) and actuator bracket (rear) (2).

3 : VVEL actuator sub assembly
A : Liquid gasket application point
F : End surface of VVEL ladder assembly
b : 4 mm (0.16 in)
c : 2.5 - 3.5 mm (0.098 - 0.138 in)
d : 5 mm (0.20 in)
e : 10 mm (0.39 in)
⇦ : Engine front

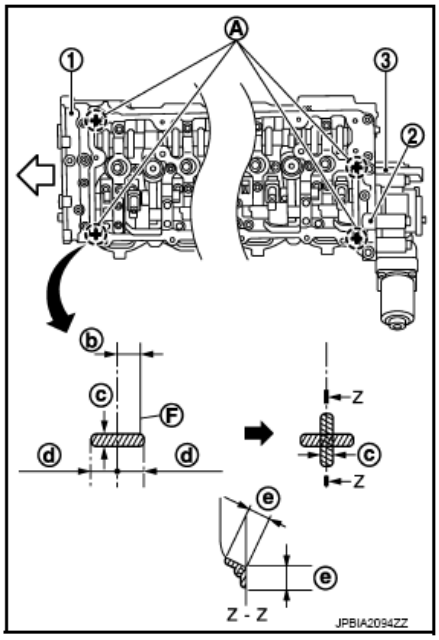


Fig. 58: Identifying Sealant Applying Dimension On VVEL Ladder Assembly And Actuator Bracket (Rear)
Courtesy of NISSAN NORTH AMERICA, INC.

Use Genuine RTV Silicone Sealant or an equivalent. Refer to "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS ".

NOTE: The figure shows an example of bank 1 side.

- Apply liquid gasket on the front and rear side of engine first. [5 mm (0.20 in) + 5 mm (0.20 in) side as shown in the figure below]

2. Install rocker cover gasket to rocker cover.
3. Install rocker cover.
   - Check that rocker cover gasket does not drop from the installation groove of rocker cover.
4. Tighten bolts in two steps separately in numerical order as shown in the figure below.

A : Bank 2
B : Bank 1
⇦ : Engine front

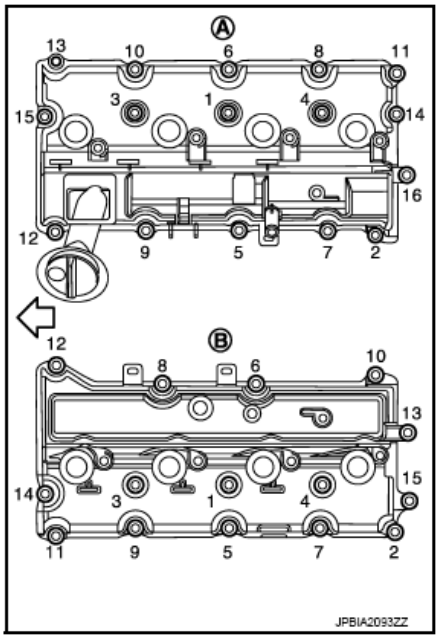


Fig. 59: Rocker Cover Mounting Bolts Tightening Sequence
Courtesy of NISSAN NORTH AMERICA, INC.

1st step: 2.0 N.m (0.2 kg-m, 18 in-lb)

2nd step: 8.3 N.m (0.85 kg-m, 73 in-lb)

- Because of the limited working space, use adapter (A) and torque wrench (B) assembly [SST: KV10119300 (-)] to tighten bolts (on the No. 7 and No. 8 cylinders) to the specified torque.

⇦ : ENgine front

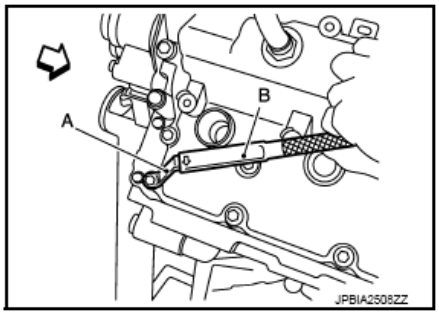


Fig. 60: Tightening Rocker Cover Mounting Bolts Using Tool
Courtesy of NISSAN NORTH AMERICA, INC.

5. Install spark plug. Refer to "**REMOVAL AND INSTALLATION**".
6. Install ignition coil.
   - Install Ignition coil marked with an identification mark (A) on cylinder No. 7 and 8.

⇦ : Engine front

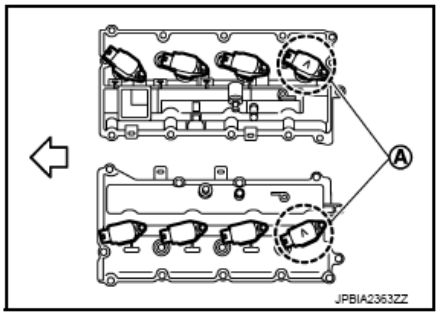


Fig. 61: Locating Ignition Coil Identification Marks
Courtesy of NISSAN NORTH AMERICA, INC.

7. Install in the reverse order of removal.

OIL SEAL

FRONT OIL SEAL

FRONT OIL SEAL: Removal and Installation

REMOVAL

1. Remove the following parts:
   - Engine undercover with power tool.
   - Drive belts: Refer to "**EXPLODED VIEW**".
   - Cooling fan assembly: Refer to "**EXPLODED VIEW** ".
   - Front cross bar: Refer to "**EXPLODED VIEW** ".
2. Remove crankshaft pulley as per the following:
   a. Remove rear plate cover. Refer to "**EXPLODED VIEW**".
   b. Set the ring gear stopper [SST: KV10119200 (J-49277)] (A) as shown in the figure below.

⇦ : Engine front

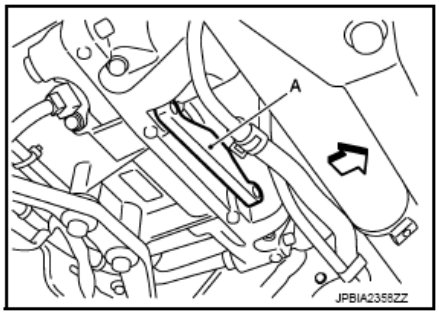


Fig. 62: Installing Ring Gear Stopper
Courtesy of NISSAN NORTH AMERICA, INC.

   c. Loosen crankshaft pulley bolt, and then pull crankshaft pulley with both hands to remove it.

CAUTION: Never remove crankshaft pulley bolt. Keep loosened crankshaft pulley bolt in place to protect removed crankshaft pulley from dropping.

3. Remove front oil seal using a suitable tool.

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

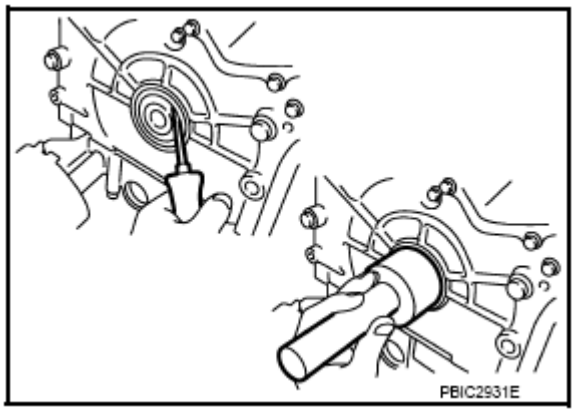


Fig. 63: Removing Front Oil Seal Using Suitable Tool
Courtesy of NISSAN NORTH AMERICA, INC.

INSTALLATION

1. Install front oil seal on front cover.
   - Apply new engine oil to both oil seal lip (A) and dust seal lip (B).
   - Install it so that each seal lip is oriented as shown in the figure below.

CAUTION: Be careful not to scratch or make burrs on circumference of oil seal.

   - Using a suitable drift [outer diameter: 56 mm (2.20 in)], press-fit oil seal until it becomes flush with front cover end face.
   - Check the garter spring is in position and seal lips are not inverted.

⇦ : Engine inside
⬅ : Engine outside

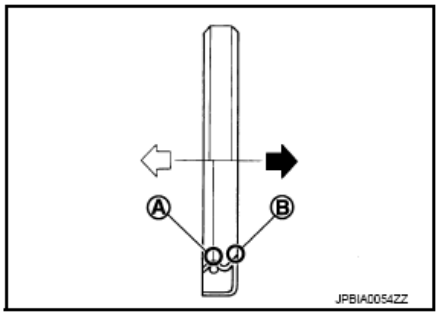


Fig. 64: Locating Oil And Dust Seal Lips
Courtesy of NISSAN NORTH AMERICA, INC.

2. Install in the reverse order of removal.

REAR OIL SEAL

REAR OIL SEAL: Removal and Installation

REMOVAL

1. Remove transmission assembly. Refer to "**EXPLODED VIEW** ".
2. Remove drive plate. Refer to "**EXPLODED VIEW**".
3. Remove rear oil seal with a suitable tool.

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

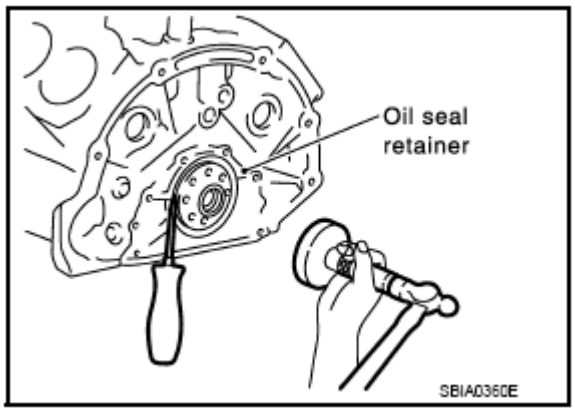


Fig. 65: Removing Rear Oil Seal Using Suitable Tool
Courtesy of NISSAN NORTH AMERICA, INC.

INSTALLATION

1. Install rear oil seal.
   - Install rear oil seal so that each seal lip is oriented as shown in the figure below.

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

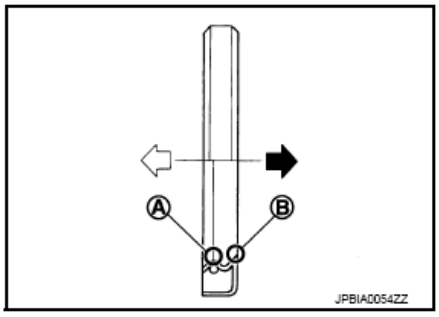


Fig. 66: Locating Oil And Dust Seal Lips
Courtesy of NISSAN NORTH AMERICA, INC.

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

B : Rear oil seal retainer rear end face
a : 0 - 0.5 mm (0 - 0.020 in)

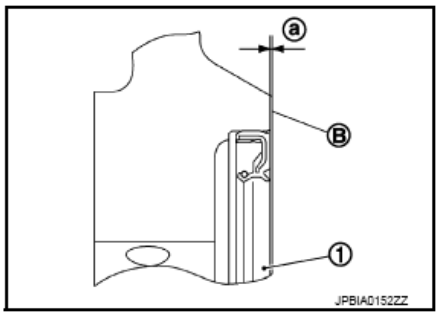


Fig. 67: Identifying Rear Oil Seal Installation Position
Courtesy of NISSAN NORTH AMERICA, INC.

- Using a suitable drift [outer diameter 101 mm (3.98 in)], press-fit until the height of rear oil seal is level with the mounting surface.
- Check the garter spring is in position and seal lips are not inverted.

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

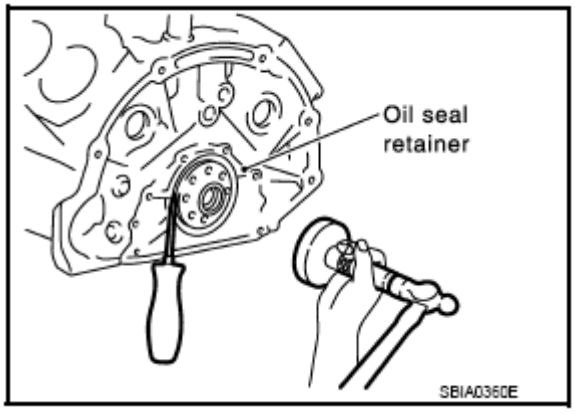


Fig. 68: Installing Rear Oil Seal Using Drift
Courtesy of NISSAN NORTH AMERICA, INC.

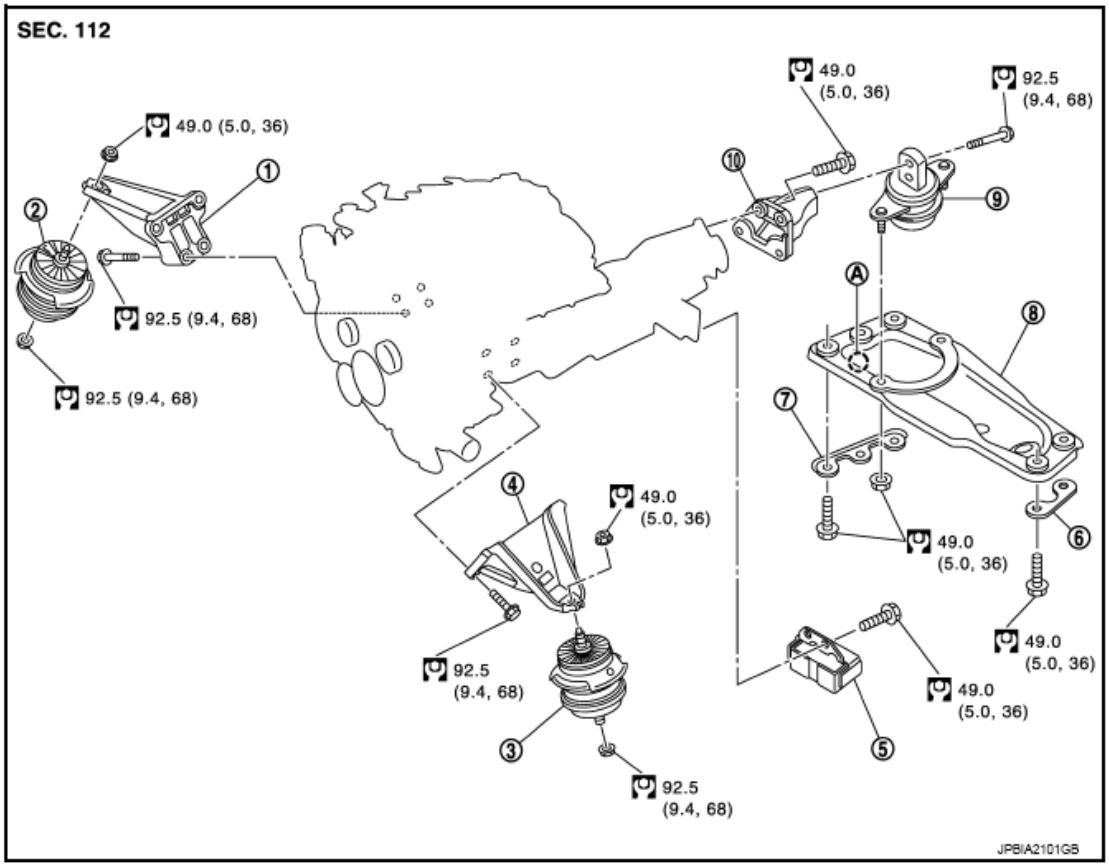
2. Install in the reverse order of removal after this step.

UNIT REMOVAL AND INSTALLATION

ENGINE ASSEMBLY

Exploded View

Symbol	Description
	N·m (kg-m, ft-lb)
	N·m (kg-m, in-lb)
	Always replace after disassembly.



1. Engine mounting bracket (RH)
2. Engine mounting insulator (RH)
3. Engine mounting insulator (LH)
4. Engine mounting bracket (LH)
5. Dynamic damper
6. Heat insulator (LH)
7. Heat insulator (RH)
8. Rear engine mounting member
9. Engine mounting insulator (rear)
10. Engine mounting bracket (rear)

A. Front mark

Fig. 69: Exploded View Of Engine Assembly With Torque Specifications
Courtesy of NISSAN NORTH AMERICA, INC.

Refer to "**SYMBOLS** " for symbols in the figure.

Removal and Installation

WARNING:

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

CAUTION:

- **Always be careful to work safely, and avoid forceful or uninstructed operations.**
- **Never start working until exhaust system and engine coolant are cool enough.**
- **If items or work required are not covered by the engine article, refer to the applicable articles.**
- **Always use the support point specified for lifting.**
- **Use either 2-pole lift type or separate type lift as much as possible. If board-on type is used for unavoidable reasons, support at rear axle jacking point with transmission jack or similar tool before starting work, in preparation for the backward shift of the center of gravity.**
- **For supporting points for lifting and jacking point at rear axle, refer to "GARAGE JACK AND SAFETY STAND AND 2-POLE LIFT ".**

NOTE:

- **When removing/installing only the engine mounting, the hold engine assembly as instructed bellow:**
- **When removing components such as hoses, tubes/lines, etc., cap or plug openings to prevent fluid from spilling.**

1. Remove food assembly. Refer to "**HOOD ASSEMBLY: EXPLODED VIEW** ".
2. Install engine slinger on both front right and front left sides of the engine.
3. Hoist the slinger to obtain room for engine assembly.

CAUTION: Use an engine lifter to prevent the engine slinger from falling and damaging the rocker cover.

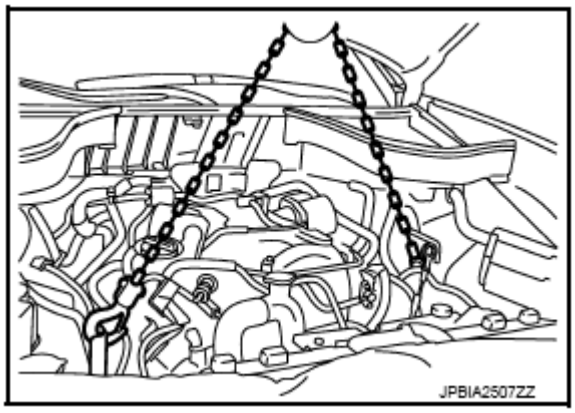


Fig. 70: Holding Engine Assembly Using Slinger
Courtesy of NISSAN NORTH AMERICA, INC.

REMOVAL

Outline

At first, remove the engine, transmission, transfer and front final drive assembly with front suspension member facing downward. Then separate the engine from transmission.

Preparation

1. Remove engine cover, engine room cover (RH and LH), battery cover and brake master cylinder cover. Refer to "**EXPLODED VIEW**".
2. Release fuel pressure. Refer to "**INSPECTION** ".
3. Remove the following parts:
   - Engine undercover (power tool)
   - Front road wheel and tires (power tool)
   - Cowl top cover: Refer to "**EXPLODED VIEW** ".
   - Air duct, air cleaner case assembly and PCV hose: Refer to "**EXPLODED VIEW**".
   - Drive belts: Refer to "**REMOVAL AND INSTALLATION**".
   - Front cross bar: Refer to "**EXPLODED VIEW** ".
4. Disconnect both battery cables. Refer to "**EXPLODED VIEW** ".
5. Drain engine coolant from radiator. Refer to "**DRAINING** ".

CAUTION: Perform this step when engine is cold.

6. Discharge refrigerant from A/C circuit. Refer to "**COLLECTION AND CHARGE** ".
7. Remove radiator hoses (upper and lower). Refer to "**EXPLODED VIEW** ".

Engine Room LH

1. Disconnect heater hose at engine side, and fit a plug onto hose end to prevent engine coolant leakage.
2. Disconnect A/C piping from A/C compressor, and temporarily fasten it on vehicle with a rope. Refer to "**EXPLODED VIEW** ".
3. Disconnect vacuum hose from brake booster. Refer to "**EXPLODED VIEW**".
4. Disconnect ground cable.

Engine Room RH

1. Disconnect all clips and connectors of the engine room harness from engine side.
2. Disconnect fuel feed hose and EVAP service port hose. Refer to "**EXPLODED VIEW**".

CAUTION: Fit plugs onto disconnected hoses to prevent fuel leakage.

3. Remove reservoir tank of power steering oil pump and piping from vehicle, and temporarily secure them on engine. Refer to "**VK50VE: EXPLODED VIEW** ".

CAUTION: When temporarily securing, keep the reservoir tank upright to avoid fluid leakage.

Vehicle Inside

Follow the procedure below to disconnect engine room harness connectors at passenger room side, and temporarily secure them on engine.

1. Remove glove box assembly and instrument assist lower panel. Refer to "**EXPLODED VIEW** ".
2. Disconnect engine room harness connectors at unit sides and other locations.
3. Disengage intermediate fixing point. Pull out engine room harnesses to engine room side, and temporarily secure them on engine.

CAUTION:

- **When pulling out harnesses, take care not to damage harnesses and connectors.**
- **After temporarily securing, cover connectors with vinyl or similar material to protect against adhesion of foreign materials.**

Vehicle Underbody

1. Remove A/T fluid cooler hoses and power steering oil pump oil cooler hoses.
2. Disconnect ground cable from exhaust manifold cover (bank 2).
3. Disconnect heated oxygen sensor 2 harness.
4. Remove three way catalyst and exhaust front tube. Refer to "**EXPLODED VIEW**" and "**EXPLODED VIEW** ".
5. Remove rear propeller shaft. Refer to "**EXPLODED VIEW** ".

6. Disconnect lower joint at power steering gear assembly side, and release lower shaft. Refer to "**WITHOUT ELECTRIC MOTOR: EXPLODED VIEW** " or "**WITH ELECTRIC MOTOR: EXPLODED VIEW** ".
7. Disengage A/T control rod at A/T shift selector side. Then, temporarily secure it on the transmission assembly, so that it does not sag. Refer to "**EXPLODED VIEW** ".
8. Preparation for the separation work of transaxle is as per the following:
   - Remove rear plate cover from oil pan (upper). Then remove bolts fixing drive plate to torque converter. Refer to "**EXPLODED VIEW**".
   - Remove transmission joint bolts that pierce at oil pan (upper) lower rear side. Refer to "**EXPLODED VIEW**".
9. Remove front stabilizer connecting rod. Refer to "**EXPLODED VIEW** ".
10. Remove front wheel sensor for ABS from steering knuckle. Refer to "**FRONT WHEEL SENSOR: EXPLODED VIEW** ".
11. Remove brake caliper assembly with piping connected from steering knuckle. Temporarily secure it on the vehicle side with a rope to avoid load on it. Refer to "**BRAKE CALIPER ASSEMBLY (4 PISTON TYPE): EXPLODED VIEW** ".
12. Separate upper link from steering knuckle. Refer to "**EXPLODED VIEW** ".
13. Separate shock absorber from transverse link. Refer to "**EXPLODED VIEW** ".

Removal Work

1. Use a manual lift table caddy (commercial service tool) or an equivalently rigid tool such as a transmission jack. Securely support bottom of suspension member and the transmission assembly.

CAUTION: Use a piece of wood or a similar item as the supporting surface to secure a completely stable condition.

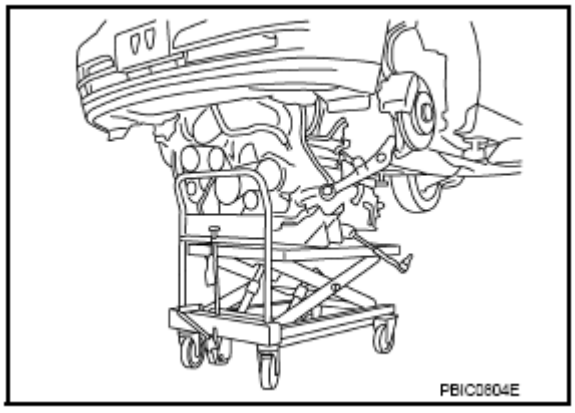


Fig. 71: Supporting Bottom Of Suspension Member And Transmission Assembly Using Transmission Jack
Courtesy of NISSAN NORTH AMERICA, INC.

2. Loosen rear engine mounting member mounting bolts.

3. Loosen front suspension member mounting bolts. Refer to "**EXPLODED VIEW** ".
4. Carefully lower jack, or raise lift, to remove the engine, the transmission assembly and front suspension member. When performing work, observe the following caution items:

CAUTION:
- **Confirm there is no interference with the vehicle.**
- **Check that all connection points have been disconnected.**
- **Keep in mind that the center of gravity of the vehicle changes. If necessary, use jack(s) to support the vehicle at rear jacking point(s) to prevent it from falling off the lift.**

Separation Work

1. Install engine slingers into front of cylinder head (bank 1) and rear of cylinder head (bank 2).

1 : Engine front slinger (bank 1)
2 : Engine rear slinger (bank 2)
⇦ : Engine front

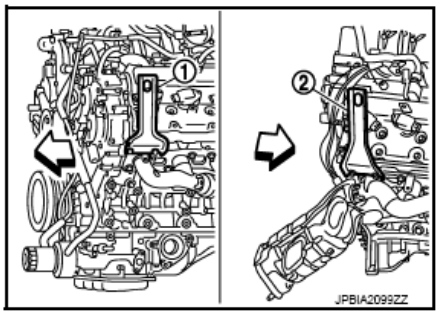


Fig. 72: Identifying Engine Front And Rear Slinger
Courtesy of NISSAN NORTH AMERICA, INC.

Slinger bolts:

Torque Value: 45.0 N.m (4.6 kg-m, 33 ft-lb)

2. Hang the lifting hook of a two-point engine lifter (commercial service tool) (A) from the front and rear engine slingers to hoist engine and flywheel housing assembly.
   - For the flywheel housing side, use a webbing slinger (B) or an equivalent to hoist the assembly horizontally.

CAUTION: Always hoist the engine by using a two-point engine lifter (i.e. hoisting the front and rear slingers from one point in the air), or the rocker cover and parts around the engine may be damaged due to the fall of the engine slinger.

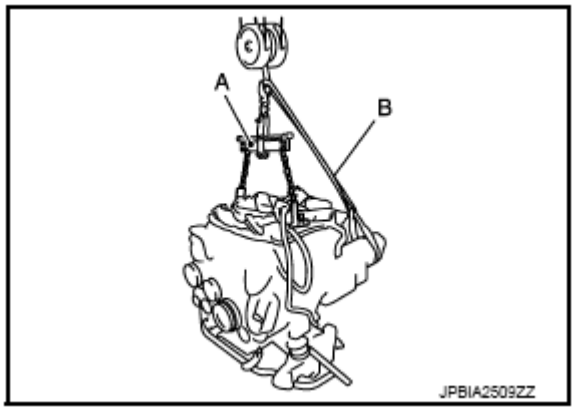


Fig. 73: Hoisting Engine From Slingers
Courtesy of NISSAN NORTH AMERICA, INC.

3. Remove power steering oil pump from engine side. Refer to "**VK50VE: EXPLODED VIEW** ".
4. Remove engine mounting insulators (RH and LH) under side nuts with power tool.
5. Lift with hoist and separate the engine, transmission, transfer and front final drive assembly from front suspension member.

CAUTION:
- **Before and during this lifting, always check that any harnesses are left connected.**
- **Never damage engine mounting insulator and avoid oil/grease smearing or spills onto engine mounting insulator.**

6. Remove alternator. Refer to "**VK50VE: EXPLODED VIEW** ".
7. Separate the engine from the transmission assembly. Refer to "**EXPLODED VIEW** ".
8. Remove front propeller shaft. Refer to "**VK50VE: EXPLODED VIEW** ".
9. Remove the front final drive assembly from oil pan (upper). Refer to "**VK50VE: EXPLODED VIEW** ".
10. Remove each engine mounting insulator and each engine mounting bracket from the engine with power tool.

INSTALLATION

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

- Do not allow engine mounting insulator to be damage and careful no engine oil gets on it.
- For a location with a positioning pin, insert it securely into hole of matching part.
- For a part with a specified installation orientation, refer to component figure in "**EXPLODED VIEW**".
- When installing engine mounting bracket (RH and LH) on cylinder block, tighten two upper bolts (A) first. Then tighten two lower bolts (B).

⇦: Engine front

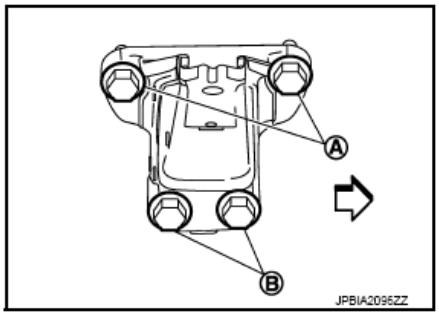


Fig. 74: Engine Mounting Bracket (RH And LH) Upper And Lower Bolts With Tightening Sequence
Courtesy of NISSAN NORTH AMERICA, INC.

NOTE: This figure shows an example of bank 2.

- When installing engine mounting bracket (rear) on transfer, tighten two upper bolts (B) first. Then tighten two lower bolts (C).

A : Rear view

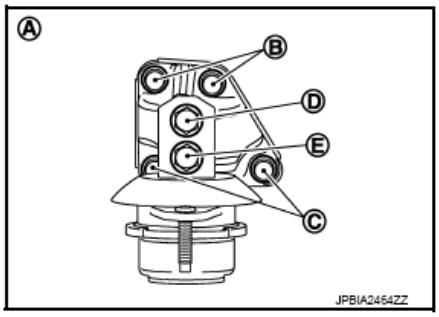


Fig. 75: Rear Engine Mounting Member Bolts With Tightening Sequence
Courtesy of NISSAN NORTH AMERICA, INC.

- When installing engine mounting insulator (rear) on engine mounting bracket (rear), tighten upper bolts (D) first. Then tighten lower bolts (E).
- Tighten rear engine mounting member bolts in numerical order as shown in the figure below.

⇦: Vehicle front

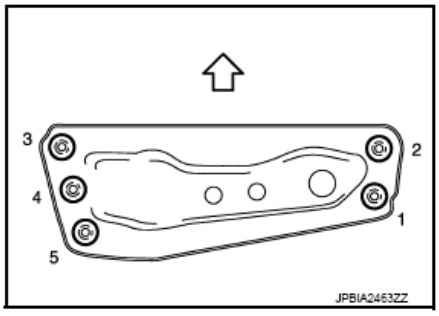


Fig. 76: Rear Engine Mounting Member Bolts With Tightening Sequence
Courtesy of NISSAN NORTH AMERICA, INC.

- Check that all engine mounting insulators are seated properly, then tighten mounting nuts and bolts.

Inspection

INSPECTION AFTER INSTALLATION

Inspection for Leakage

The following are procedures for checking fluid leakage, lubricant leakage.

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

NOTE: If hydraulic pressure inside chain tensioner drops after removal/installation, slack in guide may generate a pounding noise during and just after the engine start. However, this does not indicate a malfunction. The noise will stop after hydraulic pressure rises.

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

SUMMARY OF INSPECTION ITEMS

Items		Before starting engine	Engine running	After engine stopped
Engine coolant		Level	Leakage	Level
Engine oil		Level	Leakage	Level
Transmission/transaxle fluid	A/T and CVT models	Level	Level/Leakage	Level
	M/T models	Level/Leakage	Level	Level/Leakage
Other oils and fluid(1)		Level	Leakage	Level
Fuel		Leakage	Leakage	Leakage
Exhaust gases		-	Leakage	-
(1) Power steering fluid, brake fluid, etc.				

UNIT DISASSEMBLY AND ASSEMBLY

ENGINE STAND SETTING

Setting

NOTE: Explained here is how to disassemble with engine stand supporting transmission surface. When using a different type of engine stand, note the difference in the steps, etc.

1. Remove the engine assembly from the vehicle. Refer to "**EXPLODED VIEW**".
2. Remove crankshaft pulley. Refer to "**FRONT OIL SEAL: REMOVAL AND INSTALLATION**".

NOTE: The drive plate is fixed with a ring gear stopper [SST: KV10119200 (J-49277)]. Loosen the crankshaft pulley mounting bolts before installing the engine stand.

3. Remove the parts that may restrict installation of engine to a widely used engine stand.
   - Fix crankshaft with a ring gear stopper [SST: KV10119200 (J-49277)]. Loosen drive plate mounting bolt with power tool.
   - Check for deformation or damage of drive plate. Refer to "**INSPECTION**".

NOTE: The procedure is described assuming that you use a widely used engine stand holding the surface, to which transmission is installed.

4. Remove pilot converter using the pilot bushing puller (commercial service tool), if necessary.
5. Lift the engine with hoist to install it onto the widely used engine stand.

CAUTION: Use an engine stand that has a load capacity [240 kg (529 lb) or more] large enough for supporting the engine weight.

- If the load capacity of the stand is not adequate, remove the following parts beforehand to reduce the potential risk of overturning the stand.
  - Remove intake manifold. Refer to "**EXPLODED VIEW**".
  - Remove fuel injector and fuel tube assembly. Refer to "**EXPLODED VIEW**".
  - Remove ignition coil. Refer to "**EXPLODED VIEW**".
  - Remove rocker cover. Refer to "**EXPLODED VIEW**".
  - Remove exhaust manifold. Refer to "**EXPLODED VIEW**".
  - Other removable brackets.

NOTE: The figure shows an example of widely used engine stand (A) that can hold mating surface of transmission with drive plate removed.

CAUTION: Before removing the hanging chains, check the engine stand is stable and there is no risk of overturning.

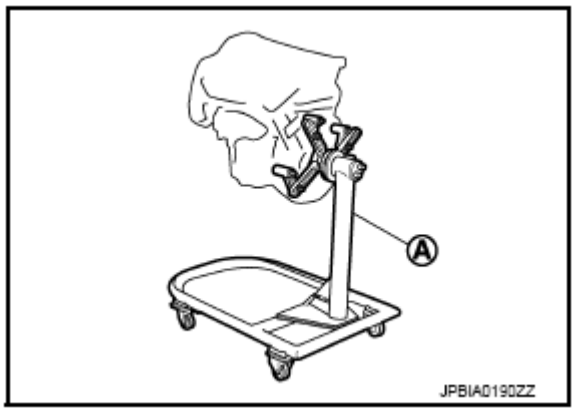


Fig. 77: Mounting Engine On Engine Stand
Courtesy of NISSAN NORTH AMERICA, INC.

6. Drain engine oil. Refer to "**DRAINING** ".
7. Drain engine coolant by removing water drain plug (3) from both sides of the cylinder block as shown in the figure below.

Symbol	Description
	N·m (kg-m, ft-lb)
	N·m (kg-m, in-lb)
	Always replace after disassembly.

1 : Washer
2 : Plug
4 : Plug
5 : Washer
⇦ : Engine front

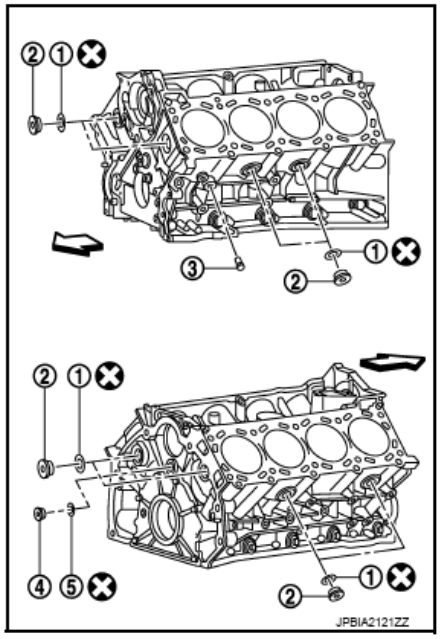


Fig. 78: Locating Drain Plugs And Washers On Cylinder Block
Courtesy of NISSAN NORTH AMERICA, INC.

ENGINE UNIT

Disassembly

1. Remove intake manifold. Refer to "**EXPLODED VIEW**".
2. Remove exhaust manifold. Refer to "**EXPLODED VIEW**".
3. Remove oil pan (lower). Refer to "**EXPLODED VIEW**".
4. Remove ignition coil, spark plug and rocker cover. Refer to "**EXPLODED VIEW**".
5. Remove timing chain. Refer to "**EXPLODED VIEW**".
6. Remove camshaft (EXH) and VVEL ladder assembly. Refer to "**EXPLODED VIEW**".
7. Remove cylinder head. Refer to "**EXPLODED VIEW**".

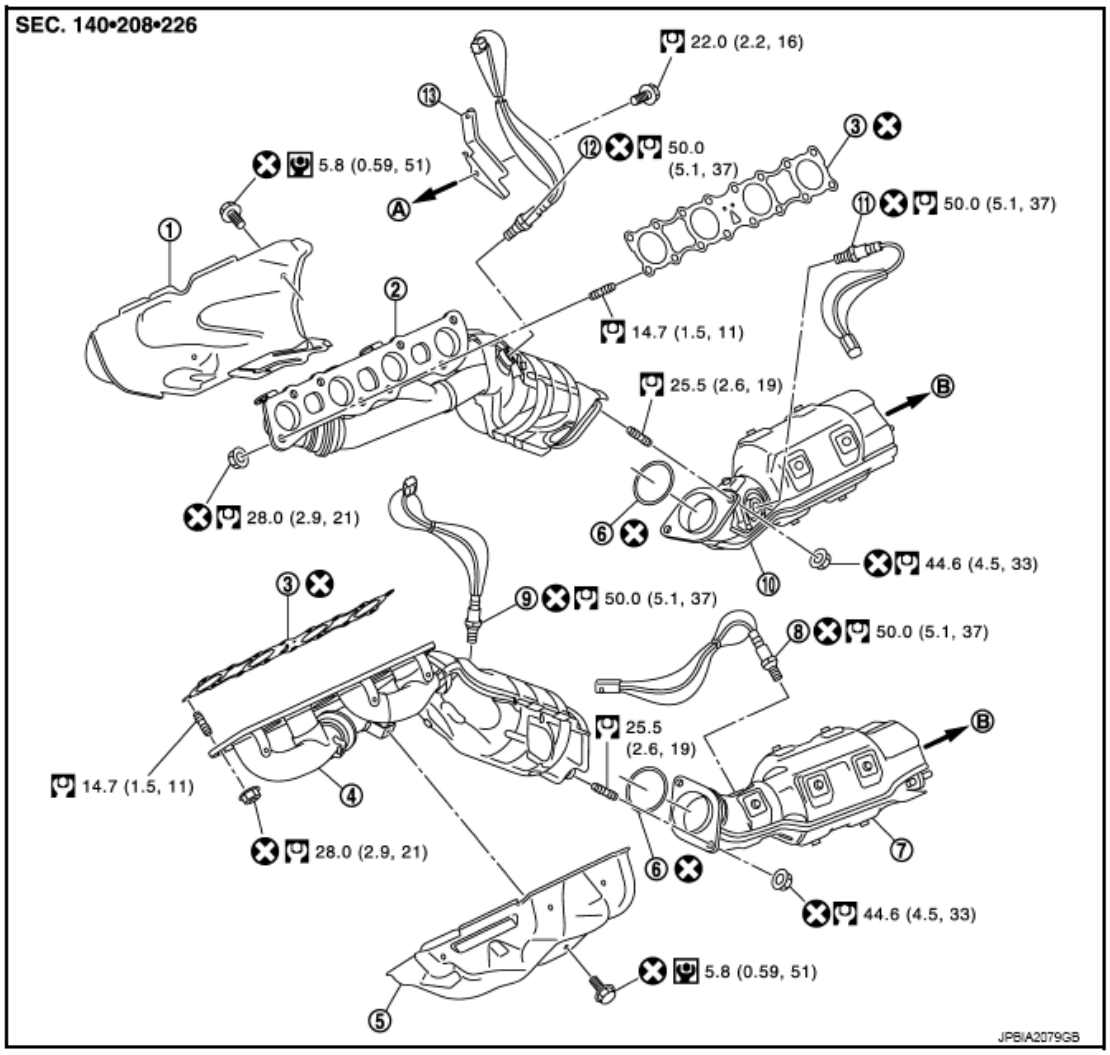
Assembly

Assemble in the reverse order of disassembly.

EXHAUST MANIFOLD AND THREE WAY CATALYST

Exploded View

Symbol	Description
	N·m (kg-m, ft-lb)
	N·m (kg-m, in-lb)
	Always replace after disassembly.



1.	Exhaust manifold cover (bank 2)	2.	Exhaust manifold (bank 2)	3.	Gasket
4.	Exhaust manifold (bank 1)	5.	Exhaust manifold cover (bank 1)	6.	Gasket
7.	Three way catalyst (bank 1)	8.	Heated oxygen sensor 2 (bank 1)	9.	Air fuel ratio sensor 1 (bank 1)
10.	Three way catalyst (bank 2)	11.	Heated oxygen sensor 2 (bank 2)	12.	Air fuel ratio sensor 1 (bank 2)
13.	Harness bracket				
A.	To cylinder head (bank 2)	B.	To exhaust front tube		

Fig. 79: Exploded View Of Exhaust Manifold And Three Way Catalyst With Torque Specifications
Courtesy of NISSAN NORTH AMERICA, INC.

Refer to "**SYMBOLS** " for symbols in the figure.

Disassembly and Assembly

DISASSEMBLY

1. Remove heated oxygen sensor 2.

CAUTION: Heated oxygen sensor 2 is not reusable. Never remove heated oxygen sensor 2 unless this is required.

- Using the heated oxygen sensor wrench [SST: KV10114400 (J-38365)] (A), remove heated oxygen sensor 2 (1).

NOTE:
- **The heated oxygen sensor 2 is removable under vehicle-mounted condition.**
- **The figure shows an example of bank 1.**

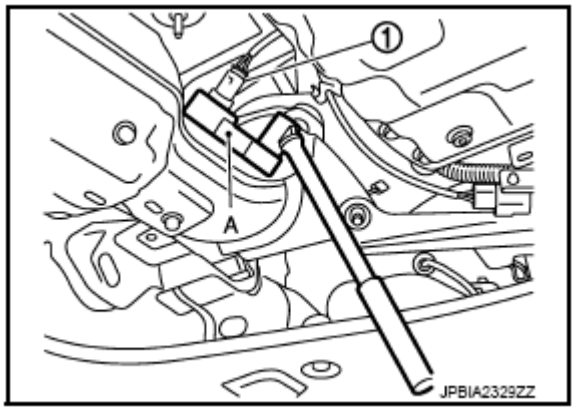


Fig. 80: Removing Heated Oxygen Sensor 2 Using Heated Oxygen Sensor Wrench
Courtesy of NISSAN NORTH AMERICA, INC.

2. Remove three way catalyst (bank 1 and bank 2).
3. Remove air fuel ratio sensor 1 as per the following:

CAUTION: Air fuel ratio sensor 1 is not reusable. Never remove air fuel ratio sensor 1 unless this is required.

- Using the heated oxygen sensor wrench [SST: KV10114400 (J-38365)], remove air fuel ratio sensor 1.

NOTE: The air fuel ration sensor 1 is removable under vehicle-mounted condition.

4. Remove exhaust manifold.
   - Loosen nuts in the reverse order of figure to remove exhaust manifold with power tool.

A : Bank 1
B : Bank 2
⇦ : Engine front

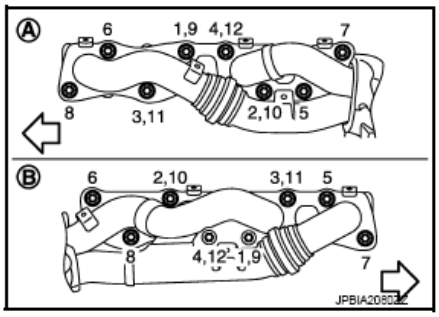


Fig. 81: Exhaust Manifold Mounting Nuts Tightening Sequence
Courtesy of NISSAN NORTH AMERICA, INC.

NOTE: Disregard No. 9 to No. 12 when loosening.

5. Remove exhaust manifold gaskets.

CAUTION: Cover engine openings to avoid entry of foreign materials.

ASSEMBLY

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

Exhaust Manifold Gasket

- Install exhaust manifold gasket in directional shown in the figure below.

A : Triangle press
⇦ : Above

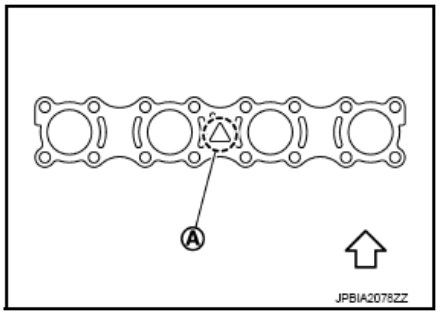


Fig. 82: Identifying Exhaust Manifold Gasket Triangle Press
Courtesy of NISSAN NORTH AMERICA, INC.

Exhaust Manifold

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

A : Bank 1
B : Bank 2
⇦ : Engine front

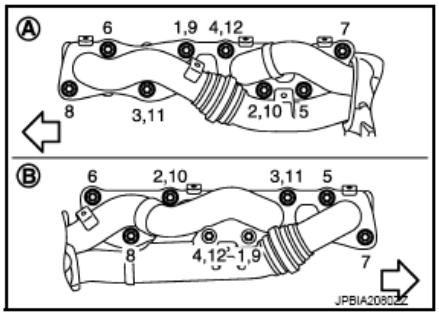


Fig. 83: Exhaust Manifold Mounting Nuts Tightening Sequence
Courtesy of NISSAN NORTH AMERICA, INC.

NOTE: **Tighten mounting nuts No. 1 to 4 in two steps. The numerical order No. 9 to 12 shown second steps.**

Air Fuel Ratio Sensor 1, Heated Oxygen Sensor 2

CAUTION:

- **Before installing a new sensors, clean exhaust system threads using oxygen sensor thread cleaner (commercial service tool: J-43897-18 or 43897-12), and apply anti-seize lubricant (commercial service tool).**
- **Sensors are not reusable. Replace them with a new one after removal. When replacing them, handle with care not to impact on them.**
- **When installing the new sensors, set the heated oxygen sensor wrenc [SST: KV10114400 (J-38365)] (A) in the hexagonal part to tighten the th**
- **Prevent rust preventatives from coating the sensor body.**

1 : Heated oxygen sensor 2 (bank 1)

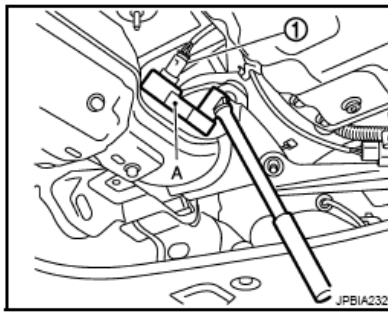


Fig. 84: Removing Heated Oxygen Sensor 2 Using Heated Oxygen Sen Wrench
Courtesy of NISSAN NORTH AMERICA, INC.

- **Never over torque sensors. Doing so may cause damage to the sensor resulting in "MIL" coming on.**

Inspection

INSPECTION AFTER DISASSEMBLY

Surface Distortion

- Check the surface distortion of the exhaust manifold mating surface with a straightedge (A) and a feeler gauge (B).

  Limit: Refer to "EXHAUST MANIFOLD".

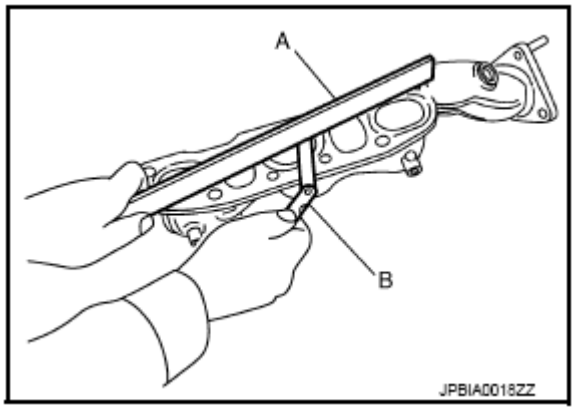


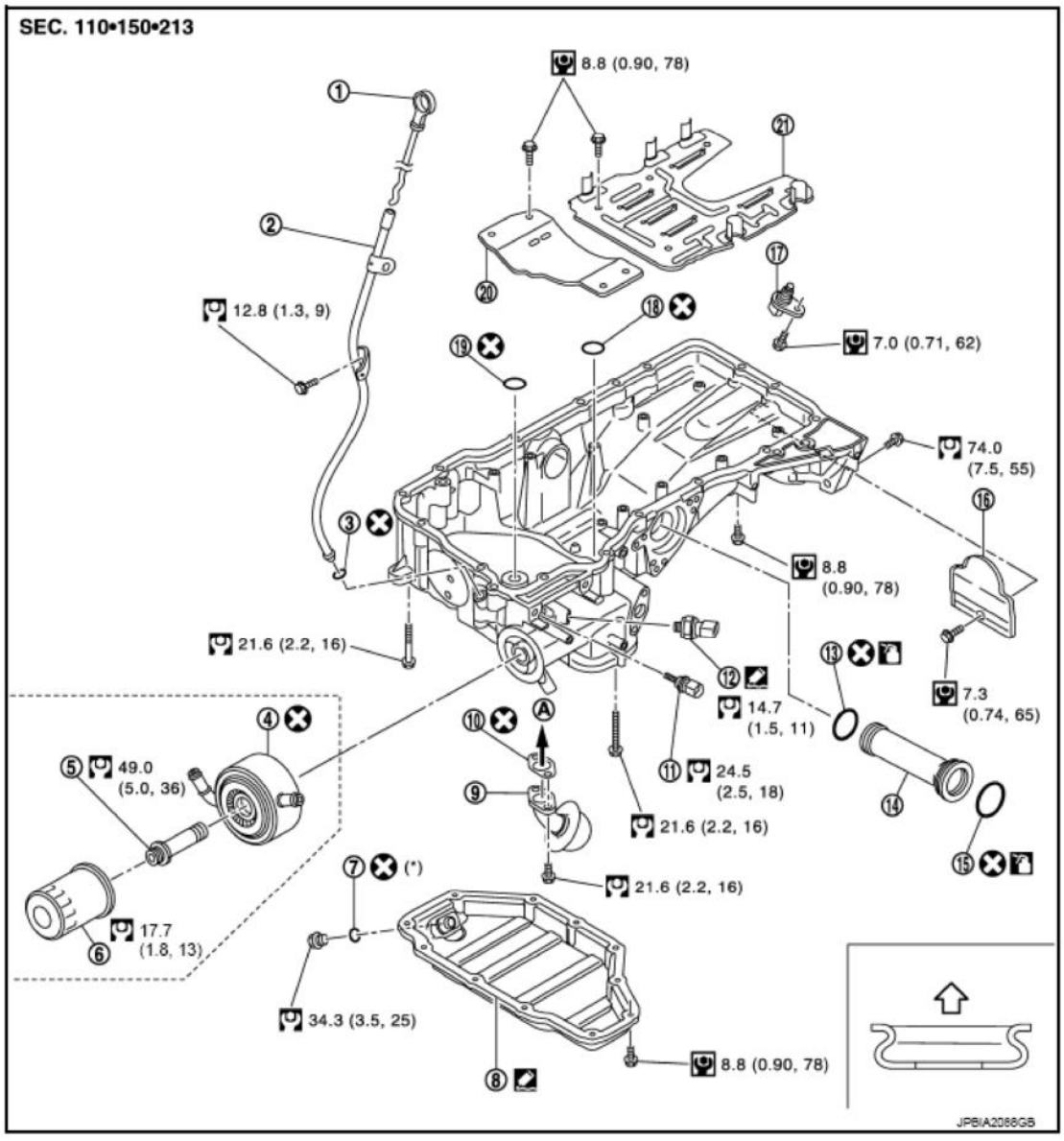
Fig. 85: Checking Surface Distortion Of Exhaust Manifold Mating Surface Using Straightedge And Feeler Gauge
Courtesy of NISSAN NORTH AMERICA, INC.

- If it exceeds the limit, replace exhaust manifold.

OIL PAN (UPPER)

Exploded View

Symbol	Description
	N·m (kg-m, ft-lb)
	N·m (kg-m, in-lb)
	Always replace after disassembly.



1. Oil level gauge
2. Oil level gauge guide
3. O-ring
4. Oil cooler
5. Connector bolt
6. Oil filter
7. Drain plug washer
8. Oil pan (lower)
9. Oil strainer
10. Gasket
11. Oil temperature sensor
12. Oil pressure switch
13. O-ring
14. Axle pipe
15. O-ring
16. Rear plate cover
17. Crankshaft position sensor (POS)
18. O-ring
19. O-ring
20. Baffle plate
21. Baffle plate

A. Oil pump side

⇦ : Oil pan side

Fig. 86: Exploded View Of Oil Pan (Upper) With Torque Specifications

Courtesy of NISSAN NORTH AMERICA, INC.

Refer to "**SYMBOLS** " for symbols in the figure.

Disassembly and Assembly

DISASSEMBLY

WARNING: To avoid the danger of being scalded, never drain engine oil when engine is hot.

1. Remove oil filter. Refer to "**REMOVAL AND INSTALLATION** ".
2. Remove oil cooler. Refer to "**EXPLODED VIEW** ".
3. Remove A/C compressor and A/C compressor bracket. Refer to "**EXPLODED VIEW** " and "**EXPLODED VIEW**".
4. Remove oil level gauge and oil level gauge guide.
5. Remove oil pressure switch and oil temperature sensor if necessary.
6. Remove rear plate cover.
7. Remove oil pan (lower). Refer to "**EXPLODED VIEW**".
8. Remove oil strainer. Refer to "**EXPLODED VIEW**".
9. Remove oil pan (upper) as per the following:
   a. Loosen mounting bolts in the reverse order as shown in the figure below with power tool to remove.

⇦ : Engine front

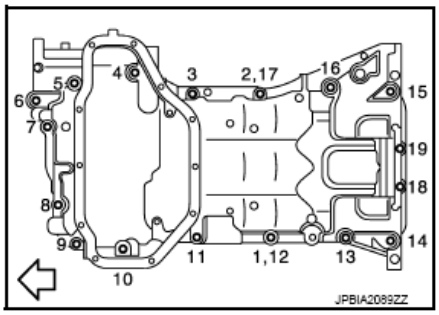


Fig. 87: Oil Pan (Upper) Mounting Bolts Tightening Sequence
Courtesy of NISSAN NORTH AMERICA, INC.

NOTE: Disregard No. 12, 17 when loosening.

   b. Insert a suitable tool into the notch at oil pan (upper) (1) as shown below.
      - Pry off case by moving a suitable tool.

⇦ : Engine front

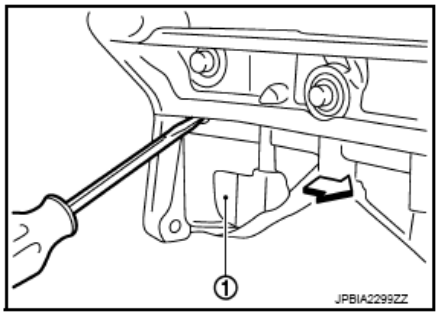


Fig. 88: Removing Oil Pan (Upper) Case Using Tool
Courtesy of NISSAN NORTH AMERICA, INC.

CAUTION: Be careful not to damage the mating surfaces.

10. Remove O-ring from bottom of cylinder block and oil pump.
11. Remove baffle plate, if necessary.
12. Remove axle pipe from oil pan (upper), if necessary.
    - Pull axle pipe from oil pan (upper) using a suitable drift.

ASSEMBLY

CAUTION: Do not reuse O-rings.

1. Install axle pipe (1) to oil pan (upper), if removed.

CAUTION: Do not reuse O-rings.

Symbol	Description
	N·m (kg-m, ft-lb)
	N·m (kg-m, in-lb)
	Always replace after disassembly.

2 : O-ring
3 : O-ring (with identification paint)
A : Front final drive side
B : Drive shaft (LH) side

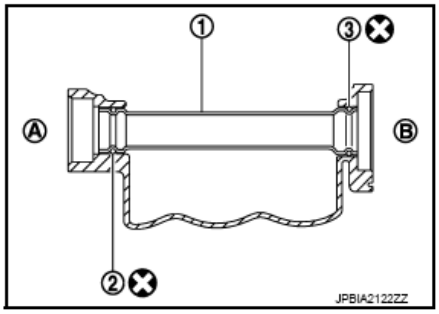


Fig. 89: Installing Oil Pan (Upper) Axle Pipe

Courtesy of NISSAN NORTH AMERICA, INC.

- Lubricate O-ring groove of axle pipe, O-ring, and O-ring joint of oil pan with new engine oil.
- Install axle pipe to oil pan (upper) from drive shaft (LH) side.

CAUTION: Insert it with care to prevent O-ring from sliding.

2. Install oil pan (upper) as per the following:
   a. Use a scraper (A) to remove old liquid gasket from mating surfaces.
      - Also remove the old liquid gasket from mating surface of cylinder block.
      - Remove old liquid gasket from the bolt holes and threads.

CAUTION: Never scratch or damage the mating surfaces when cleaning off old liquid gasket.

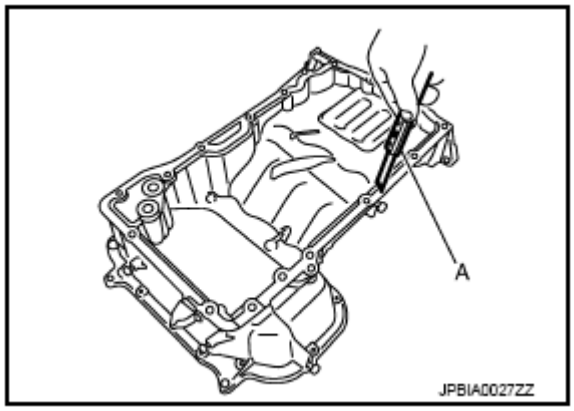


Fig. 90: Removing Liquid Gasket From Mating Surfaces Using Scraper
Courtesy of NISSAN NORTH AMERICA, INC.

   b. Install new O-rings on the bottom of cylinder block and oil pump.

CAUTION: Do not reuse O-rings.

   c. Apply a continuous bead of liquid gasket with tube presser (commercial service tool) to the cylinder block mating surfaces of oil pan (upper) to a limited portion as shown in the figure below.

a : 5.5 - 7.5 mm (0.217 - 0.295 in)
b : ϕ4.0 - 5.0 mm (0.157 - 0.197 in)
⇦ : Engine front

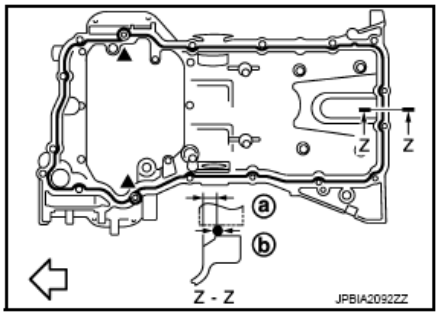


Fig. 91: Liquid Gasket Application Area
Courtesy of NISSAN NORTH AMERICA, INC.

Use Genuine RTV Silicone Sealant or an equivalent. Refer to "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS ".

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

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

⇦ : Engine front

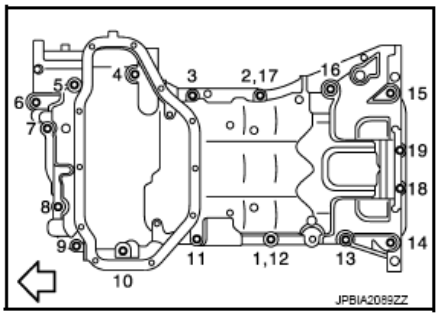


Fig. 92: Oil Pan (Upper) Mounting Bolts Tightening Sequence
Courtesy of NISSAN NORTH AMERICA, INC.

CAUTION: Install avoiding misalignment of O-rings.

NOTE: Tighten mounting bolts No. 1 and 2 in two steps. The numerical order No. 12 and 17 shown second steps.

- There are three types of mounting bolts. Refer to the following for locating bolts.

  M6 x 30 mm. (1.18 in): 18, 19

  M8 x 100 mm (3.94 in): 3, 4, 5, 7, 10, 11, 14, 15

  M8 x 45 mm (1.77 in): Except the above

e. Tighten transmission joint bolts.
f. Install rear plate cover.

3. Install oil strainer.
4. Install oil pan (lower). Refer to "**REMOVAL AND INSTALLATION**".
5. Install in the reverse order of removal.

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

Inspection

INSPECTION AFTER DISASSEMBLY

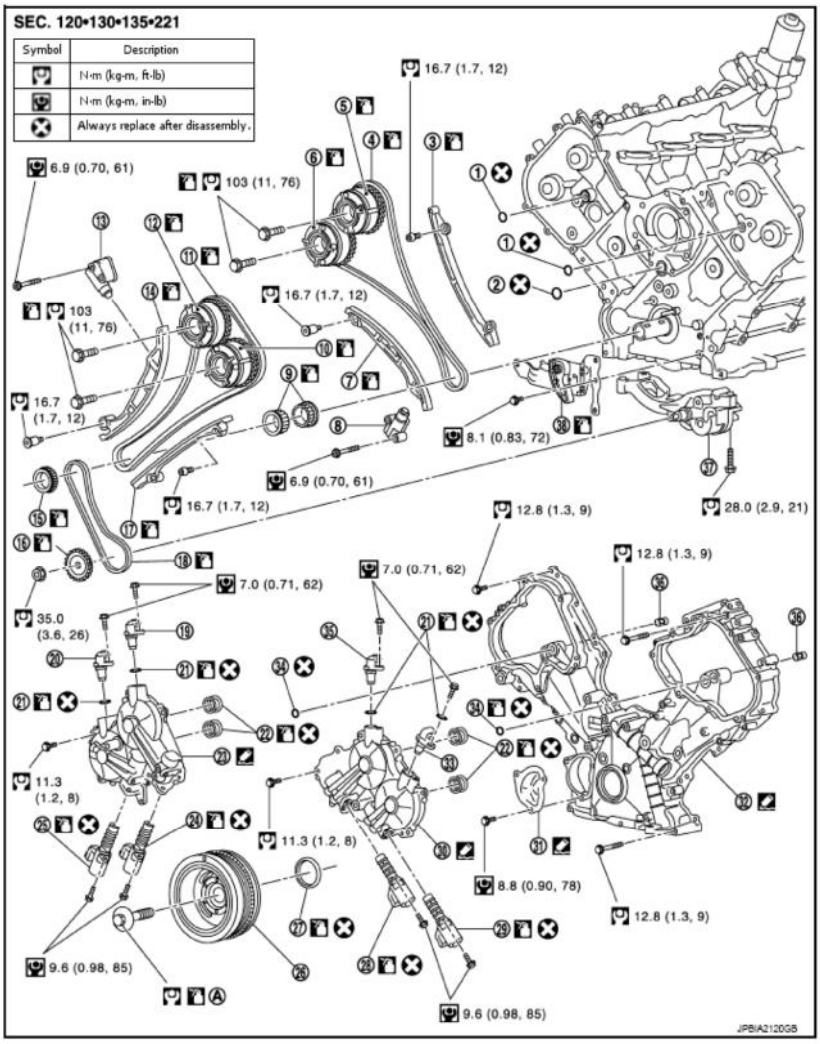
Clean oil strainer if any object is attached.

INSPECTION AFTER ASSEMBLY

1. Check the engine oil level and adjust engine oil. Refer to "**INSPECTION** ".
2. Start engine, and check there is no leakage of engine oil.
3. Stop engine and wait for 15 minutes.
4. Check the engine oil level again. Refer to "**INSPECTION** ".

TIMING CHAIN

Exploded View

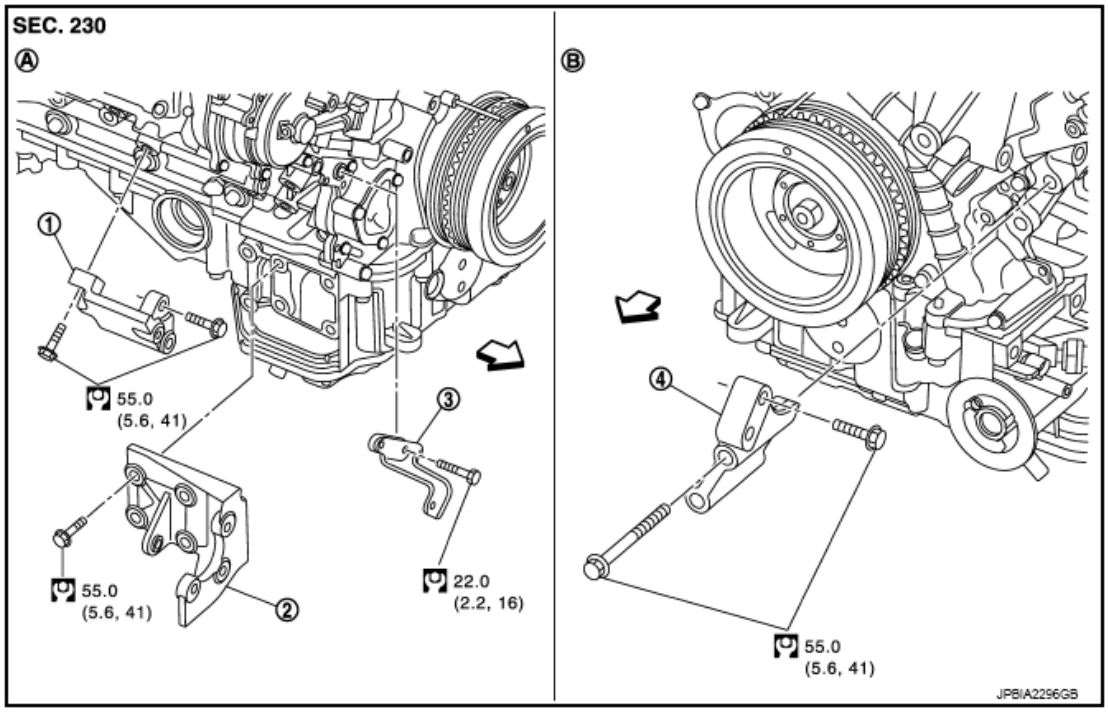


1.	O-ring	2.	O-ring	3.	Tension guide (bank 2)
4.	Timing chain (bank 2)	5.	Camshaft sprocket (INT) (bank 2)	6.	Camshaft sprocket (EXH) (bank 2)
7.	Slack guide (bank 2)	8.	Timing chain tensioner (bank 2)	9.	Crankshaft sprocket
10.	Camshaft sprocket (EXH) (bank 1)	11.	Timing chain (bank 1)	12.	Camshaft sprocket (INT) (bank 1)
13.	Timing chain tensioner (bank 1)	14.	Slack guide (bank 1)	15.	Oil pump sprocket (crankshaft side)
16.	Oil pump sprocket (oil pump side)	17.	Tension guide (bank 1)	18.	Oil pump drive chain
19.	Camshaft position sensor (INT) (bank 2)	20.	Camshaft position sensor (EXH) (bank 2)	21.	O-ring
22.	Seal ring	23.	Valve timing control cover (bank 2)	24.	Intake valve timing control solenoid valve (bank 2)
25.	Exhaust valve timing control solenoid valve (bank 2)	26.	Crankshaft pulley	27.	Front oil seal
28.	Intake valve timing control solenoid valve (bank 1)	29.	Exhaust valve timing control solenoid valve (bank 1)	30.	Valve timing control cover (bank 1)
31.	Timing chain tensioner cover	32.	Front cover	33.	Camshaft position sensor (EXH) (bank 1)
34.	O-ring	35.	Camshaft position sensor (INT) (bank 1)	36.	Oil filter (for valve timing control solenoid valve)
37.	Oil pump	38.	Oil pump drive chain tensioner		
A.	Comply with the installation procedure when tightening.				

Fig. 93: Exploded View Of Timing Chain With Torque Specifications
Courtesy of NISSAN NORTH AMERICA, INC.

Refer to "**COMPONENTS** " for symbol marks in the figure.

Symbol	Description
	N·m (kg-m, ft-lb)
	N·m (kg-m, in-lb)
	Always replace after disassembly.



1. Alternator bracket
2. Power steering pump bracket
3. Alternator support
4. A/C compressor bracket
A. Right side
B. Front side
⇦ : Engine front

Fig. 94: Exploded View Of Accessory Brackets With Torque Specifications
Courtesy of NISSAN NORTH AMERICA, INC.

Refer to "**COMPONENTS** " for symbol marks in the figure.

Disassembly and Assembly

DISASSEMBLY

1. Remove auto tensioners and idler pulley. Refer to "**EXPLODED VIEW**".
2. Remove oil level gauge and oil level gauge guide. Refer to "**EXPLODED VIEW**".
3. Remove alternator bracket and alternator stay.
4. Remove camshaft position sensors.

A : Keep free from magnetic materials

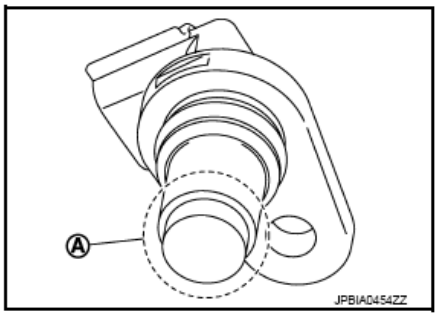


Fig. 95: Locating Camshaft Position Sensors Magnetic Part
Courtesy of NISSAN NORTH AMERICA, INC.

CAUTION:
- **Handle carefully to avoid dropping and shocks.**
- **Never disassemble.**
- **Never allow metal powder to cling to magnetic part at sensor tip.**
- **Never place sensors in a location where they are exposed to magnetism.**

5. Remove valve timing control cover as per the following:
   a. Disconnect valve timing control solenoid valve harness connector.
   b. Loosen mounting bolts in the reverse order as shown in the figure below.

A : Bank 2
B : Bank 1
C : Dowel pin hole

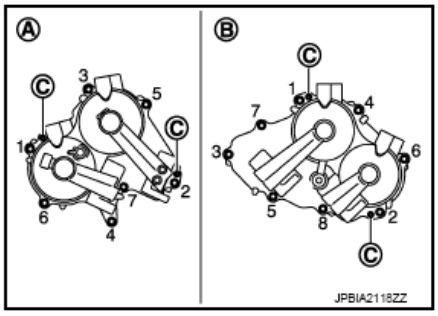


Fig. 96: Valve Timing Control Cover Mounting Bolts Tightening Sequence
Courtesy of NISSAN NORTH AMERICA, INC.

CAUTION:
- **Exercise care not to damage mating surfaces.**
- **Shaft is internally jointed with camshaft sprocket center hole. When removing, keep it horizontal until it is completely disconnected.**

6. Remove valve timing control solenoid valve (INT and EXH), if necessary.

CAUTION: Valve timing control solenoid valve is not reusable. Never remove it

unless required.

7. Remove O-rings (1) from front cover.

Symbol	Description
	N·m (kg-m, ft-lb)
	N·m (kg-m, in-lb)
	Always replace after disassembly.

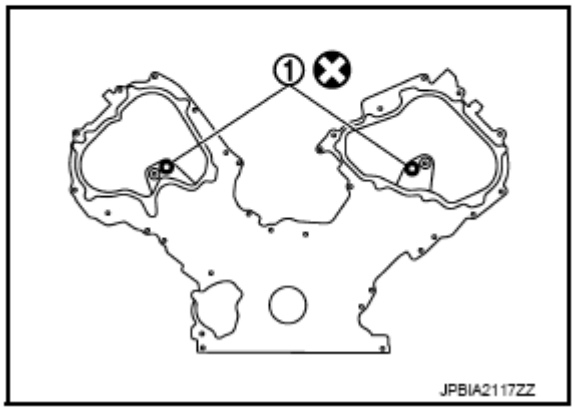


Fig. 97: Locating Front Cover O-Rings
Courtesy of NISSAN NORTH AMERICA, INC.

8. Remove rocker cover. Refer to "**EXPLODED VIEW**".
9. Obtain No. 1 cylinder at TDC of its compression stroke. Refer to "**INSPECTION**".
10. Remove crankshaft pulley. Refer to "**FRONT OIL SEAL: REMOVAL AND INSTALLATION**".
11. Remove water pump pulley. Refer to "**EXPLODED VIEW** ".
12. Remove oil pan (lower) and oil strainer. Refer to "**EXPLODED VIEW**".
13. Remove oil pan (upper). Refer to "**EXPLODED VIEW**".
14. Remove front cover as per the following:
    a. Loosen mounting bolts in reverse order as shown in the figure below.
    b. Insert a suitable tool into the notch at front cover.
        - Pry off case by moving a suitable tool.

CAUTION:
- **Exercise care not to damage mating surfaces.**
- **After removal, handle front cover carefully so it does not tilt, cant, or warp under a load.**

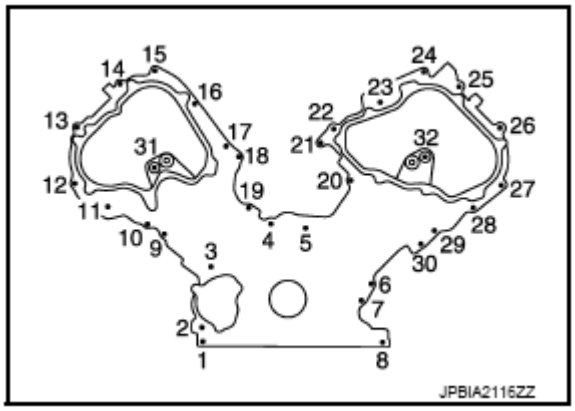


Fig. 98: Front Cover Mounting Bolts Tightening Sequence
Courtesy of NISSAN NORTH AMERICA, INC.

15. Remove front oil seal from front cover using suitable tool.
    - Use screwdriver for removal.

CAUTION: Be careful not to damage front cover.

16. Remove O-rings (1), (2) from cylinder heads and cylinder block.

Symbol	Description
	N·m (kg-m, ft-lb)
	N·m (kg-m, in-lb)
	Always replace after disassembly.

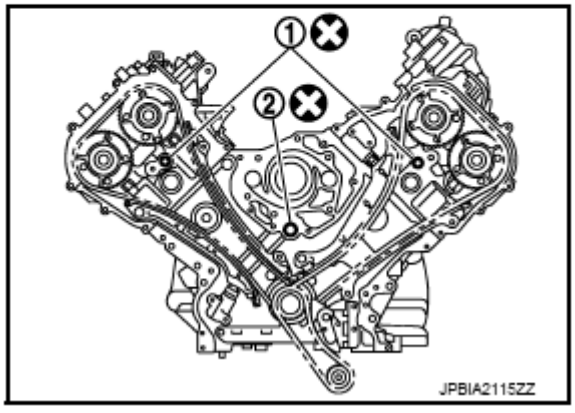


Fig. 99: Locating Cylinder Heads And Cylinder Block O-Rings
Courtesy of NISSAN NORTH AMERICA, INC.

17. Remove oil filter (for valve timing control solenoid valve), if necessary.
18. Remove timing chain tensioner cover from front cover, if necessary.

- Use seal cutter [SST: KV10111100 (J-37228)] to cut liquid gasket for removal.

19. Remove oil pump drive chain as per the following:
    a. Push oil pump drive chain tensioner (1).
    b. Insert a stopper pin (A) into the body hole.

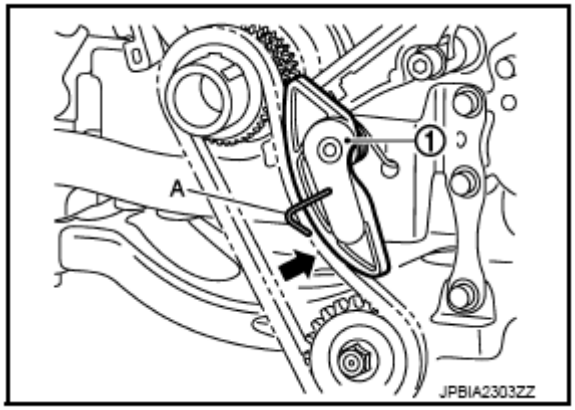


Fig. 100: Inserting Stopper Pin Into Body Hole
Courtesy of NISSAN NORTH AMERICA, INC.

    c. Hold the two flat parts of oil pump shaft, and then loosen the oil pump sprocket (oil pump side) nut.

1 : Oil pump sprocket (oil pump side)

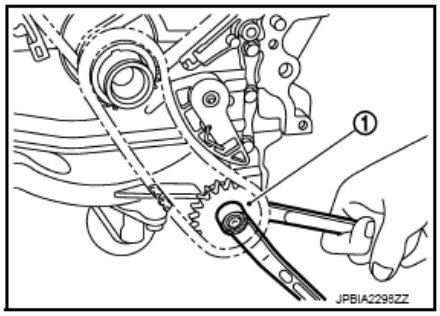


Fig. 101: Loosening Oil Pump Sprocket (Oil Pump Side) Nut Using Tool
Courtesy of NISSAN NORTH AMERICA, INC.

CAUTION: Secure the oil pump unit shaft with the two flat parts.

20. Remove oil pump drive chain tensioner.
21. Remove timing chain tensioner (bank 1) as per the following:

NOTE: To remove timing chain and related parts, start with those on bank 1. The procedure for removing parts on bank 2 is omitted because it is the same as that for bank 1.

a. Push both sides of spring (A) against spring tension, and then press in plunger with a slack guide (2).

1 : Timing chain tensioner (bank 1)

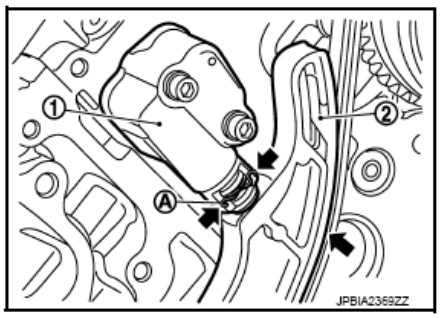


Fig. 102: Pressing Spring Against Tension
Courtesy of NISSAN NORTH AMERICA, INC.

b. Insert a stopper pin (A) into the body hole, and then fix it with the plunger pushed in.

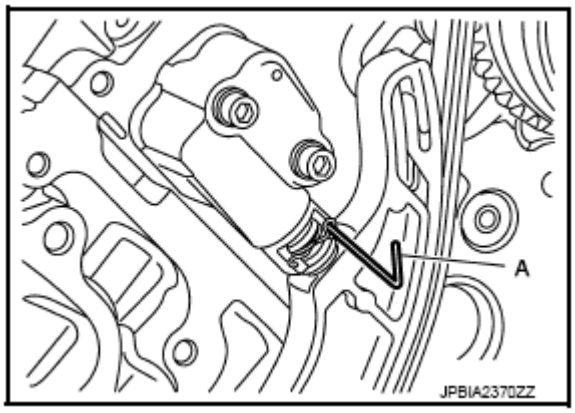


Fig. 103: Inserting Stopper Pin Into Body Hole
Courtesy of NISSAN NORTH AMERICA, INC.

22. Remove tension guide and slack guide.
23. Remove timing chain and crankshaft sprocket.

CAUTION: After removing timing chain, never turn crankshaft and camshaft separately, or valves will strike the piston head.

24. Remove camshaft sprocket (INT) and (EXH) as per the following:

Exhaust side:

- Secure the hexagonal portion of camshaft (EXH) using a wrench to loosen mounting bolt. Refer to "**EXPLODED VIEW**".

Intake side:

- Secure the hexagonal portion (located in between journal No. 1 and journal No. 2) of drive shaft (A) using a wrench (B) to loosen mounting bolt. Refer to "**EXPLODED VIEW**".

⇦ : Engine front

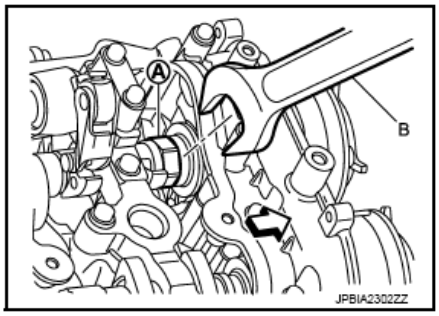


Fig. 104: Locating Intake Side Camshaft Hexagonal Portion
Courtesy of NISSAN NORTH AMERICA, INC.

NOTE: The figure shows an example of bank 2.

CAUTION:

- **Never loosen the mounting bolt by securing anything other than the camshaft (drive shaft) hexagonal portion or with tensioning the timing chain.**
- **When holding the hexagonal part of camshaft (drive shaft) with a wrench, be careful not to allow the wrench to cause interference with other parts.**
- **Never disassemble camshaft sprocket. [Never loosen bolts (C), (D) as shown in the figure below.]**

A : Intake
B : Exhaust

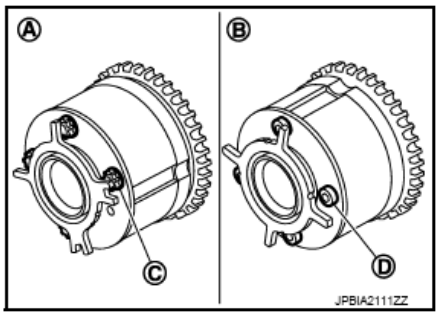


Fig. 105: Locating Intake And Exhaust Camshaft Sprocket Bolts (Never Loosen)
Courtesy of NISSAN NORTH AMERICA, INC.

25. Use scraper to remove all traces of old liquid gasket from front cover and opposite mating surfaces.
    - Remove old liquid gasket from bolt hole and thread.

A : Remove old liquid gasket that is stuck
B : Bolt hole

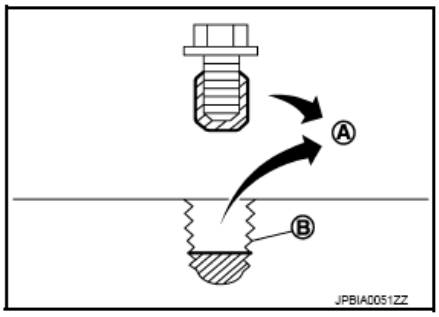
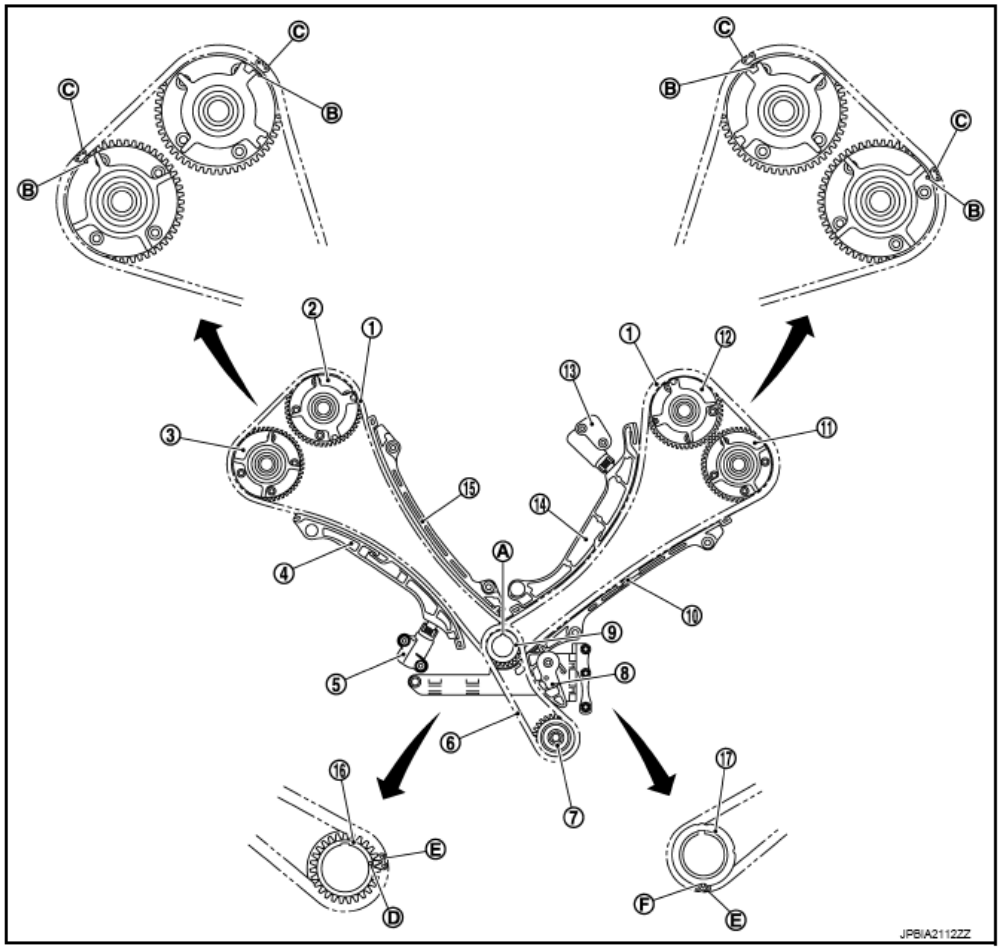


Fig. 106: Removing Liquid Gasket From Bolt Hole And Thread
Courtesy of NISSAN NORTH AMERICA, INC.

ASSEMBLY

CAUTION: Do not reuse O-rings.



1. Timing chain	2. Camshaft sprocket (INT) (bank 2)	3. Camshaft sprocket (EXH) (bank 2)
4. Slack guide (bank 2)	5. Timing chain tensioner (bank 2)	6. Oil pump drive chain
7. Oil pump sprocket (oil pump side)	8. Oil pump drive chain tensioner	9. Oil pump sprocket (crankshaft side)
10. Tension guide (bank 1)	11. Camshaft sprocket (EXH) (bank 1)	12. Camshaft sprocket (INT) (bank 1)
13. Timing chain tensioner (bank 1)	14. Slack guide (bank 1)	15. Tension guide (bank 2)
16. Crankshaft sprocket (bank 2 side)	17. Crankshaft sprocket (bank 1 side)	
A. Crankshaft key	B. Matching mark (outer groove)	C. Matching mark (copper link)
D. Matching mark (punched)	E. Matching mark (yellow link)	F. Matching mark (notched)

Fig. 107: Locating Timing Chain Components
Courtesy of NISSAN NORTH AMERICA, INC.

NOTE:

- **The above figure shows the relationship between the matching mark on each timing chain and that on the corresponding sprocket, with the components installed.**
- **Parts with an identification mark (R or L) should be installed on the corresponding bank according to the mark.**
  - **Camshaft sprocket (INT), camshaft sprocket (EXH)**
  - **Tension guide**
  - **Slack guide**

- **To install timing chain and related parts, start with those on bank 2. The procedure for installing parts on bank 1 is omitted because it is the same as that for installation on bank 2.**
- **There is no matching mark in the oil pump related parts.**

1. Check that crankshaft key (1) and dowel pin (A) of each camshaft are located as shown in the figure below.

   Camshaft dowel pin

   : At cylinder head upper face side in each bank

   Crankshaft key

   : Straight up

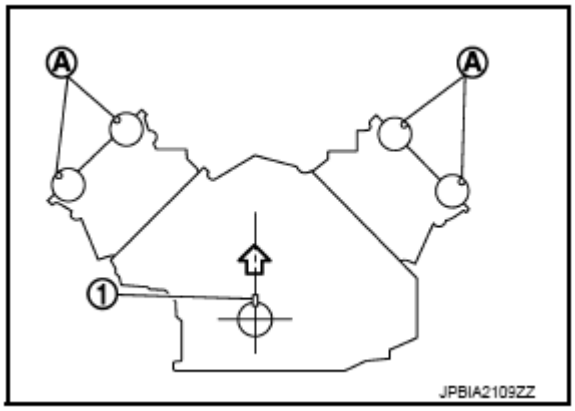


Fig. 108: Identifying Crankshaft Key And Dowel Pin Positions
Courtesy of NISSAN NORTH AMERICA, INC.

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

2. Install camshaft sprockets (INT and EXH).
   - Install onto correct side by checking with identification mark (A) on surface.

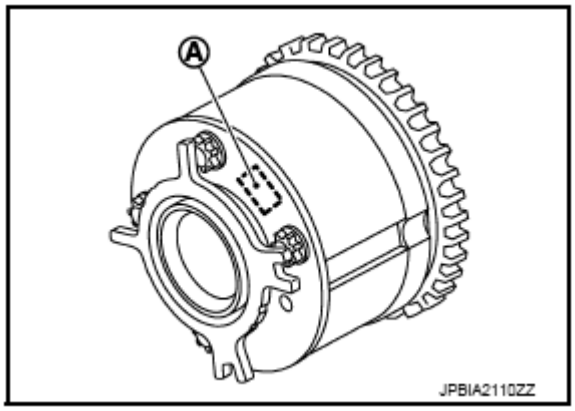


Fig. 109: Locating Camshaft Sprockets Identification Mark
Courtesy of NISSAN NORTH AMERICA, INC.

Exhaust side:

- Secure the hexagonal portion of camshaft (EXH) using a wrench to tighten mounting bolt. Refer to "**EXPLODED VIEW**".

Intake side:

- Secure the hexagonal portion (located in between journal No. 1 and journal No. 2) of drive shaft (A) using a wrench (B) to tighten mounting bolt. Refer to "**EXPLODED VIEW**".

⇦ : Engine front

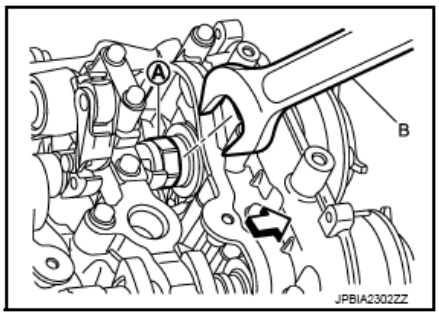


Fig. 110: Securing Hexagonal Portion Of Drive Shaft Using Wrench
Courtesy of NISSAN NORTH AMERICA, INC.

NOTE: The figure shows an example of bank 2.

3. Install timing chains as per the following:
   a. Install crankshaft sprockets for both banks.
      - Install each crankshaft sprocket so that its flange side (the larger diameter side without teeth) (A) faces in the direction shown in the figure below.

1 : Crankshaft sprocket (bank 1 side)
2 : Crankshaft sprocket (bank 2 side)

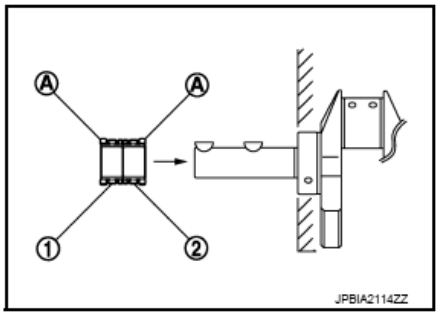


Fig. 111: Locating Crankshaft Sprocket And Flange Side
Courtesy of NISSAN NORTH AMERICA, INC.

NOTE: The same parts are used but facing directions are different.

b. Install timing chains.

Bank 2 (F):

- Install timing chain so that the matching mark (outer groove) (B) on camshaft sprocket is aligned with the copper link (A) on timing chain, while the matching mark (punched) (C) on crankshaft sprocket is aligned with the yellow link (D) one on timing chain, as shown in the figure below.

Bank 1 (G):

- Install timing chain so that the matching mark (outer groove) (B) on camshaft sprocket is aligned with the copper link (A) on timing chain, while the matching mark (notched) (E) on crankshaft sprocket is aligned with the yellow link (D) one on timing chain, as shown in the figure below.

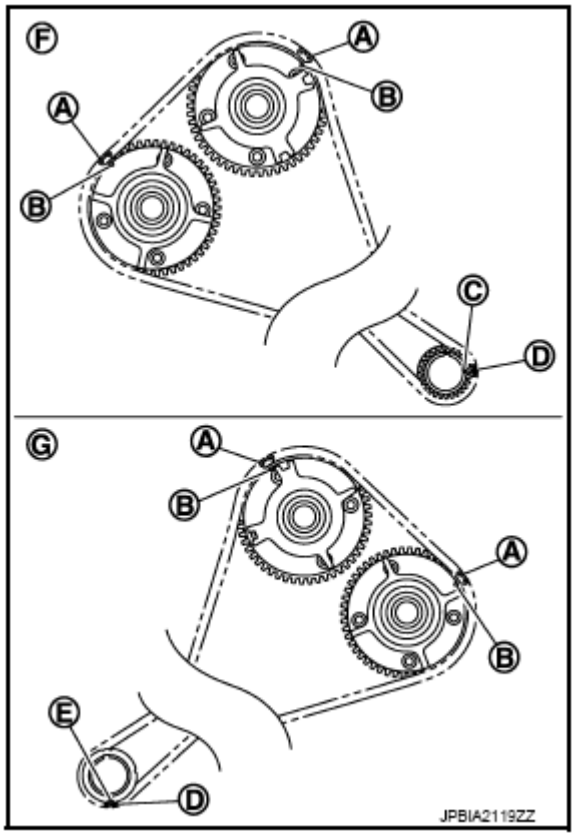


Fig. 112: Locating Matching Marks On Timing Chain
Courtesy of NISSAN NORTH AMERICA, INC.

4. Install slack guides and tension guides onto correct side by checking with identification mark (A) on surface.

1 : Slack guide (bank 2)
2 : Tension guide (bank 2)
3 : Slack guide (bank 1)
4 : Tension guide (bank 1)

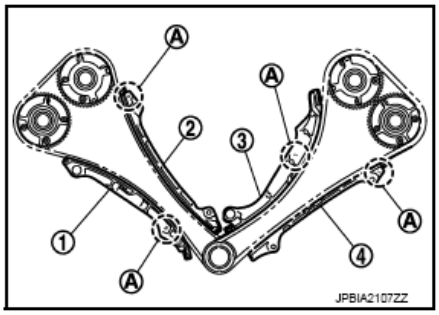


Fig. 113: Locating Slack And Tension Guides (Bank 1 And 2) And Identification Marks
Courtesy of NISSAN NORTH AMERICA, INC.

CAUTION: Never overtighten slack guide mounting bolt (2). It is normal for a gap (A) to exist under the bolt seats when mounting bolt are tightened to the specification.

1 : Slack guide
3 : Cylinder block

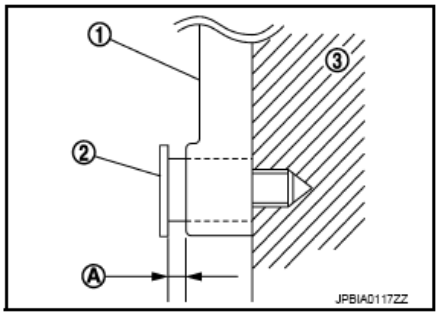


Fig. 114: Slack Guide Mounting Bolt Installation Dimension
Courtesy of NISSAN NORTH AMERICA, INC.

5. Install timing chain tensioner as per the following:
   a. Fix the plunger at the most compressed position using a stopper pin (A).
      - Remove any dirt and foreign materials completely from the back and the mounting surfaces of timing chain tensioner.
   b. Pull out stopper pin after installing, and then release plunger.

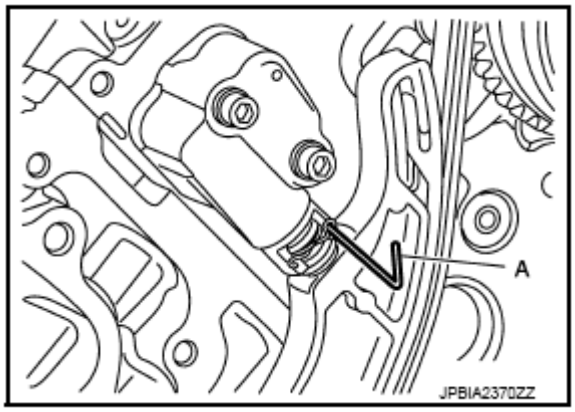


Fig. 115: Removing Stopper Pin From Body Hole
Courtesy of NISSAN NORTH AMERICA, INC.

6. Check again that the matching marks on sprockets and timing chain have not slipped out of alignment.
7. Install oil pump drive chain as per the following:
   a. Install oil pump drive chain tensioner.
      - Fix the tensioner at the most compressed position using a stopper pin. and then install it.
   b. Install the oil pump sprocket (crankshaft side), oil pump sprocket (oil pump side) and oil pump drive chain at the same time.
      - Install each oil pump sprocket so that its flange side (the larger diameter side without teeth) (A) faces in the direction shown in the figure below.

1 : Oil pump sprocket (crankshaft side)
2 : Oil pump sprocket (oil pump side)
3 : Oil pump
4 : Crankshaft

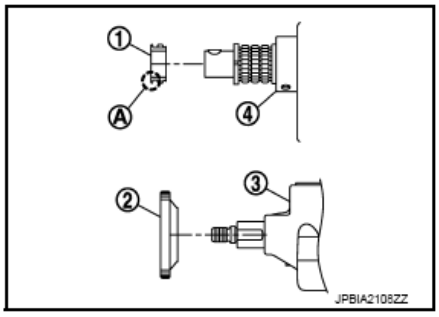


Fig. 116: Locating Sprocket, Crankshaft And Oil Pump
Courtesy of NISSAN NORTH AMERICA, INC.

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

c. Hold the two flat parts of oil pump shaft, and then tighten the oil pump sprocket (oil pump side) nut.

1 : Oil pump sprocket (oil pump side)

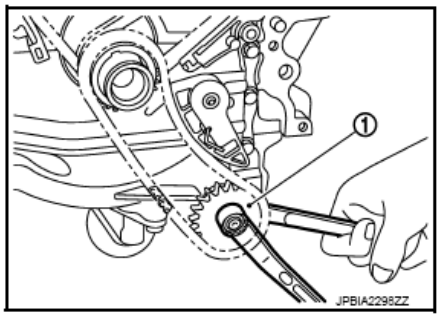


Fig. 117: Tightening Oil Pump Sprocket Mounting Nut Using Tool
Courtesy of NISSAN NORTH AMERICA, INC.

CAUTION: Secure the oil pump shaft with the two flat parts.

d. Securely pull out the stopper pin (A) after installing the oil pump drive chain.
   - Check that the tension is applied to the oil pump drive chain (1) after installing.

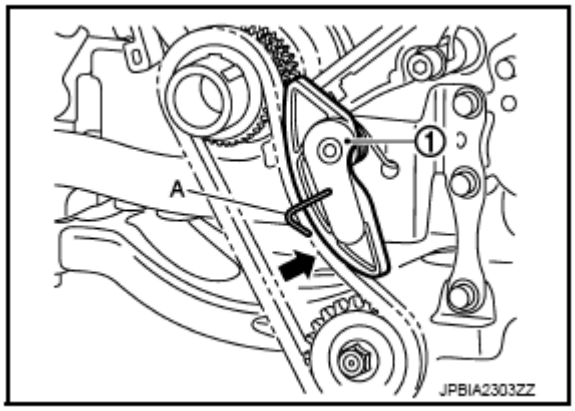


Fig. 118: Pulling Stopper Pin From Body Hole
Courtesy of NISSAN NORTH AMERICA, INC.

8. Install front oil seal on front cover. Refer to "**FRONT OIL SEAL: REMOVAL AND INSTALLATION**".
9. Install timing chain tensioner cover (2) to front cover (1).

a : ϕ3.4 - 4.4 mm (0.134 - 0.173 in)

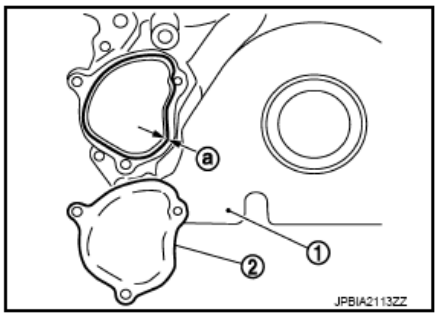


Fig. 119: Locating Timing Chain Tensioner Cover Sealant Application Area
Courtesy of NISSAN NORTH AMERICA, INC.

- Apply a continuous bead of liquid gasket with tube presser (commercial service tool) to front cover as shown in the figure below.

  Use Genuine RTV Silicone Sealant or an equivalent. Refer to "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS ".

10. Install oil filter (for valve timing control solenoid valve) (1) in the direction shown in the figure, if removed.
    - Check that the oil filter does not protrude from the upper surface of front cover (2) after installation.

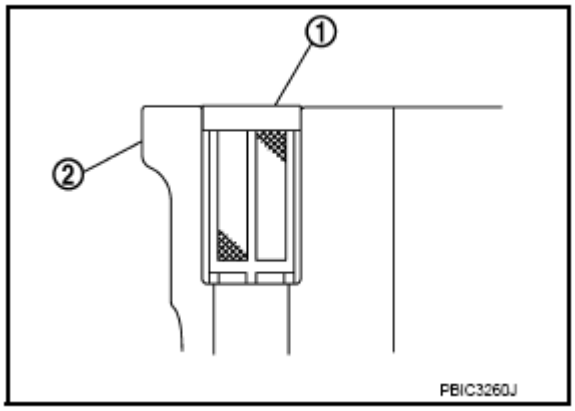


Fig. 120: Locating Oil Filter And Front Cover
Courtesy of NISSAN NORTH AMERICA, INC.

11. Install front cover as per the following:
    a. Install new O-ring (1), (2) onto cylinder heads and cylinder block.

CAUTION: Do not reuse O-rings.

Symbol	Description
	N·m (kg-m, ft-lb)
	N·m (kg-m, in-lb)
	Always replace after disassembly.

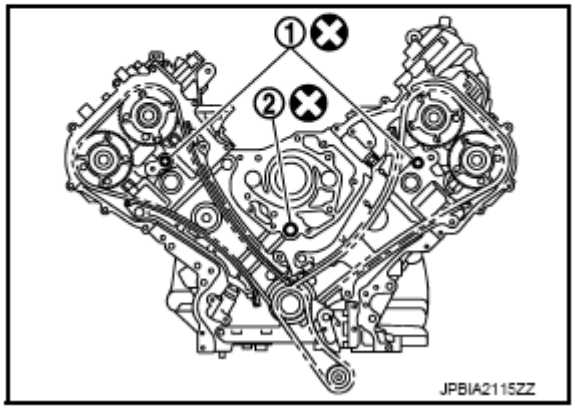


Fig. 121: Locating Cylinder Heads And Cylinder Block O-Rings
Courtesy of NISSAN NORTH AMERICA, INC.

    b. Apply a continuous bead of liquid gasket with tube presser (commercial service tool) to front cover as shown in the figure below.

Use Genuine RTV Silicone Sealant or equivalent. Refer to "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS ".

A : Junction between cylinder block and cylinder head
B : Protrusion
c : 4.3 - 5.3 mm (0.169 - 0.209 in)
d : ϕ3.4 - 4.4 mm (0.134 - 0.173 in)
e : ϕ4.0 - 5.6 mm (0.157 - 0.220 in)
f : ϕ4.8 - 5.8 mm (0.189 - 0.228 in)

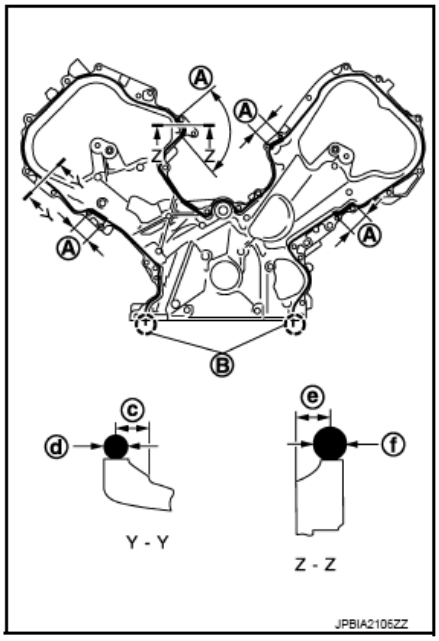


Fig. 122: Identifying Liquid Gasket Application Width On Front Cover
Courtesy of NISSAN NORTH AMERICA, INC.

c. Check again that the matching marks on timing chain and that on each sprocket are aligned. Then, install front cover.

CAUTION: Be careful not to damage front oil seal by interference with front end of crankshaft.

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

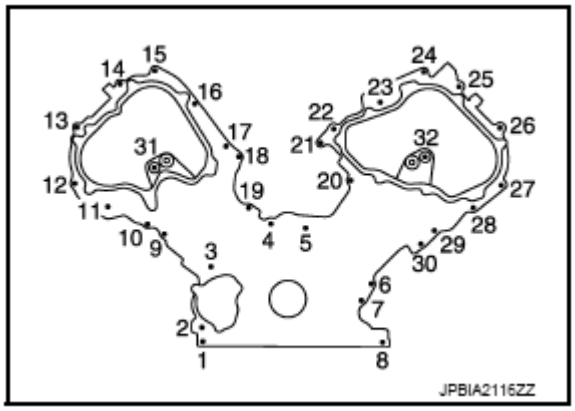


Fig. 123: Timing Chain Mounting Bolts Tightening Sequence
Courtesy of NISSAN NORTH AMERICA, INC.

- There are three types of mounting bolts.

A: 20 mm (0.79 in)

B: 45 mm (1.77 in)

C: 80 mm (3.15 in)

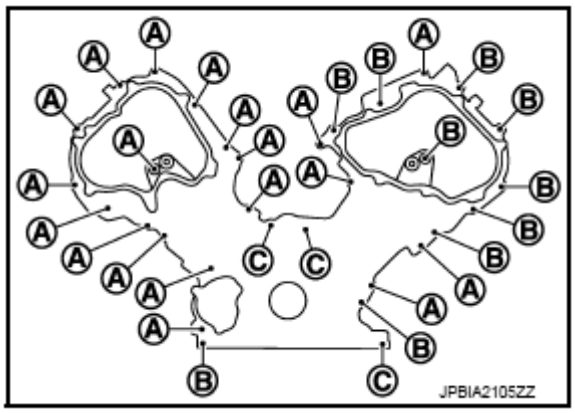


Fig. 124: Identifying Timing Chain Mounting Bolts
Courtesy of NISSAN NORTH AMERICA, INC.

e. After all mounting bolts are tightened, retighten them in numerical order as shown in the figure below.

CAUTION: Be sure to wipe out any excessive liquid gasket leaking onto surface mating with oil pan.

12. Install valve timing control cover as per the following:
    a. Install new O-rings (1) on front cover.

CAUTION: Do not reuse O-rings.

Symbol	Description
	N·m (kg-m, ft-lb)
	N·m (kg-m, in-lb)
	Always replace after disassembly.

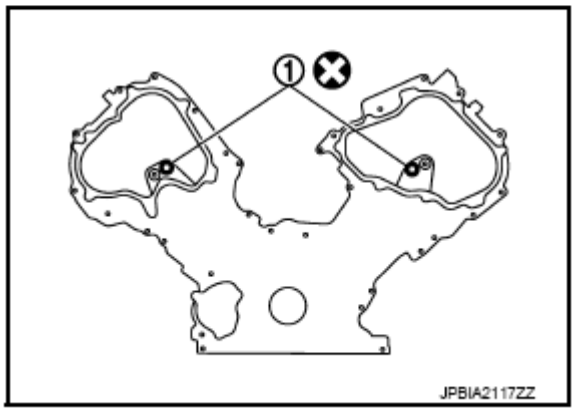


Fig. 125: Locating Front Cover O-Rings
Courtesy of NISSAN NORTH AMERICA, INC.

b. Install new seal rings (1) in shaft grooves.

CAUTION: When replacing seal ring, replace all rings with new ones.

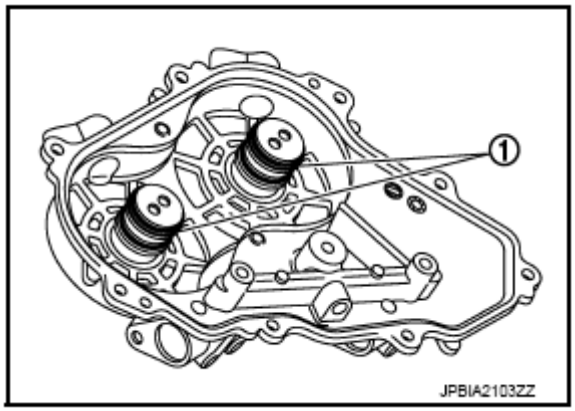


Fig. 126: Locating Shaft Grooves Seal Rings
Courtesy of NISSAN NORTH AMERICA, INC.

c. Apply a continuous bead of liquid gasket with tube presser (commercial service tool) to valve timing control covers as shown in the figure below.

A : Bank 1
B : Bank 2
c : ϕ3.4 - 4.4 mm (0.134 - 0.173 in)

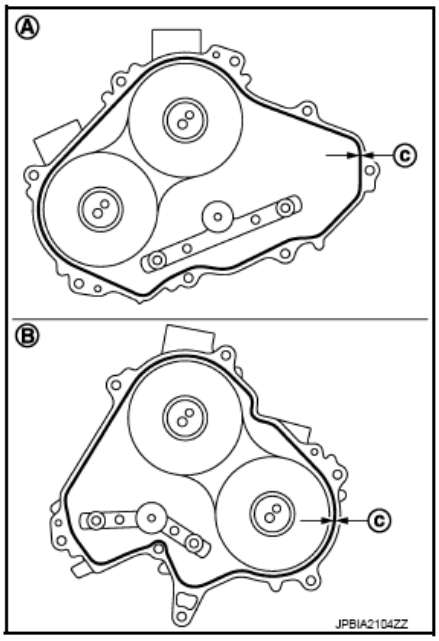


Fig. 127: Identifying Liquid Gasket Application Area On Valve Timing Control Covers
Courtesy of NISSAN NORTH AMERICA, INC.

Use Genuine RTV Silicone Sealant or equivalent. Refer to "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS ".

d. Being careful not to move seal ring from the installation groove, align dowel pins on front cover with dowel pin holes (C) to install valve timing control covers.

A : Bank 2
B : Bank 1

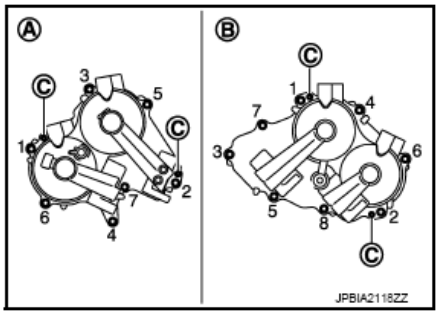


Fig. 128: Valve Timing Control Covers Mounting Bolts Tightening Sequence
Courtesy of NISSAN NORTH AMERICA, INC.

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

13. Install camshaft position sensor and valve timing control solenoid valve (RH and LH) to valve timing control cover, if removed.
    - Be sure to tighten mounting bolts with flanges completely seated.
14. Install oil pan (lower) and oil strainer. Refer to "**EXPLODED VIEW**".
15. Install oil pan (upper). Refer to "**EXPLODED VIEW**".

16. Install water pump pulley. Refer to "**EXPLODED VIEW** ".
17. Install crankshaft pulley.
    - Fix the crankshaft as instructed in the removal procedure. Refer to "**FRONT OIL SEAL: REMOVAL AND INSTALLATION**".
    a. Install crankshaft pulley, taking care not to damage front oil seal.
    b. Apply engine oil onto threaded parts of crankshaft pulley bolt and seating area.
        - Lightly tapping its center with plastic hammer, insert crankshaft pulley.

CAUTION: Never tap crankshaft pulley on the side surface where belt is installed (outer circumference).

    c. Tighten crankshaft pulley bolt.

Torque Value: 157 N.m (16 kg-m, 116 ft-lb)

    d. Put a paint mark (A) on crankshaft pulley (1) aligning with angle mark (B) on crankshaft pulley bolt.
    e. Tighten crankshaft pulley bolt (clockwise).

Angle tightening: 90 degrees (c)

        - Check the tightening angle by referencing to the notches. The angle between two notches is 90 degrees.

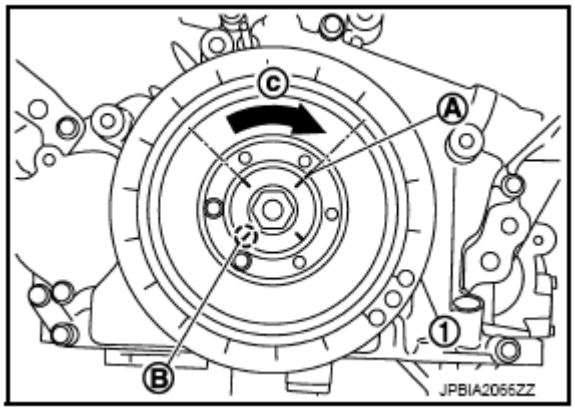


Fig. 129: Tightening Crankshaft Pulley Bolt
Courtesy of NISSAN NORTH AMERICA, INC.

18. Rotate crankshaft pulley in normal direction (clockwise when viewed from engine front) to confirm it turns smoothly.
19. Install in the reverse order of removal.

Inspection

INSPECTION AFTER DISASSEMBLY

Timing Chain

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

A : Crack
B : Wear

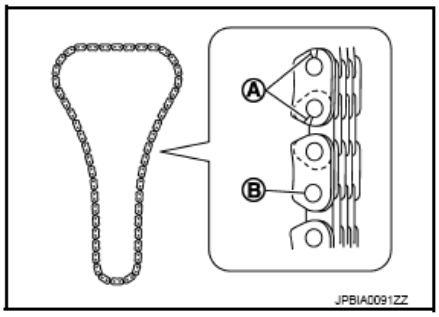


Fig. 130: Inspecting Timing Chain For Cracks Or Wear
Courtesy of NISSAN NORTH AMERICA, INC.

INSPECTION AFTER ASSEMBLY

Inspection for Leakage

The following are procedures for checking fluid leakage, lubricant leakage.

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

NOTE: If hydraulic pressure inside chain tensioner drops after removal/installation, slack in guide may generate a pounding noise during and just after the engine start. However, this does not indicate a malfunction. The noise will stop after hydraulic pressure rises.

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

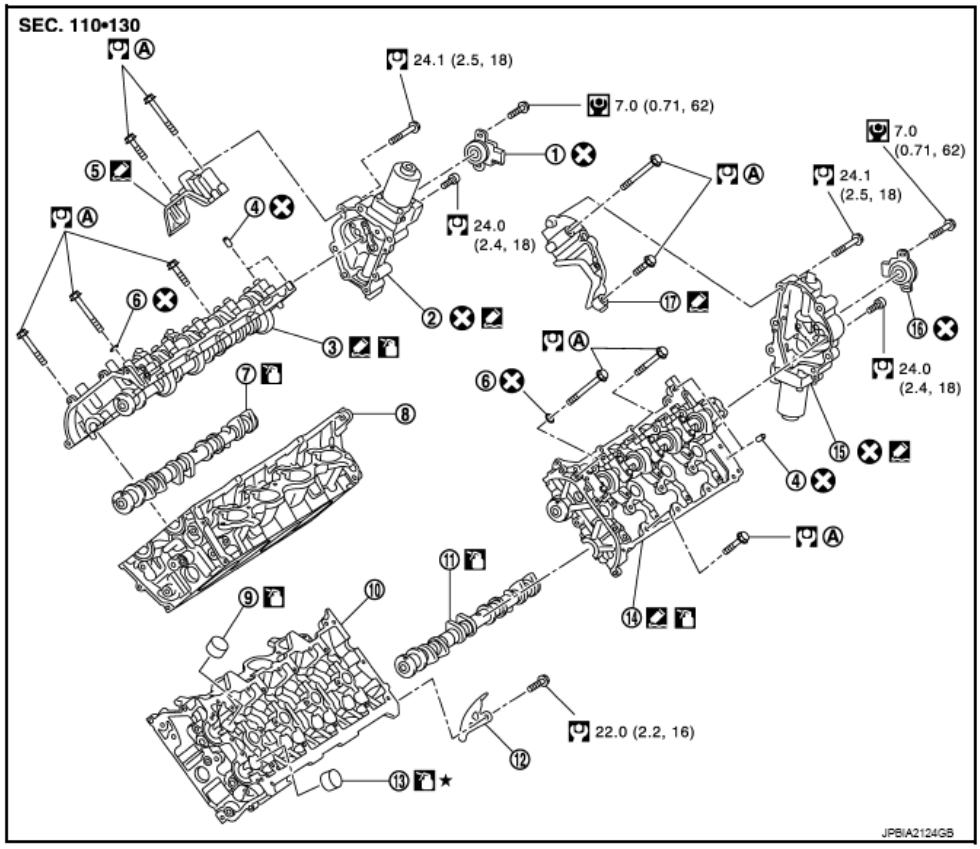
SUMMARY OF INSPECTION ITEMS

Items		Before starting engine	Engine running	After engine stopped
Engine coolant		Level	Leakage	Level
Engine oil		Level	Leakage	Level
Transmission/transaxle fluid	AT Models	Leakage	Level/Leakage	Leakage
	MT Models	Level/Leakage	Leakage	Level/Leakage
Other oils and fluids(1)		Level	Leakage	Level
Fuel		Leakage	Leakage	Leakage
Exhaust gases		-	Leakage	-
(1) Power steering fluid, brake fluid, etc.				

CAMSHAFT

Exploded View

Symbol	Description
	N·m (kg-m, ft-lb)
	N·m (kg-m, in-lb)
	Always replace after disassembly.



1.	VVEL control shaft position sensor (bank 2)	2.	VVEL actuator sub assembly (bank 2)	3.	VVEL ladder assembly (bank 2)
4.	Dowel pin	5.	Actuator bracket (rear) (bank 2)	6.	Washer
7.	Camshaft (EXH) (bank 2)	8.	Cylinder head (bank 2)	9.	Valve lifter (INT)
10.	Cylinder head (bank 1)	11.	Camshaft (EXH) (bank 1)	12.	Actuator cover
13.	Valve lifter (EXH)	14.	VVEL ladder assembly (bank 1)	15.	VVEL actuator sub assembly (bank 1)
16.	VVEL control shaft position sensor (bank 1)	17.	Actuator bracket (rear) (bank 1)		
A.	Comply with the installation procedure when tightening.				

Fig. 131: Exploded View Of Camshaft
Courtesy of NISSAN NORTH AMERICA, INC.

Refer to "**COMPONENTS** " for symbol marks in the figure.

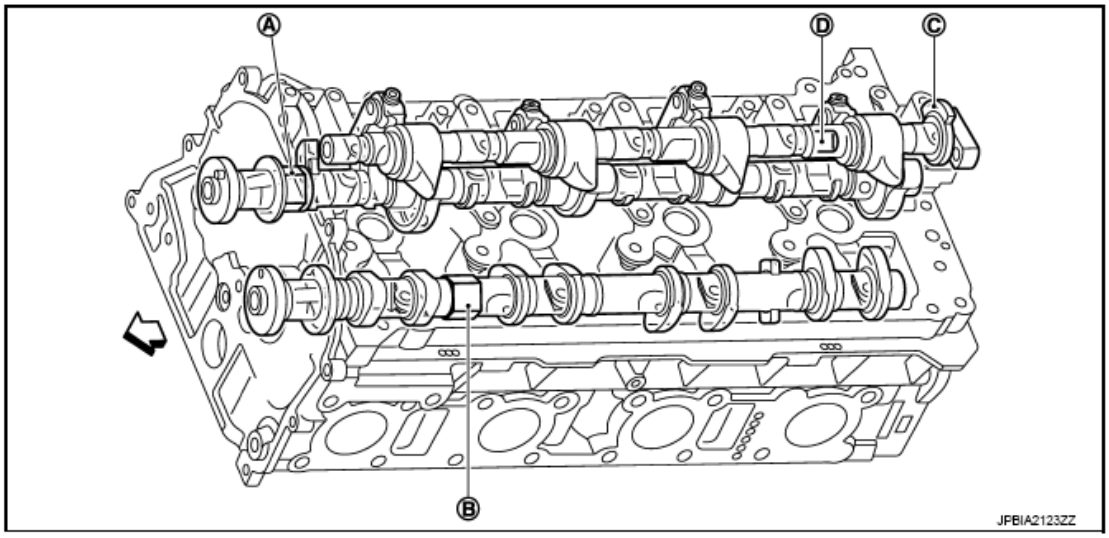
CAUTION: A high degree of precision is required for a valve on the intake side. Never remove the valve related parts unless necessary.

NOTE:

- **As for replacement of parts on the intake side as shown in the exploded view below, replace VVEL ladder assembly & cylinder head assembly.**

- **VVEL ladder assembly cannot be replaced as a single part, because it is machined together with cylinder head assembly.**

VVEL Ladder Assembly & Cylinder Head Assembly Features



A. Hexagonal part of drive shaft (for holding)
B. Hexagonal part of camshaft (EXH) (for holding)
C. Stopper of control shaft
D. Two flat areas of control shaft (for holding)
⇦ : Engine front

Fig. 132: VVEL Ladder Assembly And Cylinder Head Assembly Features
Courtesy of NISSAN NORTH AMERICA, INC.

NOTE: The figure shows an example of bank 1.

Disassembly and Assembly

DISASSEMBLY

CAUTION: Never loosen adjusting bolts (A) and mounting bolts (black color) (B) of VVEL ladder assembly. If loosened, the stroke of cam lift becomes out of adjustment. In such case, replacement of VVEL ladder assembly and cylinder head assembly is required.

NOTE: VVEL ladder assembly cannot be replaced as a single part, because it is machined together with cylinder head assembly.

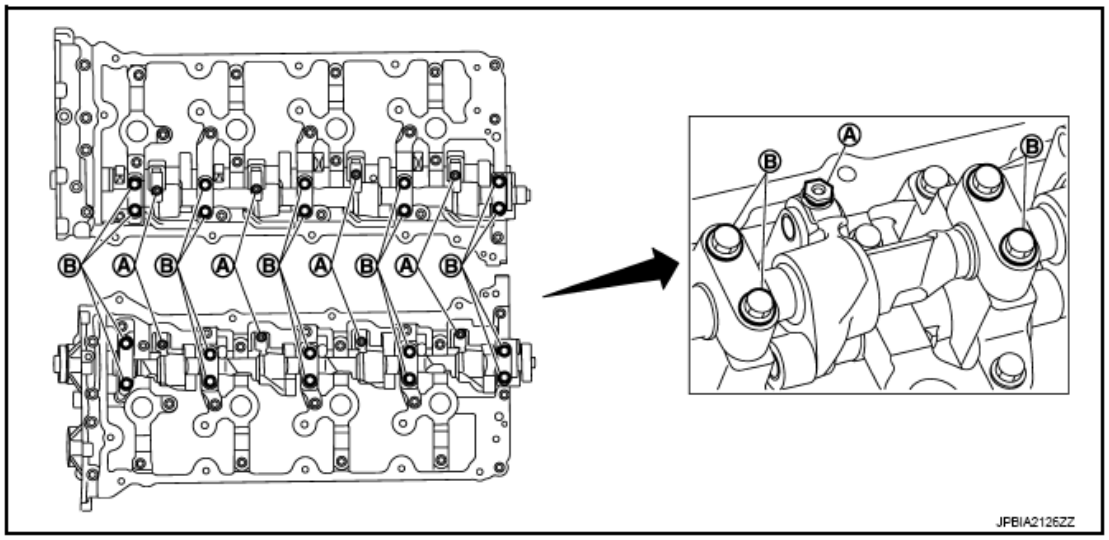


Fig. 133: VVEL Ladder Assembly, Adjusting And Mounting Bolts (Never Loosen)
Courtesy of NISSAN NORTH AMERICA, INC.

1. Remove rocker covers (bank 1 and bank 2). Refer to "**EXPLODED VIEW**".
2. Remove VVEL actuator sub assembly as per the following:

CAUTION: VVEL actuator sub assembly and VVEL control shaft position sensor are not reusable. Never remove them unless they are required.

a. Remove VVEL control shaft position sensor.
b. Fix two flat areas (C) of control shaft with a wrench to remove mounting bolts of control shaft.

A : Bank 2
B : Bank 1
⇦ : Engine front

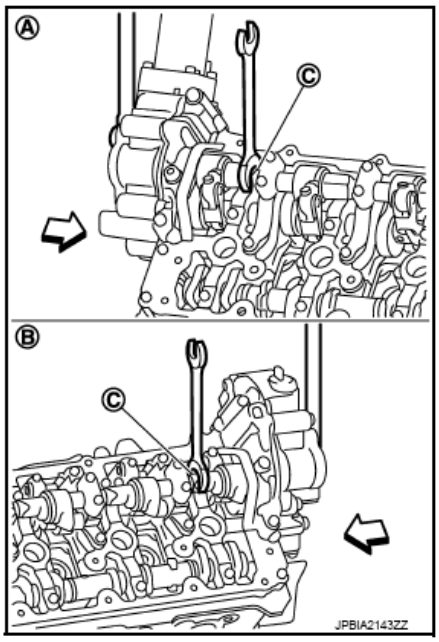


Fig. 134: Removing VVEL Actuator Sub Assemblies
Courtesy of NISSAN NORTH AMERICA, INC.

CAUTION:
- **During the operation, never allow a wrench to interfere with other parts.**
- **Fix control shaft to prevent the interference of the stopper surface.**

c. Remove VVEL actuator sub assembly.
- Loosen mounting bolts in the reverse order as shown in the figure below.

A : Bank 1
B : Bank 2

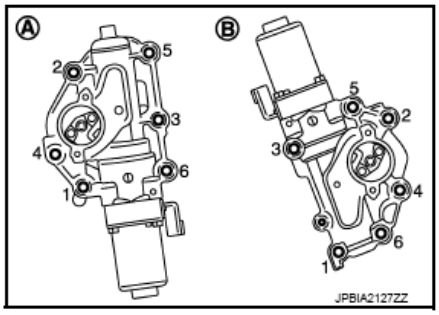


Fig. 135: VVEL Actuator Sub Assembly Mounting Bolts Tightening Sequence
Courtesy of NISSAN NORTH AMERICA, INC.

CAUTION:
- **When removing, prepare wastes because oil spills.**
- **When installing, be careful with VVEL actuator sub assembly (bank 1) mounting bolt No. 4 because its length is different.**

d. Remove actuator bracket (rear).
- Loosen mounting bolts in the reverse order as shown in the figure below.

A : Bank 2
B : Bank 1
⇦ : Engine front

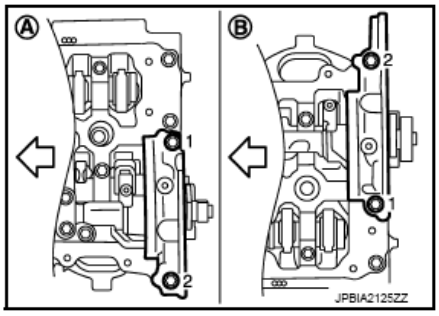


Fig. 136: Actuator Bracket (Rear) Mounting Bolts Tightening Sequence
Courtesy of NISSAN NORTH AMERICA, INC.

3. Remove front cover, camshaft sprockets, and timing chains. Refer to "**EXPLODED VIEW**".

4. Remove VVEL ladder assembly.
    - Loosen mounting bolts (gold color) in the reverse order as shown in the figure below.

A : Bank 2
B : Bank 1
⇦ : Engine front

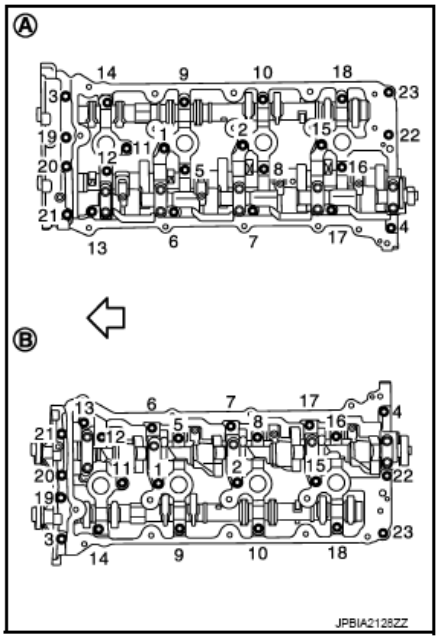


Fig. 137: VVEL Ladder Assembly Mounting Bolts Tightening Sequence
Courtesy of NISSAN NORTH AMERICA, INC.

CAUTION:
- **Never loosen adjusting bolts and mounting bolts (black color).**
- **When removing VVEL ladder assembly, hold the drive shaft from below so as not to drop it.**

5. Remove camshaft (EXH).
6. Remove valve lifter, if necessary.
    - Identify installation positions, and store them without mixing them up.

ASSEMBLY

CAUTION: Do not reuse washers.

1. Install valve lifter.
    - Install it in the original position.
2. Install camshaft (EXH).
    - Distinction between camshaft (EXH) is performed with the identification mark.

⇦ : Engine front

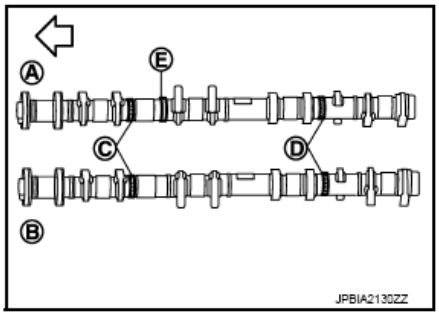


Fig. 138: Locating Camshaft (EXH) Identification Rib And Paint Mark
Courtesy of NISSAN NORTH AMERICA, INC.

Bank	Paint marks		Identification rib (E)
	M1 (C)	M2 (D)	
Bank 2 (A)	No	Green	Yes
Bank 1 (B)	No	Green	No

3. Install VVEL ladder assembly as per the following:
   a. Apply a continuous bead of liquid gasket with tube presser (commercial service tool) to the cylinder head as shown in the figure below.

A : Bank 1
B : Bank 2
c : ϕ3.4 - 4.4 mm (0.134 - 0.173 in)
⇦ : Engine front

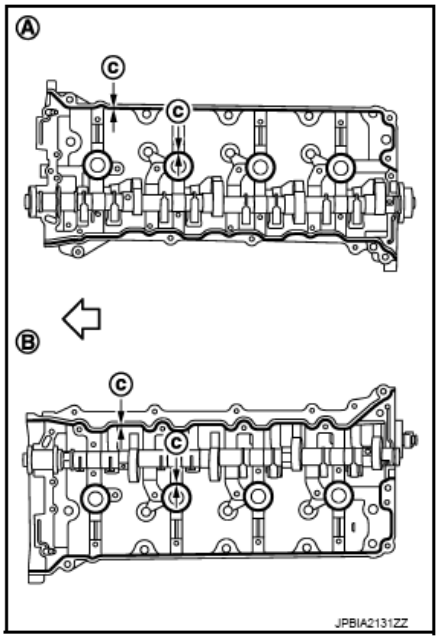


Fig. 139: Locating Liquid Gasket Application Area On Cylinder Head
Courtesy of NISSAN NORTH AMERICA, INC.

Use Genuine RTV Silicone Sealant or an equivalent. Refer to "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS ".

   b. Tighten mounting bolts in the following step, in numerical order as shown below.

A : Bank 2
B : Bank 1
⇦ : Engine front

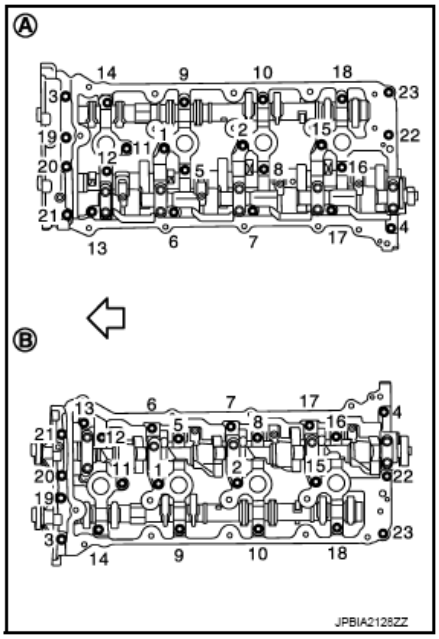


Fig. 140: VVEL Ladder Assembly Mounting Bolts Tightening Sequence
Courtesy of NISSAN NORTH AMERICA, INC.

CAUTION: Do not reuse washers.

i. Tighten bolts in numerical order as shown.

Torque Value: 1.96 N.m (0.20 kg-m, 1 ft-lb)

ii. ii. Tighten bolts in numerical order as shown.

Torque Value: 5.88 N.m (0.60 kg-m, 4 ft-lb)

iii. iii. Tighten bolts in numerical order as shown.

Torque Value: 10.4 N.m (1.1 kg-m, 8 ft-lb)

4. Install camshaft sprockets and timing chains. Refer to "**EXPLODED VIEW**".
5. Install actuator bracket (rear) as per the following:
   a. Refer to the figure to replace new dowel pins (2), if removed.

1 : Actuator bracket
3 : VVEL ladder assembly
a : 4.0 - 6.0 mm(0.157 - 0.236 in)

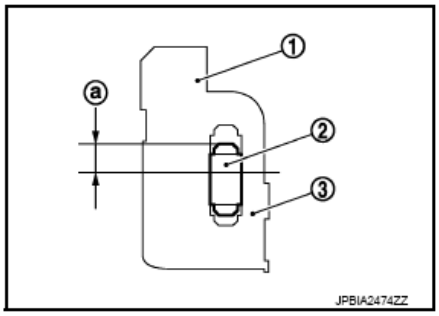


Fig. 141: Locating Actuator Bracket, VVEL Ladder Assembly And Dowel Pins
Courtesy of NISSAN NORTH AMERICA, INC.

b. Apply a continuous bead of liquid gasket with tube presser (commercial service tool) to the actuator bracket (rear) as shown in the figure below.

A : Bank 2
B : Bank 1
c : ϕ3.4 - 4.4 mm (0.134 - 0.173 in)
⇦ : Engine front

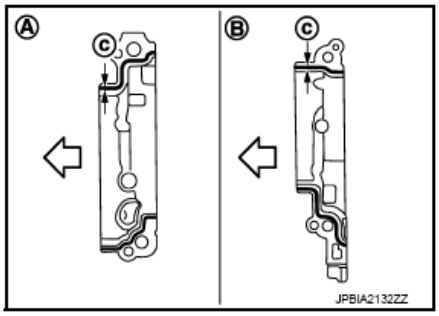


Fig. 142: Locating Liquid Gasket Application Area On Actuator Bracket (Rear)
Courtesy of NISSAN NORTH AMERICA, INC.

Use Genuine RTV Silicone Sealant or an equivalent. Refer to "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS ".

CAUTION: Never apply gasket to the oil passage.

c. Tighten mounting bolts in the following steps, in numerical order as shown below.

A : Bank 2
B : Bank 1
⇦ : Engine front

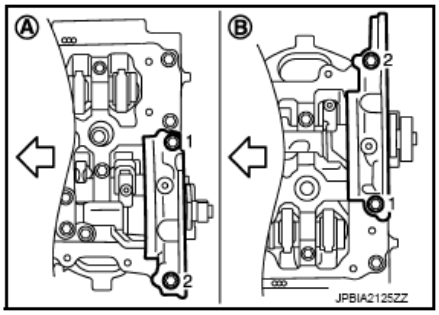


Fig. 143: Actuator Bracket (Rear) Mounting Bolts Tightening Sequence

Courtesy of NISSAN NORTH AMERICA, INC.

CAUTION: Do not reuse washers.

i. Tighten bolts in numerical order as shown.

Torque Value: 1.96 N.m (0.20 kg-m, 1 ft-lb)

ii. ii. Tighten bolts in numerical order as shown.

Torque Value: 5.88 N.m (0.60 kg-m, 4 ft-lb)

iii. iii. Tighten bolts in numerical order as shown.

Torque Value: 31.4 N.m (3.2 kg-m, 23 ft-lb)

6. Install new VVEL actuator sub assembly as per the following:

CAUTION: Regarding replacement, because VVEL actuator sub assembly and VVEL control shaft position sensor are controlled on a one-on-one basis, replace them as a set.

NOTE:

- **VVEL actuator arm (B) is factory-fixed at 10 degrees from the small lift with a holding jig (A).**
- **The holding jig is supplied in the new VVEL actuator sub assembly.**

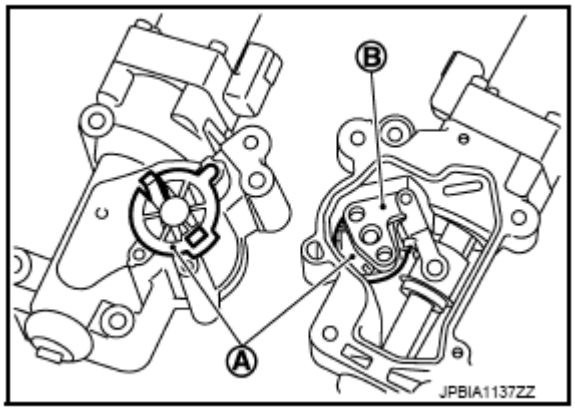


Fig. 144: Locating VVEL Actuator Arm And Holding Jig
Courtesy of NISSAN NORTH AMERICA, INC.

CAUTION:

- **Never disassemble VVEL actuator sub assembly. [Never loosen actuator motor mounting bolts (A) shown in the figure below]**

- **Never impact VVEL actuator sub assembly.**

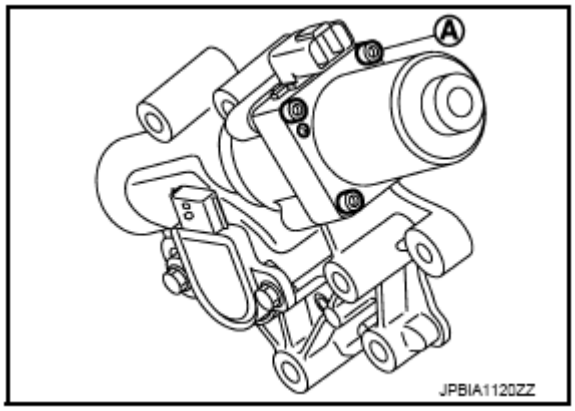


Fig. 145: Locating Actuator Motor Mounting Bolts (Never Loosen)
Courtesy of NISSAN NORTH AMERICA, INC.

a. Move control shaft to the position of small lift stopper.
   - The position where a part of the stopper of control shaft contacts VVEL ladder bracket.

1 : VVEL ladder assembly (bank 2)
2 : VVEL ladder assembly (bank 1)
A : Stopper of control shaft
⬅ : Small lift side

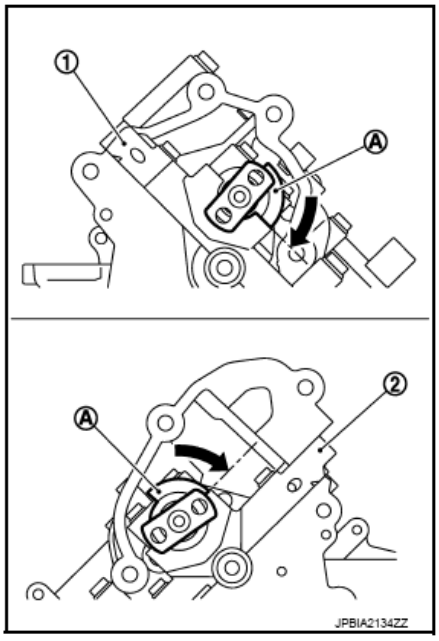


Fig. 146: Rotating Control Shaft To Position Of Small Lift Stopper
Courtesy of NISSAN NORTH AMERICA, INC.

CAUTION: Be careful not to damage the stopper surface.

- If control shaft cannot be moved, set crankshaft in position referring to the information

below. (To displace cam nose)

Bank 1: Turn 360 degrees from No. 1 cylinder at TDC

Bank 2: No. 1 cylinder at TDC

b. Hold two flat areas of control shaft with a wrench, and rotate the control shaft (10 degrees from the stopper) to the large lift side. (This is for aligning the bolt hole of control shaft and the hole of VVEL actuator arm.)

1 : VVEL actuator sub assembly (bank 2)
A : Control shaft
B : View B
C : Holding jig
d : 10 degrees
⬅ : Large lift side

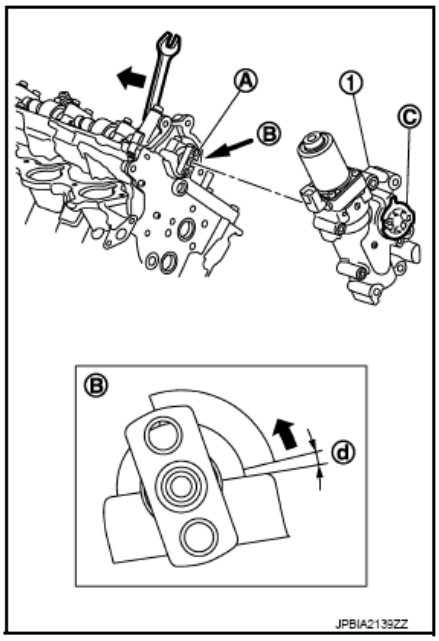


Fig. 147: Rotating Control Shaft Using Wrench
Courtesy of NISSAN NORTH AMERICA, INC.

NOTE: The figure shows an example of bank 2.

c. Apply a continuous bead of liquid gasket with tube presser (commercial service tool) to the VVEL actuator sub assembly as shown in the figure below.

1 : VVEL actuator sub assembly (bank 2)
2 : VVEL actuator sub assembly (bank 1)
a : 4.0 - 5.6 mm (0.157 - 0.220 in)
b : ϕ3.4 - 4.4 mm (0.134 - 0.173 in)

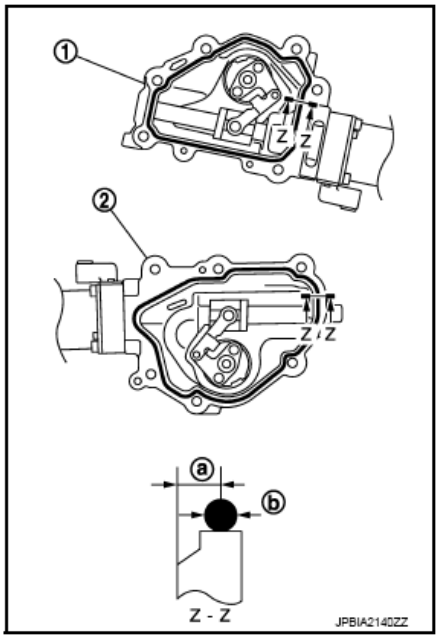


Fig. 148: Locating Liquid Gasket Application Area On VVEL Actuator Sub Assembly
Courtesy of NISSAN NORTH AMERICA, INC.

Use Genuine RTV Silicone Sealant or an equivalent. Refer to "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS ".

CAUTION: Never apply gasket to the oil passage.

d. Install new VVEL actuator sub assembly.
   - Tighten mounting bolts in the following step, in numerical order as shown below.

A : Bank 1
B : Bank 2

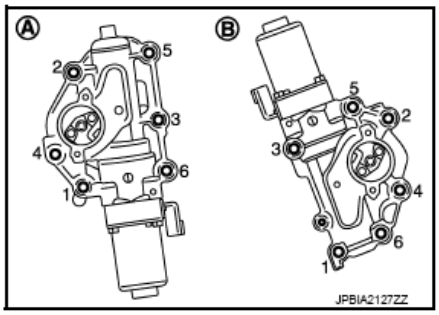


Fig. 149: VVEL Actuator Sub Assembly Mounting Bolts Tightening Sequence
Courtesy of NISSAN NORTH AMERICA, INC.

CAUTION:
- **When installing, be careful with VVEL actuator sub assembly (bank 1) mounting bolt No. 4 because its length is different.**

- **Be sure to check that the VVEL actuator sub assembly is in contact with the cylinder head before tightening the mounting bolts.**

e. Remove holding jig.

f. Check that VVEL actuator arm bolt hole is aligned with control shaft tapped hole. If it is not aligned, turn control shaft for alignment.

CAUTION: Never give an impact to the magnet part. (A)

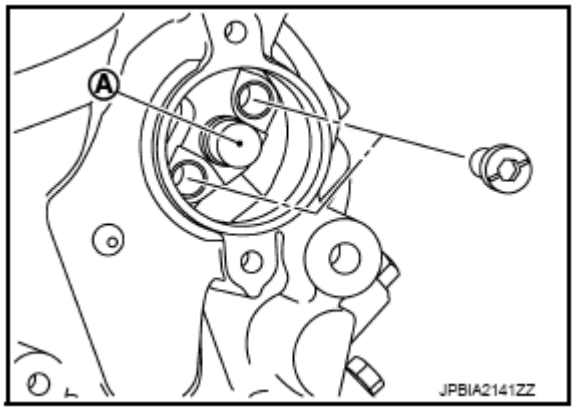


Fig. 150: Locating VVEL Actuator Sub Assembly Magnet Part
Courtesy of NISSAN NORTH AMERICA, INC.

g. Fix two flat areas (C) of control shaft with a wrench to tighten mounting bolts of control shaft.

CAUTION:

- **During the operation, never allow a wrench to interfere with other parts.**
- **Fix control shaft to prevent the interference of the stopper surface.**

A : Bank 2
B : Bank 1
⇦ : Engine front

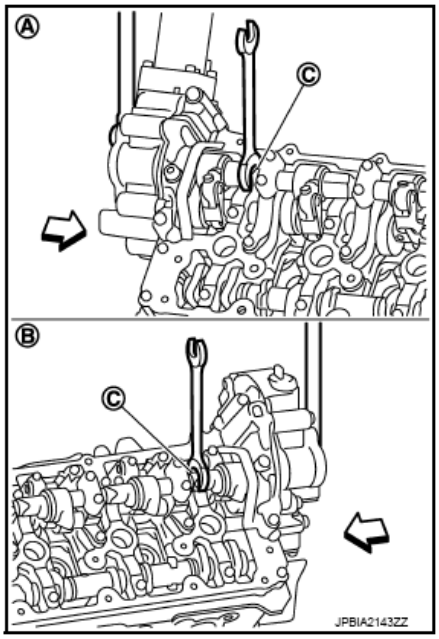


Fig. 151: Tightening Control Shaft Mounting Bolts Using Wrench
Courtesy of NISSAN NORTH AMERICA, INC.

7. Install new VVEL control shaft position sensor as per the following:

CAUTION: Regarding replacement, because VVEL actuator sub assembly and VVEL control shaft position sensor are controlled on a one-on-one basis, replace them as a set.

a. Apply engine oil to O-ring or contact surface of O-ring.
b. Align matching marks (B) of VVEL control shaft position sensor and upper housing.
   - Face connector toward matching mark (A).

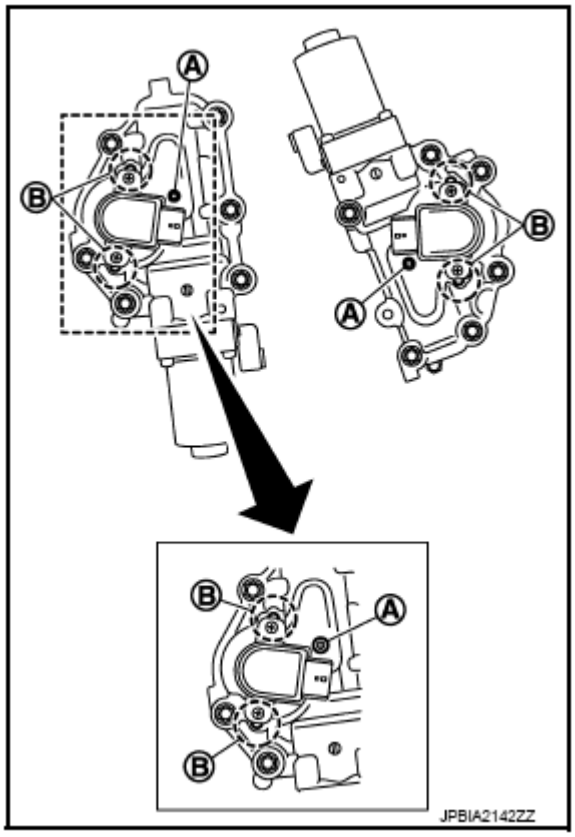


Fig. 152: Locating VVEL Control Shaft Position Sensor And Upper Housing Matching Marks
Courtesy of NISSAN NORTH AMERICA, INC.

c. Temporarily tighten bolt.
d. Adjust VVEL control shaft position sensor after setting the engine assembly in the vehicle. Refer to "**VVEL CONTROL SHAFT POSITION SENSOR ADJUSTMENT: DESCRIPTION** ".

CAUTION: Be sure to adjust VVEL control shaft position sensor.

e. After adjusting VVEL control shaft position sensor, tighten bolts to the specified torque.

8. Install actuator cover.
9. Inspect the valve clearance. Refer to "**INSPECTION**".
10. Install in the reverse order of removal.

Inspection

CAMSHAFT (EXH) VALVE CLEARANCE ADJUSTMENT

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

1. Measure the valve clearance. Refer to "**INSPECTION**".
2. Remove VVEL ladder assembly and camshaft (EXH). Refer to "**DISASSEMBLY AND ASSEMBLY**".

CAUTION: Never loosen adjusting bolts and mounting bolts (black color) of VVEL ladder assembly.

3. Remove valve lifter (EXH) at the locations that are out of the standard.
4. Measure the center thickness of the removed valve lifters (EXH) with a micrometer (A).

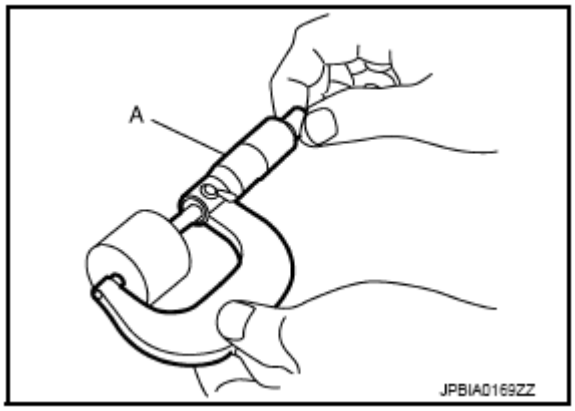


Fig. 153: Measuring Center Thickness Of Removed Valve Lifters (EXH) Using Micrometer
Courtesy of NISSAN NORTH AMERICA, INC.

5. Use the equation below to calculate valve lifter (EXH) thickness for replacement.

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

t = Valve lifter (EXH) thickness to be replaced

t1 = Removed valve lifter (EXH) thickness

C1 = Measured valve clearance

C2 = Standard valve clearance:

Exhaust: 0.33 mm (0.013 in)

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

  Stamp mark 788 indicates 7.88 mm (0.3102 in) in thickness.

A : Stamp
B : Thickness of valve lifter (EXH)

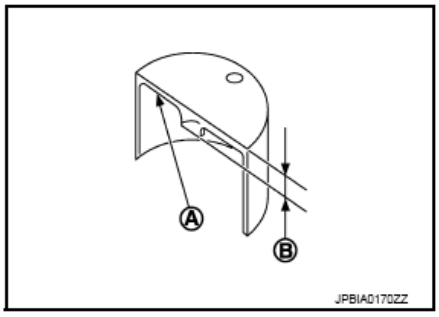


Fig. 154: Identifying Valve Lifter (EXH) Thickness And Stamp Mark
Courtesy of NISSAN NORTH AMERICA, INC.

Available thickness of valve lifter (EXH): 27 sizes with range 7.88 to 8.40 mm (0.3102 to 0.3307 in) in steps of 0.02 mm (0.0008 in) (when manufactured at factory). Refer to "**CAMSHAFT**".

6. Install selected valve lifter (EXH).
7. Install VVEL ladder assembly and camshaft (EXH). Refer to "**DISASSEMBLY AND ASSEMBLY**".
8. Manually turn crankshaft pulley a few turns.
9. Check that the valve clearances for cold engine are within the specifications by referring to the specified values. Refer to "**INSPECTION**".
10. Install all removed parts in the reverse order of removal.
11. Warm up the engine, and check for unusual noise and vibration.

INSPECTION AFTER DISASSEMBLY (EXHAUST SIDE)

Camshaft (EXH) Runout

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

CAUTION: Never support No. 1 journal (on the side of camshaft sprocket) because it has a different diameter from the other four locations.

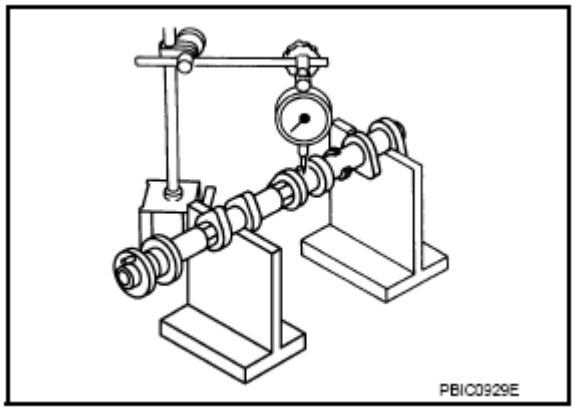


Fig. 155: Checking Camshaft (EXH) Runout Using Dial Indicator

Courtesy of NISSAN NORTH AMERICA, INC.

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

   Standard and limit

   : Refer to "CAMSHAFT".

4. If it exceeds the limit, replace camshaft (EXH).

Camshaft (EXH) Cam Height

- Measure the camshaft (EXH) cam height with a micrometer.

  Standard and limit

  : Refer to "CAMSHAFT".

- If wear exceeds the limit, replace camshaft (EXH).

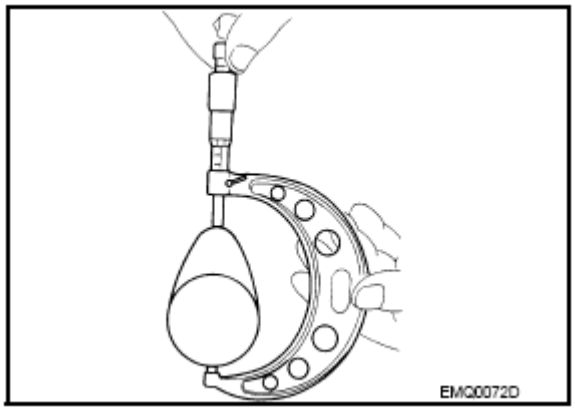


Fig. 156: Measuring Camshaft (EXH) Cam Height Using Micrometer
Courtesy of NISSAN NORTH AMERICA, INC.

Camshaft (EXH) Journal Oil Clearance

CAMSHAFT (EXH) JOURNAL DIAMETER

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

  Standard: Refer to "CAMSHAFT".

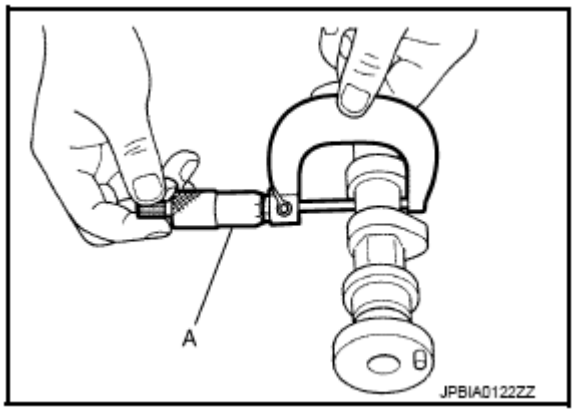


Fig. 157: Measuring Outer Diameter Of Camshaft (EXH) Journal Using Micrometer
Courtesy of NISSAN NORTH AMERICA, INC.

VVEL LADDER ASSEMBLY (EXH SIDE) INNER DIAMETER

- Tighten VVEL ladder assembly bolts to the specified torque. Refer to "**ASSEMBLY**" for the tightening procedure.
- Measure inner diameter (A) of VVEL ladder assembly (EXH side) with a bore gauge.

Standard: Refer to "CAMSHAFT".

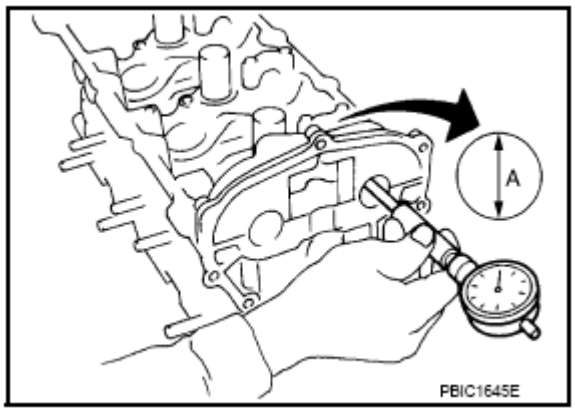


Fig. 158: Measuring Inner Diameter Of VVEL Ladder Assembly (EXH Side) Using Bore Gauge
Courtesy of NISSAN NORTH AMERICA, INC.

CAMSHAFT (EXH) JOURNAL OIL CLEARANCE

- (Oil clearance) = [VVEL ladder assembly (EXH side) inner diameter] - [Camshaft (EXH) journal diameter].

Standard and limit: Refer to "CAMSHAFT".

- If the calculated value exceeds the limit, replace either or both camshaft (EXH) and VVEL ladder

assembly & cylinder head assembly.

NOTE: VVEL ladder assembly cannot be replaced as a single part, because it is machined together with cylinder head assembly.

Camshaft (EXH) End Play

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

  Standard and limit: Refer to "CAMSHAFT".

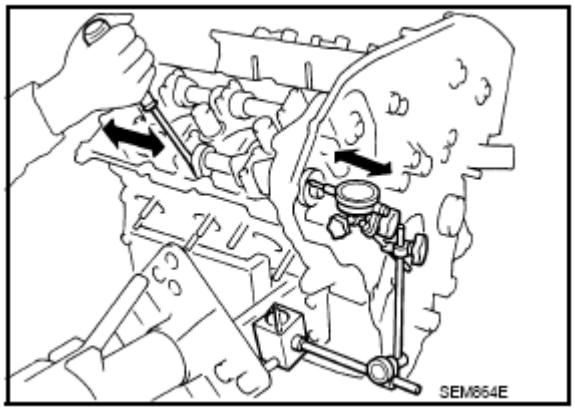


Fig. 159: Measuring Camshaft (EXH) End Play Using Dial Indicator
Courtesy of NISSAN NORTH AMERICA, INC.

- Measure the following parts if out of the limit.
  - Dimension "A" for camshaft (EXH) No. 1 journal

    Standard: 30.500 - 30.548 mm (1.2008 - 1.2027 in)

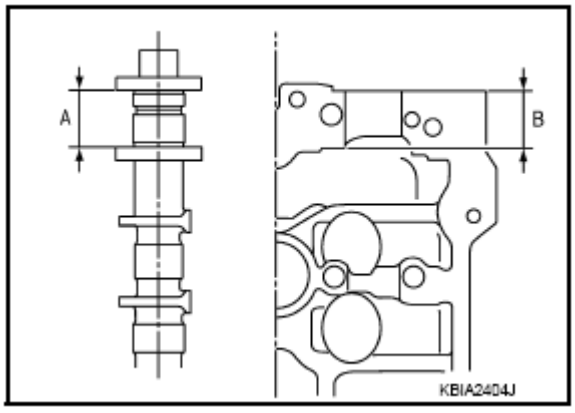


Fig. 160: Identifying Camshaft (EXH) Journal And Cylinder Head Bearing Dimension
Courtesy of NISSAN NORTH AMERICA, INC.

- Dimension "B" for cylinder head No. 1 journal bearing

  Standard: 30.360 - 30.385 mm (1.1953 - 1.1963 in)

- Refer to the standards above, and then replace camshaft (EXH) and/or VVEL ladder assembly & cylinder head assembly.

NOTE: Cylinder head assembly cannot be replaced as a single part, because it is machined together with VVEL ladder assembly.

Camshaft Sprocket (EXH) Runout

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

CAUTION: Never support No. 1 journal (on the side of camshaft sprocket) because it has a different diameter from the other four locations.

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

   Limit: Refer to "CAMSHAFT".

3. If it exceeds the limit, replace camshaft sprocket (EXH).

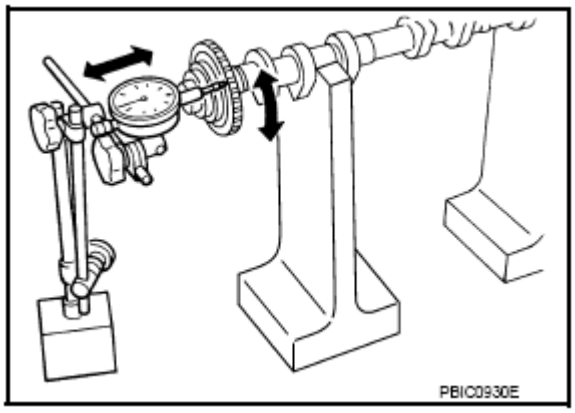


Fig. 161: Measuring Camshaft Sprocket (EXH) Runout Using Dial Indicator
Courtesy of NISSAN NORTH AMERICA, INC.

Valve Lifter (EXH)

- Check if surface of valve lifter has any wear or crack.
- If wear or crack is found, replace valve lifter (EXH). Refer to "CAMSHAFT".

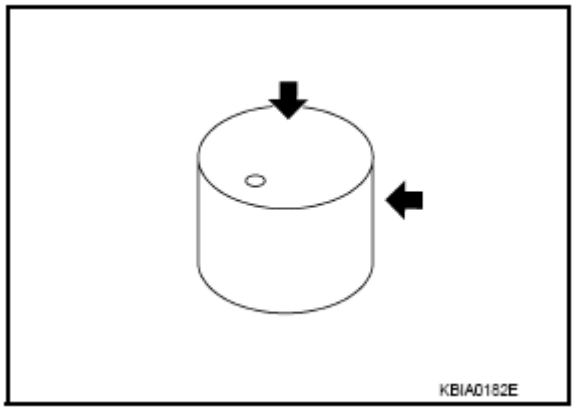


Fig. 162: Locating Valve Lifter (EXH) Inspection Points
Courtesy of NISSAN NORTH AMERICA, INC.

Valve Lifter Clearance (EXH)

VALVE LIFTER OUTER DIAMETER

- Measure the outer diameter at 1/2 height of valve lifter with a micrometer (A) since valve lifter is in barrel shape.

  Standard: Refer to "CAMSHAFT".

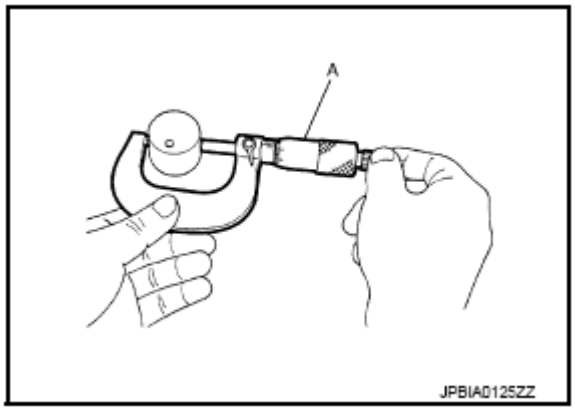


Fig. 163: Measuring Outer Diameter At 1/2 Height Of Valve Lifter Using Micrometer
Courtesy of NISSAN NORTH AMERICA, INC.

VALVE LIFTER HOLE DIAMETER

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

  Standard: Refer to "CAMSHAFT".

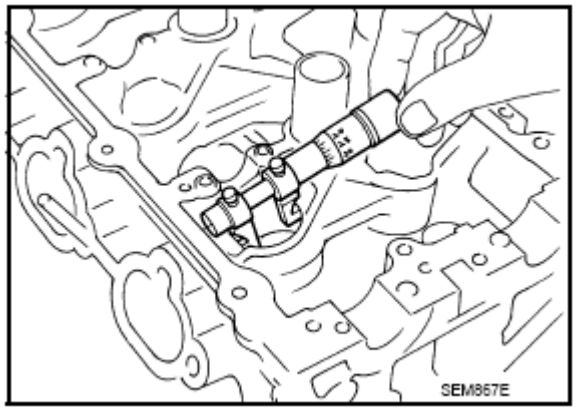


Fig. 164: Measuring Inner Diameter Of Valve Lifter Hole Of Cylinder Head Using Inside Micrometer
Courtesy of NISSAN NORTH AMERICA, INC.

VALVE LIFTER CLEARANCE

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

  Standard: Refer to "CAMSHAFT".

- If the calculated value is 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 VVEL ladder assembly & cylinder head assembly.

NOTE: Cylinder head assembly cannot be replaced as a single part, because it is machined together with VVEL ladder assembly.

INSPECTION AFTER DISASSEMBLY (INTAKE SIDE)

Drive Shaft End Play

- Install a dial indicator in thrust direction on front end of drive shaft. Measure the end play of a dial indicator when drive shaft is moved forward/backward (in direction of axis).

  Standard and limit: Refer to "CAMSHAFT".

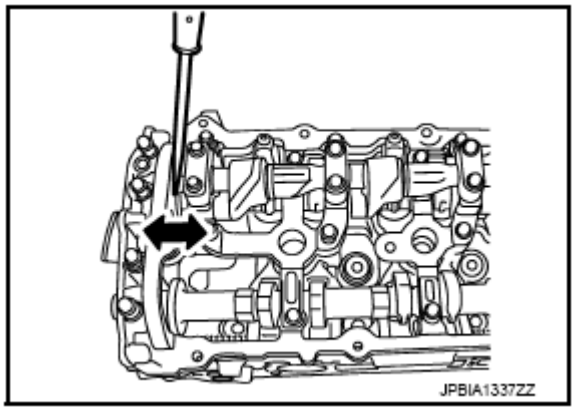


Fig. 165: Measuring Drive Shaft End Play Using Tool
Courtesy of NISSAN NORTH AMERICA, INC.

- Measure the following parts if out of the limit.
  - Dimension "A" for drive shaft No. 1 journal

    Standard: 30.500 - 30.548 mm (1.2008 - 1.2027 in)

  - Dimension "B" for cylinder head No. 1 journal bearing

    Standard: 30.360 - 30.385 mm (1.1953 - 1.1963 in)

- If it exceeds the limit, replace VVEL ladder assembly & cylinder head assembly.

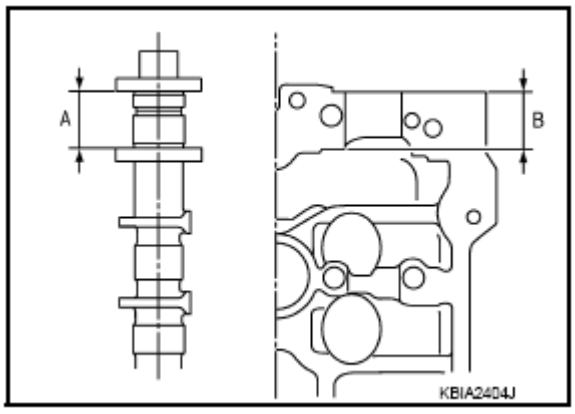


Fig. 166: Identifying Camshaft (EXH) Journal And Cylinder Head Bearing Dimension
Courtesy of NISSAN NORTH AMERICA, INC.

NOTE: Cylinder head assembly cannot be replaced as a single part, because it is machined together with VVEL ladder assembly.

Camshaft Sprocket (INT) Runout

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

CAUTION: Never support No. 1 journal (on the side of camshaft sprocket) because it has a different diameter from the other four locations.

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

Limit: Refer to "CAMSHAFT".

3. If it exceeds the limit, replace camshaft sprocket (INT).

Valve Lifter (INT)

- Check if surface of valve lifter has any wear or crack.
- If wear or crack is found, replace VVEL ladder assembly & cylinder head assembly. Refer to "**CAMSHAFT**".

NOTE: Since the valve lifter (INT) cannot be replaced by the piece, VVEL ladder assembly & cylinder head assembly replacement are required.

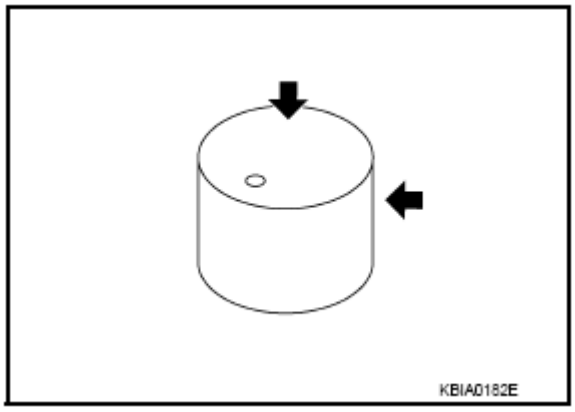


Fig. 167: Locating Valve Lifter (EXH) Inspection Points
Courtesy of NISSAN NORTH AMERICA, INC.

Valve Lifter Clearance (INT)

VALVE LIFTER OUTER DIAMETER

- Measure the outer diameter at 1/2 height of valve lifter (INT) with a micrometer (A) since valve lifter is in barrel shape.

Standard: Refer to "CAMSHAFT".

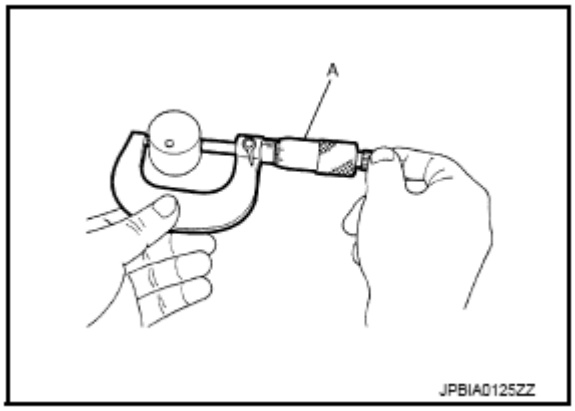


Fig. 168: Measuring Outer Diameter At 1/2 Height Of Valve Lifter Using Micrometer
Courtesy of NISSAN NORTH AMERICA, INC.

VALVE LIFTER HOLE DIAMETER

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

  Standard: Refer to "CAMSHAFT".

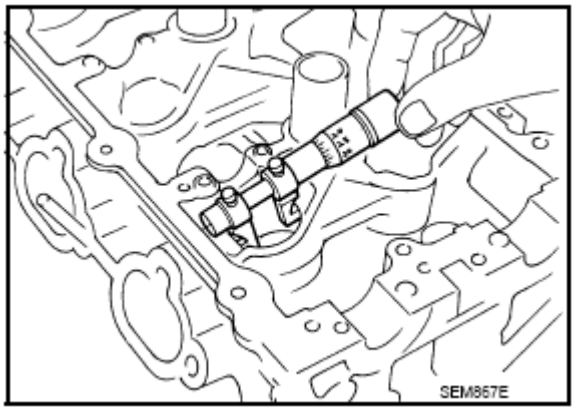


Fig. 169: Measuring Inner Diameter Of Valve Lifter Hole Of Cylinder Head Using Inside Micrometer
Courtesy of NISSAN NORTH AMERICA, INC.

VALVE LIFTER CLEARANCE

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

  Standard: Refer to "CAMSHAFT".

- If the calculated value is out of the standard, replace VVEL ladder assembly & cylinder head assembly.

NOTE: Since the valve lifter (INT) cannot be replaced by the piece, VVEL ladder

assembly & cylinder head assembly replacement are required.

VVEL Ladder Assembly

DRIVE SHAFT OPERATIONAL CHECK

- Hold the both ends of the drive shaft (A) and rotate it to check that it rotates smoothly.

CAUTION: Turn VVEL ladder assembly upside down to prevent the drive shaft from dropping off.

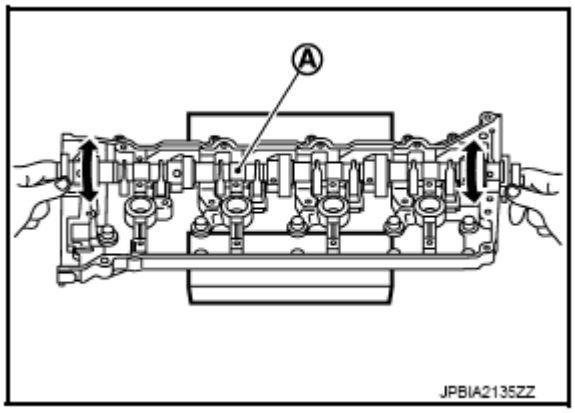


Fig. 170: Checking Drive Shaft Operation
Courtesy of NISSAN NORTH AMERICA, INC.

CONTROL SHAFT OPERATIONAL CHECK

- Move control shaft (A) to the small stopper and large stopper to check that the control shaft functions smoothly.

CAUTION: Turn VVEL ladder assembly upside down to prevent the drive shaft from dropping off.

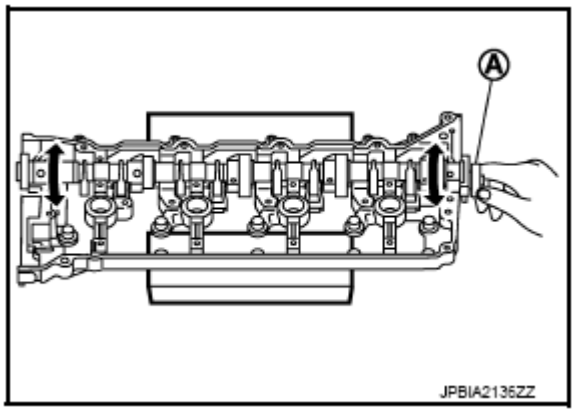


Fig. 171: Checking Control Shaft Operation
Courtesy of NISSAN NORTH AMERICA, INC.

LINK CHECK FOR BACK-LASH (BONDING)

- Check that the link and the shaft of drive shaft and control shaft are not fixed.
- Check this by moving drive shaft and control shaft in the axial and rotation directions.

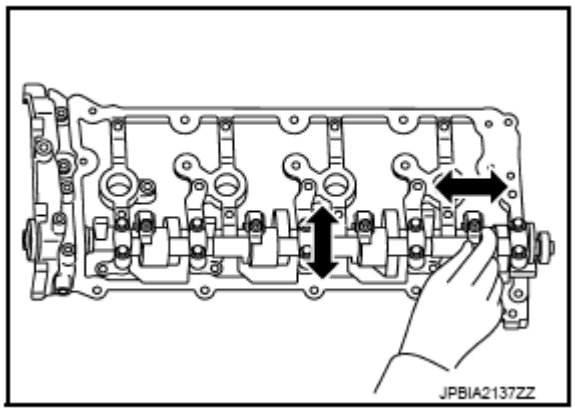


Fig. 172: Checking Drive Shaft And Control Shaft Link Back-Lash
Courtesy of NISSAN NORTH AMERICA, INC.

- If there is an unusualness related to the above three items, replace VVEL ladder assembly & cylinder head assembly.

NOTE: **VVEL ladder assembly cannot be replaced as a single part, because it is machined together with cylinder head assembly.**

INSPECTION AFTER ASSEMBLY

Inspection of Camshaft Sprocket (INT) Oil Groove

CAUTION:
- **Perform this inspection only when DTC P0011, P0012 is detected in**

self-diagnostic results of CONSULT and it is directed according to inspection procedure of Engine Control article. Refer to "DIAGNOSIS DESCRIPTION ".

- Check when engine is cold to prevent burns from the splashing engine oil.

1. Check engine oil level. Refer to "**INSPECTION** ".
2. Perform the following procedure to prevent the engine from being unintentionally started while checking.
   a. Release the fuel pressure. Refer to "**INSPECTION** ".
   b. Disconnect ignition coil and injector harness connectors. Refer to "**EXPLODED VIEW**".
3. Remove valve timing control solenoid valve. Refer to "**EXPLODED VIEW**".
4. Crank engine, and then check that engine oil comes out from valve timing control solenoid valve hole (A). End crank after checking.

1 : Valve timing control cover (bank 2)

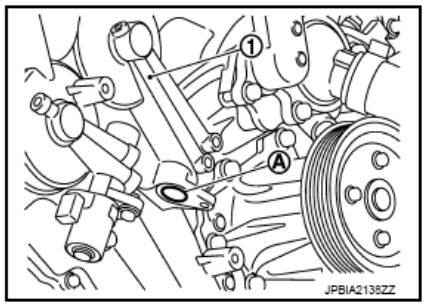


Fig. 173: Locating Valve Timing Control Cover And Solenoid Valve Hole
Courtesy of NISSAN NORTH AMERICA, INC.

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

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

5. Perform the following inspection if engine oil does not come out from valve timing control solenoid valve oil hole of the valve timing control cover.
   - Remove oil filter, and then clean it. Refer to "**EXPLODED VIEW**".
   - Clean oil groove between oil strainer and valve timing control solenoid valve. Refer to "**ENGINE LUBRICATION SYSTEM** " and "**ENGINE LUBRICATION SYSTEM SCHEMATIC** ".

6. Remove components between valve timing control solenoid valve and camshaft sprocket, and then check each oil groove for clogging.
   - Clean oil groove if necessary. Refer to "**ENGINE LUBRICATION SYSTEM** " and "**ENGINE LUBRICATION SYSTEM SCHEMATIC** ".
7. After inspection, install removed parts in the reverse order.

Inspection for Leakage

The following are procedures for checking fluid leakage, lubricant leakage.

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

NOTE: If hydraulic pressure inside chain tensioner drops after removal/installation, slack in guide may generate a pounding noise during and just after the engine start. However, this does not indicate a malfunction. The noise will stop after hydraulic pressure rises.

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

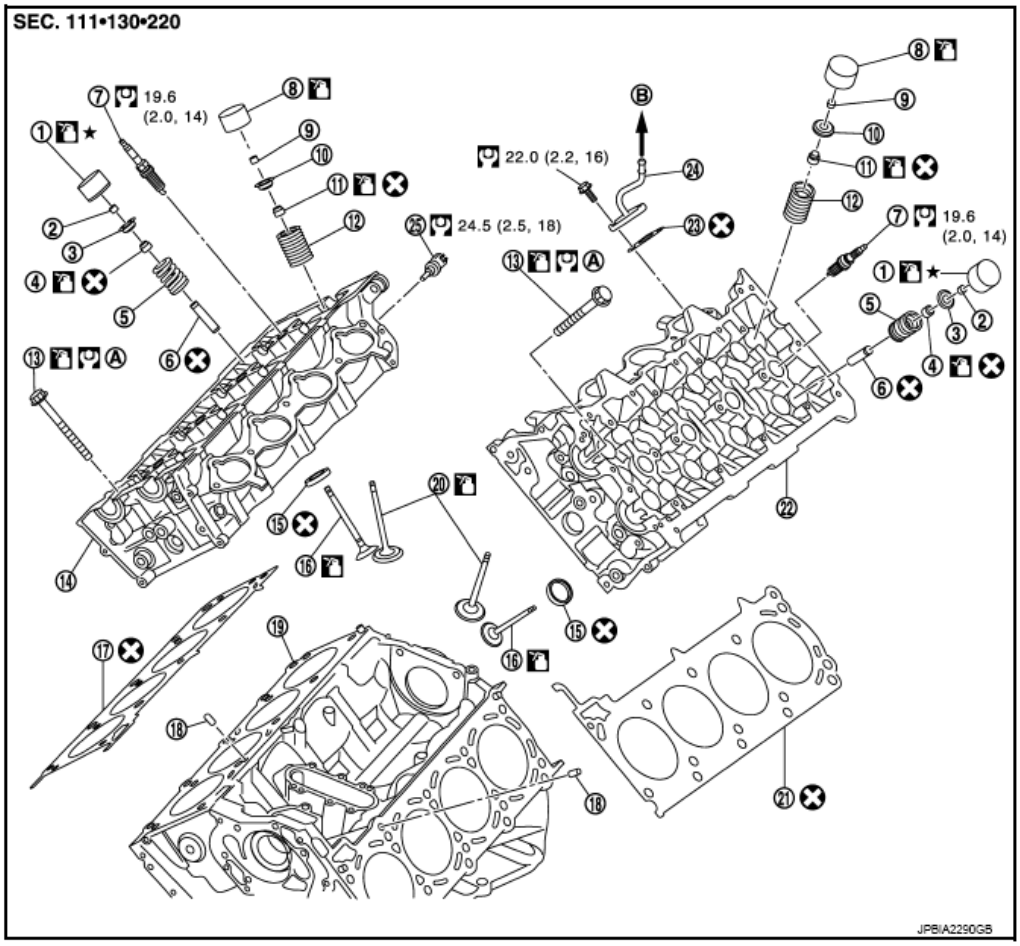
SUMMARY OF INSPECTION ITEMS

Items		Before starting engine	Engine running	After engine stopped
Engine coolant		Level	Leakage	Level
Engine oil		Level	Leakage	Level
Transmission/transaxle fluid	AT Models	Leakage	Level/Leakage	Leakage
	MT Models	Level/Leakage	Leakage	Level/Leakage
Other oils and fluids(1)		Level	Leakage	Level
Fuel		Leakage	Leakage	Leakage
Exhaust gases		-	Leakage	-
(1) Power steering fluid, brake fluid, etc.				

CYLINDER HEAD

Exploded View

Symbol	Description
	N·m (kg-m, ft-lb)
	N·m (kg-m, in-lb)
	Always replace after disassembly.



1.	Valve lifter (EXH)	2.	Valve collet (EXH)	3.	Valve spring retainer (EXH)
4.	Valve oil seal (EXH)	5.	Valve spring (with valve spring seat) (EXH)	6.	Valve guide (EXH)
7.	Spark plug	8.	Valve seat (INT)	9.	Valve collet (INT)
10.	Valve spring retainer (INT)	11.	Valve oil seal (INT)	12.	Valve spring (with valve spring seat) (INT)
13.	Cylinder head bolt	14.	Cylinder head (bank 2)	15.	Valve seat (EXH)
16.	Valve (EXH)	17.	Cylinder head gasket (bank 2)	18.	Oil filter (for VVEL ladder assembly)
19.	Cylinder block	20.	Valve (INT)	21.	Cylinder head gasket (bank 1)
22.	Cylinder head (bank 1)	23.	Gasket	24.	Water pipe
25.	Engine coolant temperature sensor				
A.	Comply with the installation procedure when tightening.	B.	To Electric throttle control actuator (bank 1)		

Fig. 174: Exploded View Of Cylinder Head With Torque Specifications
Courtesy of NISSAN NORTH AMERICA, INC.

Refer to "**COMPONENTS** " for symbol marks in the figure.

CAUTION: A high degree of precision is required for a valve on the intake side. Never remove the valve related parts unless necessary.

NOTE:

- **As for replacement of parts on the intake side as shown in the exploded view above, replace VVEL ladder assembly & cylinder head assembly. (Only valve oil seals are replaceable as a single part.)**
- **VVEL ladder assembly cannot be replaced as a single part, because it is machined together with cylinder head assembly.**

Disassembly and Assembly

DISASSEMBLY

1. Remove the following parts:
   - Rocker cover and spark plug: Refer to "**EXPLODED VIEW**".
   - Intake manifold: Refer to "**EXPLODED VIEW**".
   - Exhaust manifold: Refer to "**EXPLODED VIEW**".
   - Water inlet and thermostat housing: Refer to "**EXPLODED VIEW** ".
   - Water pipe and heater pipe: Refer to "**EXPLODED VIEW** ".
   - Timing chain: Refer to "**EXPLODED VIEW**".
   - Camshaft (EXH) and VVEL ladder assembly: Refer to "**EXPLODED VIEW**".
2. Remove cylinder head.
   - Loosen mounting bolts in reverse order as shown in the figure below.

A : Bank 2
B : Bank 1
⇦ : Engine front

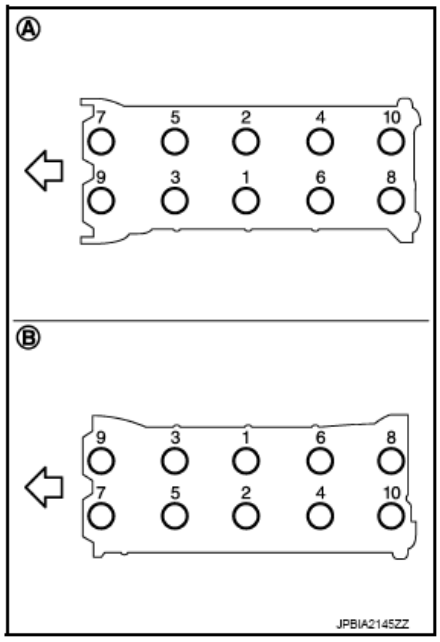


Fig. 175: Cylinder Head Mounting Bolts Tightening Sequence
Courtesy of NISSAN NORTH AMERICA, INC.

- Use TORX socket and power tool.

3. Remove cylinder head gaskets.
4. Remove oil filter (for VVEL ladder assembly) from cylinder block, if necessary.
5. Remove valve lifter.
6. Identify installation positions, and store them without mixing them up.
7. Remove valve collet.
   - Compress valve spring with the valve spring compressor [SST:

     KV10116200 (J-26336-A)] (A), the attachment [SST:

     KV10115900 (J-26336-20)] (C) and the adapter [SST:

     KV10109220 (-)] (B). Remove valve collet with a magnet hand.

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

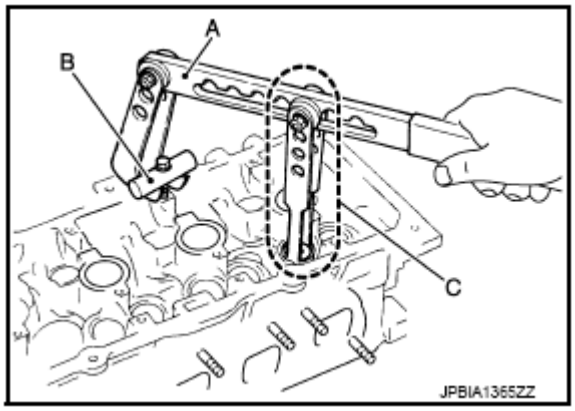


Fig. 176: Compressing Valve Spring Using Compressor
Courtesy of NISSAN NORTH AMERICA, INC.

8. Remove valve spring retainer and valve spring (with valve spring seat).
9. Push valve stem to combustion chamber side, and remove valve.
   - Identify installation positions, and store them without mixing them up.
10. Remove valve oil seal using the valve oil seal puller [SST: KV10107902 (J38959)] (A).

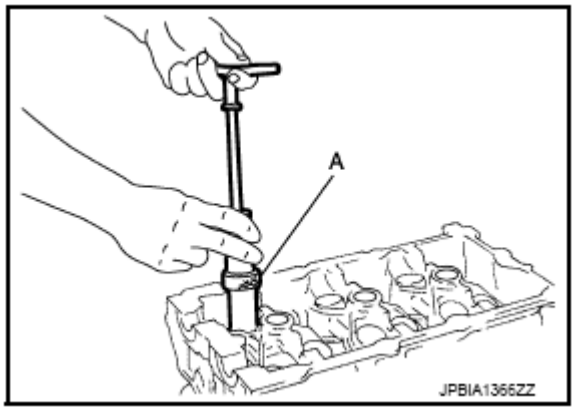


Fig. 177: Removing Valve Oil Seal Using Valve Oil Seal Puller
Courtesy of NISSAN NORTH AMERICA, INC.

11. Remove valve seat (EXH), if valve seat (EXH) must be replaced.
    - Bore out old seat until it collapses. Boring should not continue beyond the bottom face of the seat recess in cylinder head. Set the machine depth stop to ensure this. Refer to "**CYLINDER HEAD**".

CAUTION: Prevent to scratch cylinder head by excessive boring.

12. Remove valve guide (EXH), if valve guide (EXH) must be replaced.
    a. To remove valve guide (EXH), heat cylinder head to 110 to 130°C (230 to 266°F) by soaking in heated oil (A).

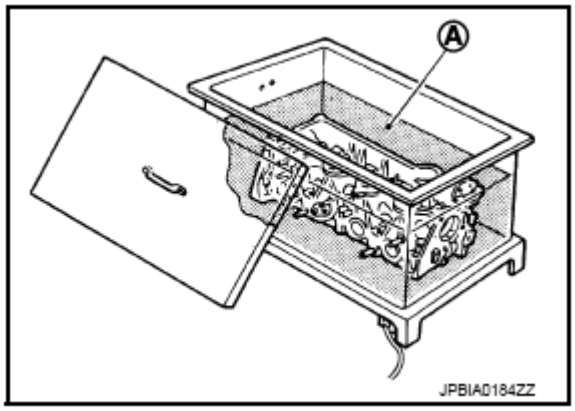


Fig. 178: Heating Cylinder Head Using Heated Oil
Courtesy of NISSAN NORTH AMERICA, INC.

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

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

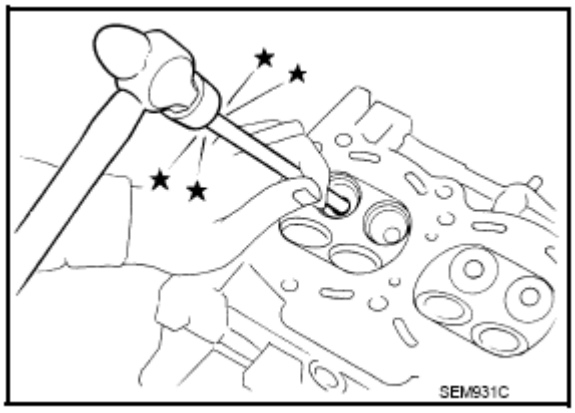


Fig. 179: Driving Out Valve Guide (EXH) Using Hammer
Courtesy of NISSAN NORTH AMERICA, INC.

ASSEMBLY

1. Install valve guide (EXH), if removed.

   Replace with oversized [0.2 mm (0.008 in)] valve guide (EXH).

   a. Using the valve guide reamer (commercial service tool) (A), ream cylinder head valve guide (EXH) hole.

      Oversize (service) [0.2 mm (0.008 in)]:

: Refer to "CYLINDER HEAD".

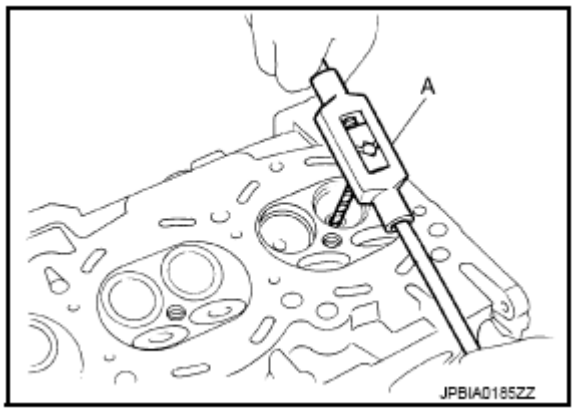


Fig. 180: Reaming Cylinder Head Valve Guide (EXH) Hole Using Valve Guide Reamer
Courtesy of NISSAN NORTH AMERICA, INC.

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

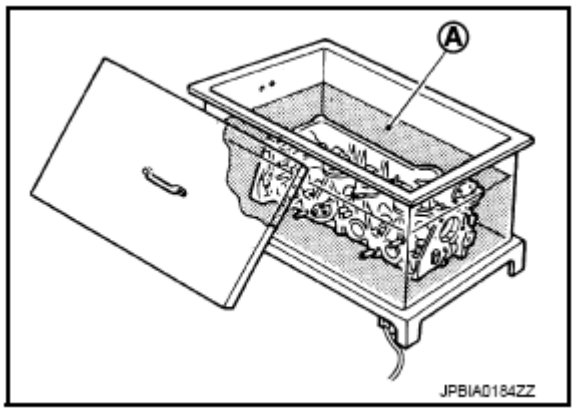


Fig. 181: Heating Cylinder Head Using Heated Oil
Courtesy of NISSAN NORTH AMERICA, INC.

c. Using the valve guide drift (commercial service tool), press valve guide (EXH) from camshaft side to the dimensions as shown in the figure below.

Projection (A)

: Refer to "CYLINDER HEAD".

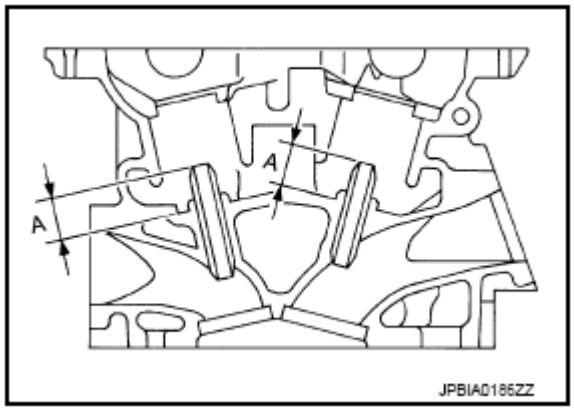


Fig. 182: Identifying Valve Guide (EXH) Installation Dimension
Courtesy of NISSAN NORTH AMERICA, INC.

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

d. Using the valve guide reamer (commercial service tool) (A), apply reamer finish to valve guide (EXH).

Standard: Refer to "CYLINDER HEAD".

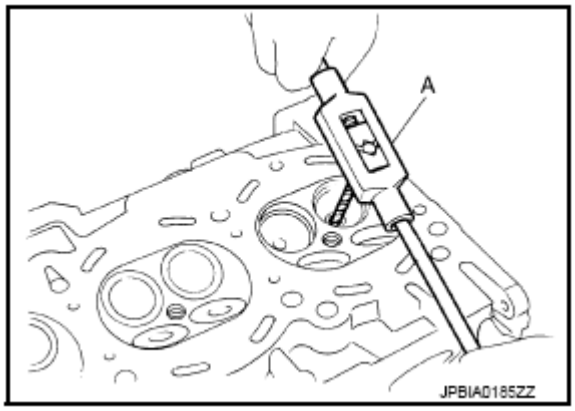


Fig. 183: Reaming Cylinder Head Valve Guide (EXH) Hole Using Valve Guide Reamer
Courtesy of NISSAN NORTH AMERICA, INC.

2. Install valve seat (EXH), if removed.

Replace with oversize [0.5 mm (0.020 in)] valve seat (EXH).

a. Ream cylinder head recess diameter (a) for service valve seat (EXH).

Oversize (service) [0.5 mm (0.020 in)]:

: Refer to "CYLINDER HEAD".

- Be sure to ream in circles concentric to valve guide center.

This enables valve to fit correctly.

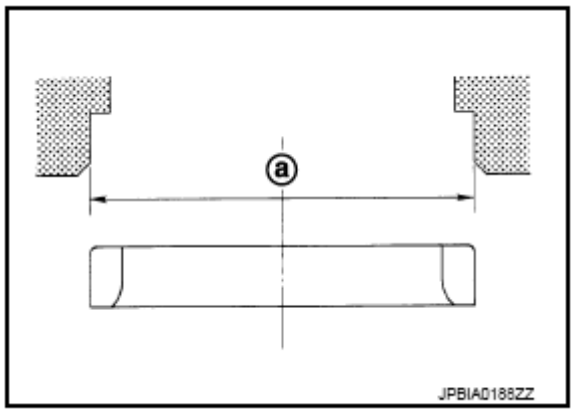


Fig. 184: Identifying Cylinder Head Recess Diameter
Courtesy of NISSAN NORTH AMERICA, INC.

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

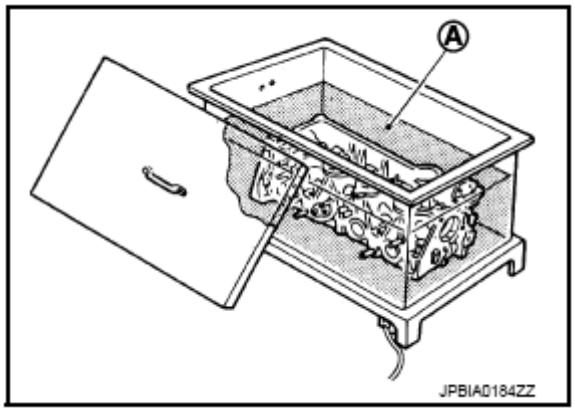


Fig. 185: Heating Cylinder Head Using Heated Oil
Courtesy of NISSAN NORTH AMERICA, INC.

c. Provide valve seats (EXH) cooled well with dry ice. Force fit valve seat (EXH) into cylinder head.

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

CAUTION: Avoid directly touching cold valve seats.

d. Using the valve seat cutter set (commercial service tool) or valve seat grinder, finish seat to the specified dimensions. Refer to "**CYLINDER HEAD**".

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

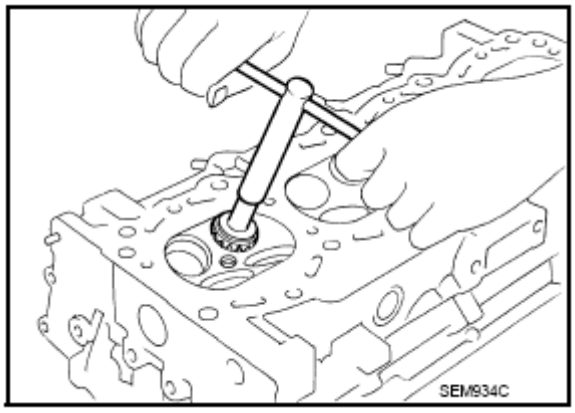


Fig. 186: Finishing Valve Seat Using Valve Seat Cutter
Courtesy of NISSAN NORTH AMERICA, INC.

e. Using compound, grind to adjust valve fitting.
f. Check again for normal contact. Refer to "**INSPECTION**".

3. Install new valve oil seals as per the following:
   a. Apply new engine oil on new valve oil seal joint and seal lip.
   b. Using the valve oil seal drift [SST: KV10115600 (J-38958)] (A), press fit valve seal to height (b) shown in figure below.

Height (b)

Intake: 14.3 - 14.9 mm (0.563 - 0.587 in)

Exhaust: 13.6 - 14.2 mm (0.535 - 0.559 in)

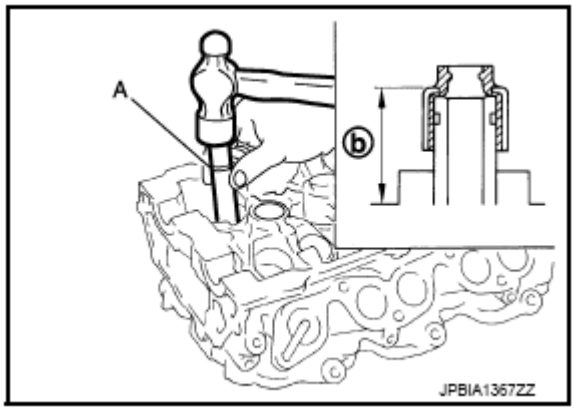


Fig. 187: Pressing Valve Seal Using Drift
Courtesy of NISSAN NORTH AMERICA, INC.

4. Install valve.

NOTE: Larger diameter valves are for intake side.

5. Install oil filter (for VVEL ladder assembly) (1) in the direction shown in the figure below, if removed.
   - Check that the oil filter does not protrude from the upper surface of cylinder block (2) after installation.

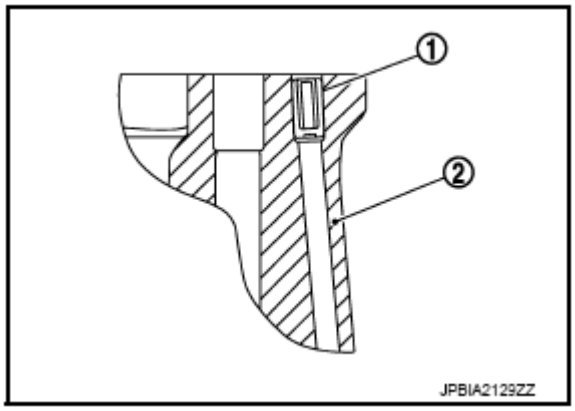


Fig. 188: Locating Oil Filter And Cylinder Block
Courtesy of NISSAN NORTH AMERICA, INC.

6. Install new cylinder head gaskets.
7. Install cylinder head as per the following:

CAUTION:
- **If cylinder head bolts are re-used, check their outer diameters before installation. Refer to "INSPECTION".**
- **Before installing cylinder head, inspect cylinder head distortion. Refer to "INSPECTION".**

- Tighten cylinder head bolts in numerical order as shown in figure below.

A : Bank 2
B : Bank 1
⇦ : Engine front

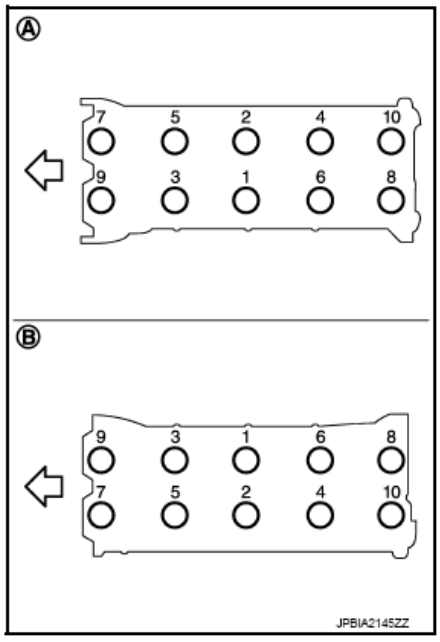


Fig. 189: Cylinder Head Mounting Bolts Tightening Sequence
Courtesy of NISSAN NORTH AMERICA, INC.

- Use TORX socket.

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

Torque Value: 40 N.m (4.1 kg-m, 30 ft-lb)

c. Tighten all cylinder head bolts (clockwise).

Angle tightening: 75 degrees

d. Completely loosen all cylinder head bolts.

Torque Value: 0 N.m (0 kg-m, 0 ft-lb)

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

e. Tighten all cylinder head bolts.

Torque Value: 40.0 N.m (4.1 kg-m, 30 ft-lb)

f. Tighten all cylinder head bolts (clockwise).

Angle tightening: 65 degrees

CAUTION: Check the tightening angle using the angle wrench [SST: KV10112100 (BT8653-A)] (A). Never make judgment by visual inspection.

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

g. Tighten all cylinder head bolts again (clockwise).

Angle tightening: 65 degrees

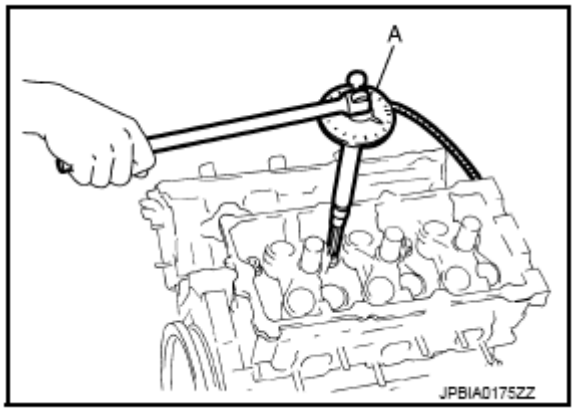


Fig. 190: Checking Tightening Angle Using Angle Wrench
Courtesy of NISSAN NORTH AMERICA, INC.

8. Install valve spring (with valve spring seat).
   - Install narrow pitch (B) end [paint mark (C)] to cylinder head side (valve spring seat side).

A : Wide pitch
⇦ : Cylinder head side

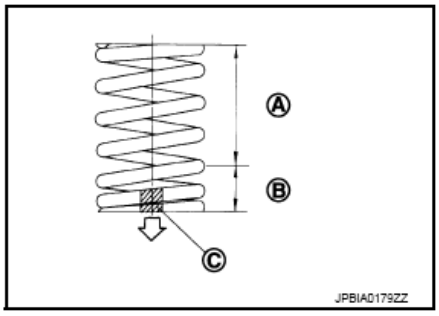


Fig. 191: Identifying Wide And Narrow Pitch Of Valve Spring
Courtesy of NISSAN NORTH AMERICA, INC.

Paint mark color

Intake: Yellow

Exhaust: Pink

9. Install valve spring retainer.
10. Install valve collet.
    - Compress valve spring with the valve spring compressor [SST:

      KV10116200 (J26336-A)] (A), the attachment [SST:

      KV10115900 (J26336-20)] (C) and the adapter [SST:

      KV10109220 (-)] (B). Install valve collet with a magnet hand.

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

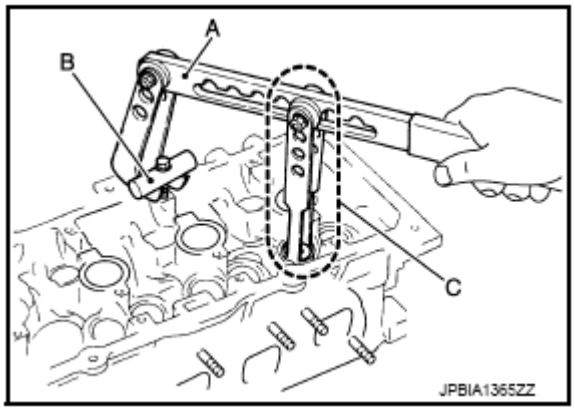


Fig. 192: Compressing Valve Spring Using Compressor
Courtesy of NISSAN NORTH AMERICA, INC.

    - Tap valve stem edge lightly with plastic hammer after installation to check its installed condition.
11. Install valve lifter.
    - Install it in the original position.
12. Install in the reverse order of removal.

Inspection

INSPECTION AFTER DISASSEMBLY

Cylinder Head Bolts Outer Diameter

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

  Limit [(B) - (A)]: 0.18 mm (0.0071 in)

c : 55 mm (2.17 in)
d : 12 mm (0.47 in)

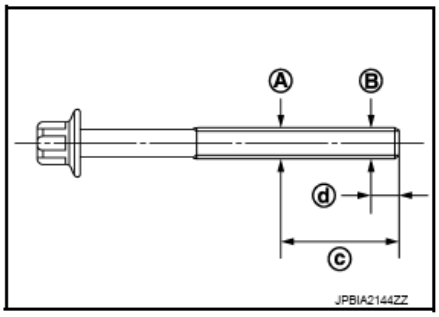


Fig. 193: Measuring Cylinder Head Bolts Outer Diameter
Courtesy of NISSAN NORTH AMERICA, INC.

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

Cylinder Head Distortion

NOTE: When performing this inspection, cylinder block distortion should be also checked. Refer to "INSPECTION".

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

   CAUTION: Never allow gasket fragments to enter engine oil or engine coolant passages.

2. At each of several locations on bottom surface of cylinder head, measure the distortion in six directions (A, B, C, D, E, F).

   Limit: Refer to "CYLINDER HEAD".

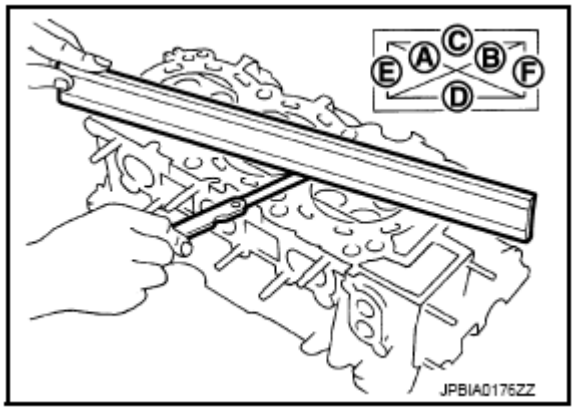


Fig. 194: Measuring Cylinder Head Distortion Using Tool
Courtesy of NISSAN NORTH AMERICA, INC.

- If it exceeds the limit, replace VVEL ladder assembly & cylinder head assembly.

NOTE: **Cylinder head assembly cannot be replaced as a single part, because it is machined together with VVEL ladder assembly.**

Valve Dimensions

- Check the dimensions of each valve. For the dimensions, refer to "**CYLINDER HEAD**".
- If dimensions are out of the standard.
  - Replace valve (EXH) and check valve seat contact. Refer to "**VALVE SEAT CONTACT**". (Exhaust side)
  - Replace VVEL ladder assembly & cylinder head assembly. Refer to "**EXPLODED VIEW**". (Intake side)

NOTE: **Since the valve (INT) cannot be replaced by the piece, VVEL ladder assembly & cylinder head assembly replacement are required.**

Valve Guide Clearance

Valve Stem Diameter

- Measure the diameter of valve stem with micrometer (A).

  Standard: Refer to "CYLINDER HEAD".

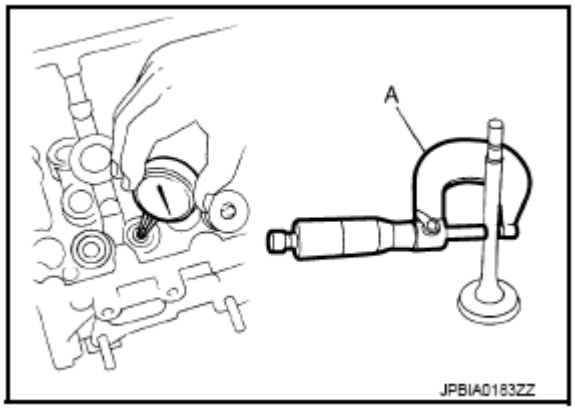


Fig. 195: Measuring Diameter Of Valve Stem Using Micrometer
Courtesy of NISSAN NORTH AMERICA, INC.

Valve Guide Inner Diameter

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

  Standard: Refer to "CYLINDER HEAD".

Valve Guide Clearance

- (Valve guide clearance) = (Valve guide inner diameter) - (Valve stem diameter)

  Standard: Refer to "CYLINDER HEAD".

- If the calculated value exceeds the limit.
  - Replace valve (EXH) and/or valve guide (EXH). Refer to "**EXPLODED VIEW**". (Exhaust side)
  - Replace VVEL ladder assembly & cylinder head assembly. Refer to "**EXPLODED VIEW**". (Intake side)

NOTE: **Since the valve (INT) and valve guide (INT) cannot be replaced by the piece, VVEL ladder assembly & cylinder head assembly replacement are required.**

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.

A : OK
B : NG

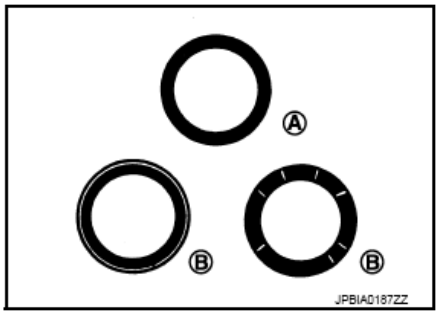


Fig. 196: Identifying Proper And Improper Valve Seat Contact Area
Courtesy of NISSAN NORTH AMERICA, INC.

  - 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 (EXH). Refer to "**EXPLODED VIEW**". (Exhaust side)
  - If not, replace VVEL ladder assembly & cylinder head assembly. Refer to "**EXPLODED VIEW**". (Intake side)

NOTE: **Since the valve seat (INT) cannot be replaced by the piece, VVEL ladder assembly & cylinder head assembly replacement are required.**

Valve Spring (with valve spring seat) Squareness

- Set a try square (A) along the side of valve spring (with valve spring seat) and rotate spring. Measure the

maximum clearance between the top of spring and try square.

B : Contact

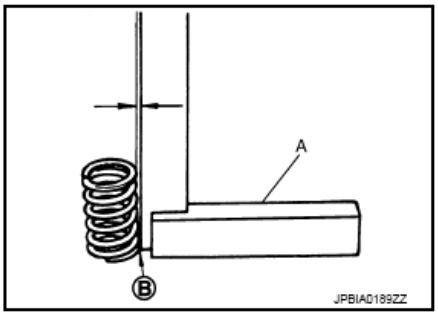


Fig. 197: Checking Valve Spring Squareness Using Try Square
Courtesy of NISSAN NORTH AMERICA, INC.

Limit: Refer to "CYLINDER HEAD".

- If it exceeds the limit.
  - Replace valve spring (with valve spring seat) (EXH). Refer to "**EXPLODED VIEW**". (Exhaust side)
  - Replace VVEL ladder assembly & cylinder head assembly. Refer to "**EXPLODED VIEW**". (Intake side)

NOTE: Since the valve spring (with valve spring seat) (INT) cannot be replaced by the piece, VVEL ladder assembly & cylinder head assembly replacement are required.

Valve Spring Dimensions and Valve Spring Pressure Load

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

Standard: Refer to "CYLINDER HEAD".

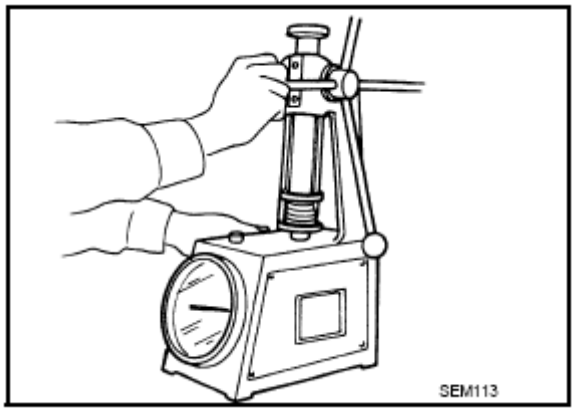


Fig. 198: Checking Valve Spring Pressure Using Tool
Courtesy of NISSAN NORTH AMERICA, INC.

- If the installation load or load with valve open is out of the standard.
  - Replace valve spring (with valve spring seat) (EXH). Refer to "**EXPLODED VIEW**". (Exhaust side)
  - Replace VVEL ladder assembly & cylinder head assembly. Refer to "**EXPLODED VIEW**". (Intake side)

NOTE: Since the valve spring (with valve spring seat) (INT) cannot be replaced by the piece, VVEL ladder assembly & cylinder head assembly replacement are required.

INSPECTION AFTER ASSEMBLY

Inspection for Leakage

The following are procedures for checking fluid leakage, lubricant leakage.

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

NOTE: If hydraulic pressure inside chain tensioner drops after removal/installation, slack in guide may generate a pounding noise during and just after the engine start. However, this does not indicate a malfunction. The noise will stop after hydraulic pressure rises.

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

SUMMARY OF INSPECTION ITEMS

Items		Before starting engine	Engine running	After engine stopped
Engine coolant		Level	Leakage	Level
Engine oil		Level	Leakage	Level
Transmission/transaxle fluid	AT Models	Leakage	Level/Leakage	Leakage
	MT Models	Level/Leakage	Leakage	Level/Leakage
Other oils and fluids(1)		Level	Leakage	Level

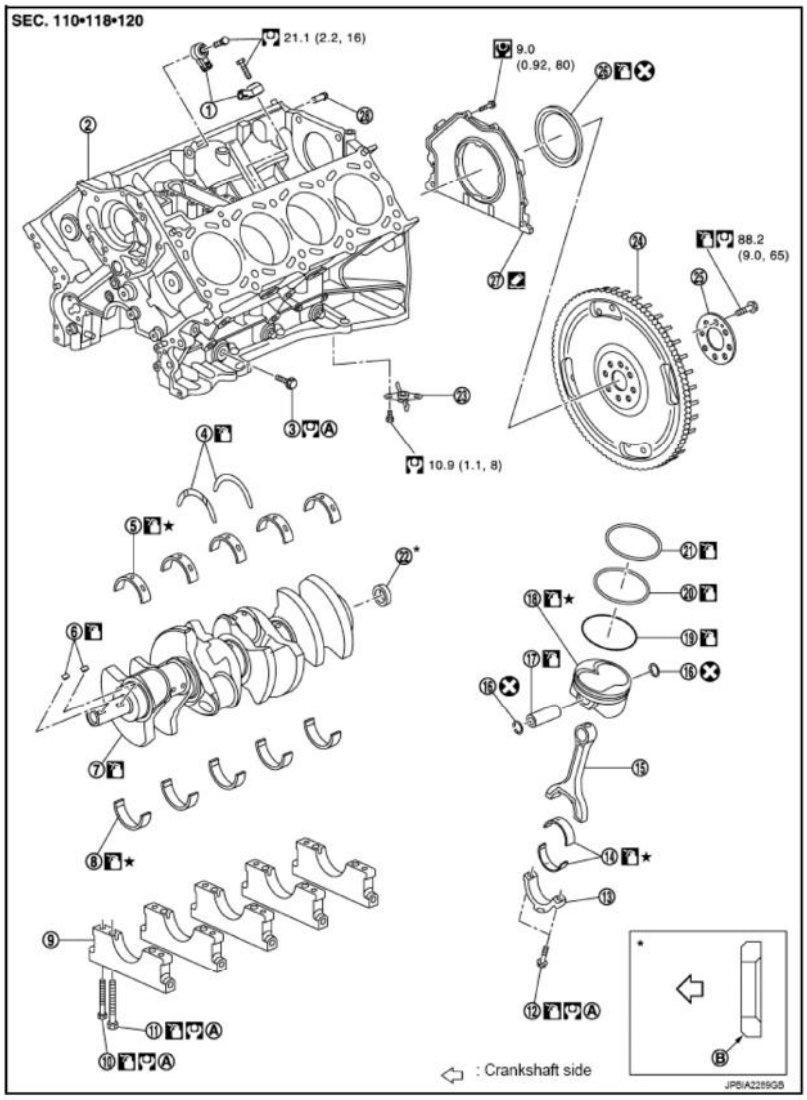
Fuel	Leakage	Leakage	Leakage
Exhaust gases	-	Leakage	-

(1) Power steering fluid, brake fluid, etc.

CYLINDER BLOCK

Exploded View

Symbol	Description
	N·m (kg-m, ft-lb)
	N·m (kg-m, in-lb)
	Always replace after disassembly.



1. Knock sensor
2. Cylinder block
3. Side bolt
4. Thrust bearing
5. Main bearing (upper)
6. Crankshaft key
7. Crankshaft
8. Main bearing (lower)
9. Main bearing cap
10. Main bearing cap sub bolt
11. Main bearing cap bolt
12. Connecting rod cap bolt
13. Connecting rod cap
14. Connecting rod bearing
15. Connecting rod
16. Snap ring
17. Piston pin
18. Piston
19. Oil ring
20. Second ring
21. Top ring
22. Pilot converter
23. Piston oil jet
24. Drive plate
25. Reinforcement plate
26. Rear oil seal
27. Rear oil seal retainer
28. Cylinder block heater (for Canada)

A. Comply with the installation procedure when tightening.
B. Chamfered

Fig. 199: Exploded View Of Cylinder Block With Torque Specifications
Courtesy of NISSAN NORTH AMERICA, INC.

Refer to "**COMPONENTS** " for symbol marks in the figure.

Disassembly and Assembly

DISASSEMBLY

1. Remove the following parts:
   - Oil pans (lower and upper): Refer to "**EXPLODED VIEW**".
   - Front cover and timing chain: Refer to "**EXPLODED VIEW**".
   - Cylinder head: Refer to "**EXPLODED VIEW**".
2. Remove knock sensor.

CAUTION: Carefully handle knock sensor avoiding shocks.

3. Remove oil filter (for VVEL ladder assembly) from cylinder block, if necessary. Refer to "**EXPLODED VIEW**".
4. Remove piston and connecting rod assembly as per the following:
   - Before removing piston and connecting rod assembly, check the connecting rod side clearance. Refer to "**INSPECTION**".

CAUTION: Be careful not to drop connecting rod bearing, and to scratch the surface.

   a. Position crankshaft pin corresponding to connecting rod to be removed onto the bottom dead center.
   b. Loosen mounting bolts, and remove connecting rod bearing cap.
   c. Using a hammer handle (A) or similar tool, push piston and connecting rod assembly out to the cylinder head side.

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

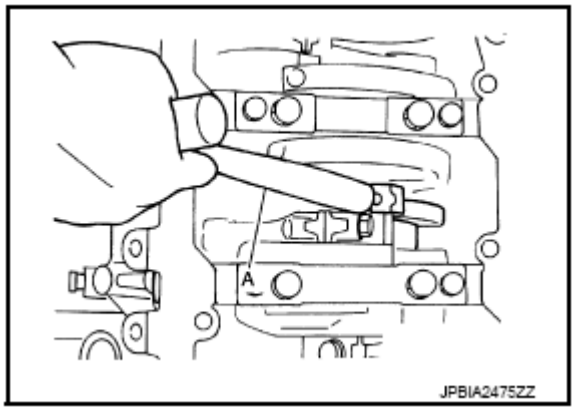


Fig. 200: Removing Piston And Connecting Rod Assembly Using Hammer Handle
Courtesy of NISSAN NORTH AMERICA, INC.

5. Remove connecting rod bearings from connecting rod and connecting rod bearing cap.

CAUTION:
- **Be careful not to drop connecting rod bearing, and to scratch the surface.**
- **Identify installation positions, and store them without mixing them up.**

6. Remove piston rings from piston.
   - Before removing piston rings, check the piston ring side clearance. Refer to "**INSPECTION**".
   - Use a piston ring expander (commercial service tool) (A).

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

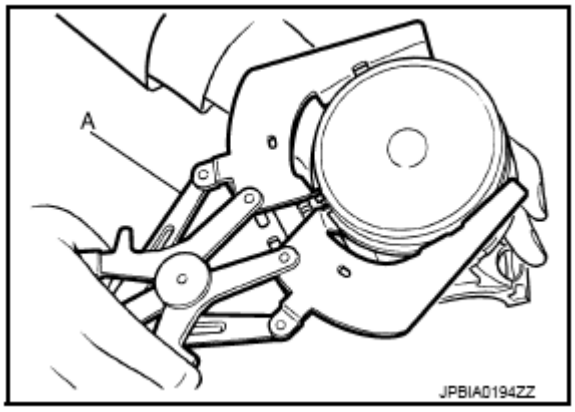


Fig. 201: Removing Piston Rings From Piston Using Ring Expander
Courtesy of NISSAN NORTH AMERICA, INC.

7. Remove piston from connecting rod as per the following:
   a. Using snap ring pliers (A), remove snap rings.

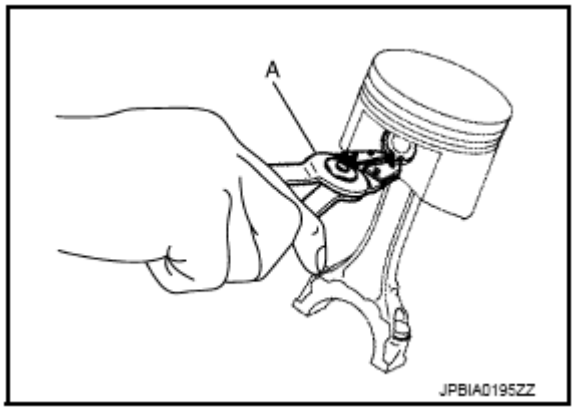


Fig. 202: Removing Snap Ring Using Pliers
Courtesy of NISSAN NORTH AMERICA, INC.

b. Heat piston to 60 to 70°C (140 to 158°F) with an industrial use dryer (A) or an equivalent.

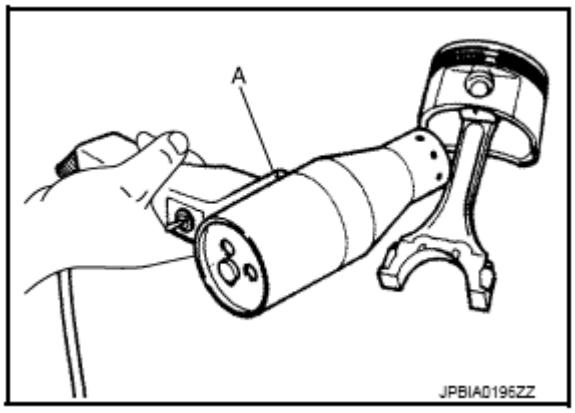


Fig. 203: Heating Piston Using Dryer
Courtesy of NISSAN NORTH AMERICA, INC.

c. Push out piston pin using a stick that has an outer diameter of approximately 20 mm (0.79 in).

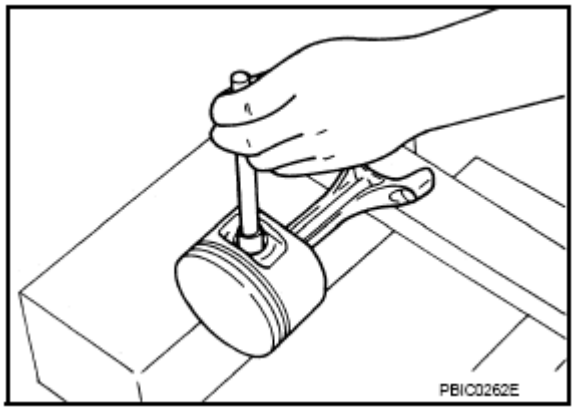


Fig. 204: Removing Piston Pin Using Stick
Courtesy of NISSAN NORTH AMERICA, INC.

8. Remove rear oil seal and rear oil seal retainer assembly from cylinder block.
   - Insert screwdriver or similar tool between rear end of crankshaft counter weight and rear oil seal retainer, and separate liquid gasket to remove.

CAUTION: Be careful not to damage the mating surfaces.

9. Using screwdriver or similar tool, and lever off rear oil seal from rear oil seal retainer.
10. Remove main bearing cap as per the following:
    - Before loosening cylinder block bolts, measure the crankshaft end play. Refer to "**INSPECTION**".

    a. Loosen side bolts starting from No. 30 to 21 to remove.

⇦ : Engine front

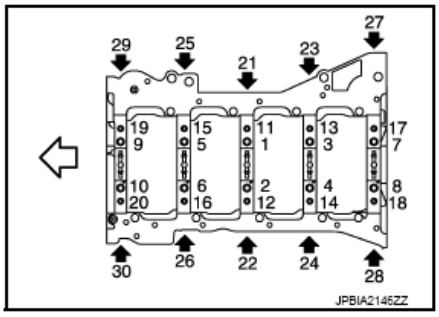


Fig. 205: Main Bearing Cap Mounting Bolts Tightening Sequence
Courtesy of NISSAN NORTH AMERICA, INC.

   b. Loosen main bearing cap sub bolts starting from No. 20 to 11 to remove.
   c. Loosen main bearing cap bolts starting from No. 10 to 1 to remove.
   d. Remove the main bearing cap.
      - Insert bolts (1) into bolt holes, and then remove main bearing cap (2) by lifting up and shaking forward and backward.

CAUTION: Be careful not to damage the mounting surface.

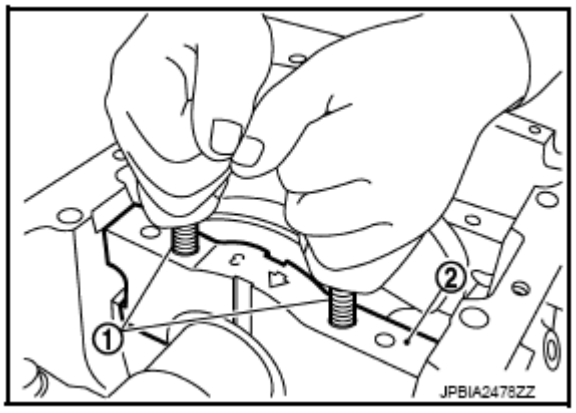


Fig. 206: Removing Main Bearing Cap
Courtesy of NISSAN NORTH AMERICA, INC.

11. Remove crankshaft.
12. Remove main bearings and thrust bearings from main bearing cap and cylinder block.

CAUTION:
- **Be careful not to drop main bearing, and to scratch the surface.**
- **Identify installation positions, and store them without mixing them up.**

13. Remove pilot converter using the pilot bushing puller (commercial service tool), if necessary.
14. Remove oil jet.

ASSEMBLY

CAUTION: Do not reuse washers.

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

CAUTION: Use goggles to protect your eyes.

2. Install each plug to cylinder block as shown in the figure below.

Symbol	Description
	N·m (kg-m, ft-lb)
	N·m (kg-m, in-lb)
	Always replace after disassembly.

⇦ : Engine front

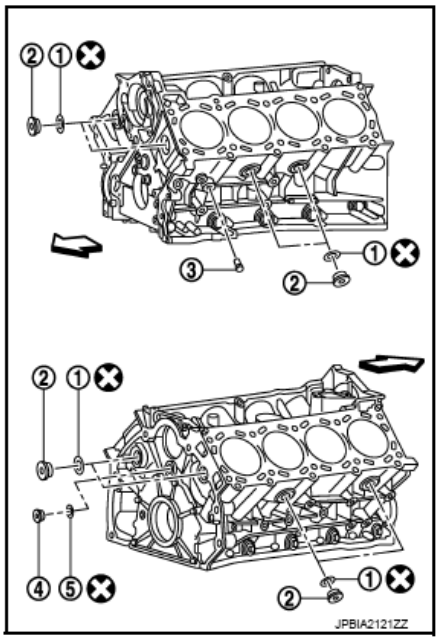


Fig. 207: Identifying Cylinder Block Drain Plugs And Washers
Courtesy of NISSAN NORTH AMERICA, INC.

- Tighten each plug as specified below.

Part	Tightening torque
Plug (2)	78.0 N.m (8.0 kg-m, 58 ft-lb)
Water drain plug (3)	19.6 N.m (2.0 kg-m, 14 ft-lb)
Plug (4)	65.0 N.m (6.6 kg-m, 48 ft-lb)

- Replace washers (1), (5) with new ones.

CAUTION: Do not reuse washers.

- Apply sealant to the thread of water drain plug (3).

  Use Genuine RTV Silicone Sealant or an equivalent. Refer to "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS ".

- Apply sealant to the thread of plug (4).

  Use Genuine High Strength Thread Locking Sealant or an equivalent. Refer to

"**RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS** ".

3. Install oil jet.
   - Insert oil jet into cylinder block hole, and tighten the mounting bolt on the corner side (A) first.

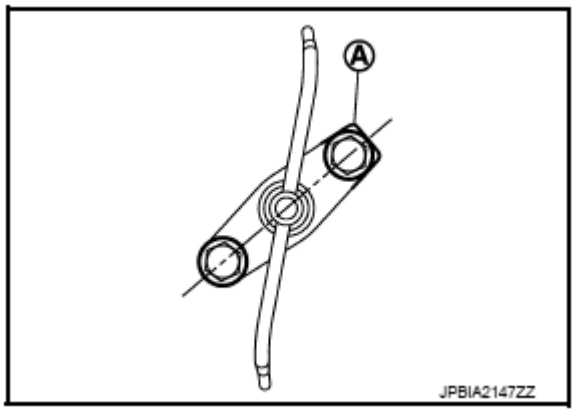


Fig. 208: Oil Jet Mounting Bolt Tightening Sequence
Courtesy of NISSAN NORTH AMERICA, INC.

4. Install pilot converter to crankshaft, if removed.
   - With drift [outer diameter: approx. 35 mm (1.38 in)], press-fit as far as it will go.

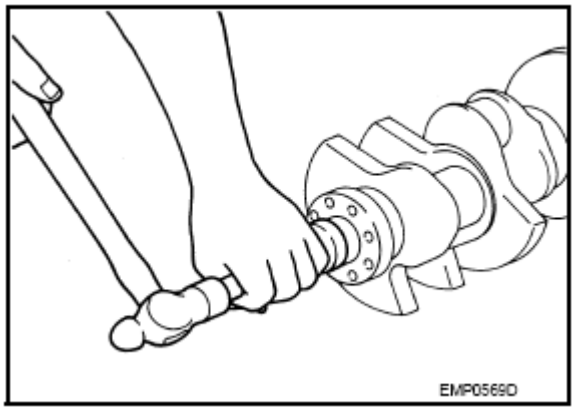


Fig. 209: Installing Pilot Converter To Crankshaft Using Drift
Courtesy of NISSAN NORTH AMERICA, INC.

   - Press-fit pilot converter with its chamfered side facing crankshaft as shown in the figure below.

⇦ : Crankshaft side

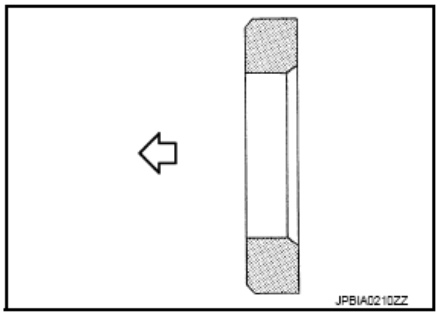


Fig. 210: Locating Pilot Converter Chamfered Side
Courtesy of NISSAN NORTH AMERICA, INC.

5. Install main bearings and thrust bearings as per the following:

CAUTION: Be careful not to drop main bearing, and to scratch the surface.

a. Remove dust, dirt, and engine oil on bearing mating surfaces of cylinder block and main bearing caps.
b. Install thrust bearings (2) to both sides of the No. 3 journal housing on cylinder block (1).

3 : Main bearing (upper) (cylinder block side)
4 : Crankshaft
5 : Main bearing (lower) (main bearing cap side)
⇦ : Engine front

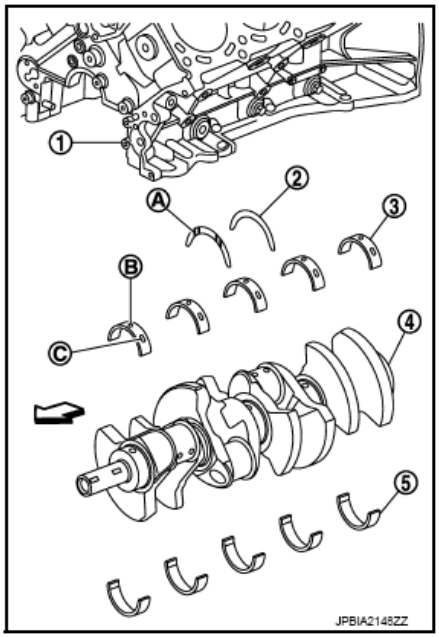


Fig. 211: Locating Cylinder Block, Thrust Bearing, Crankshaft And Main Bearing (Upper And Lower)
Courtesy of NISSAN NORTH AMERICA, INC.

- Install thrust bearings with the oil groove (A) facing crankshaft arm (outside).

c. Install main bearings paying attention to the direction.

- Main bearing with oil hole (B) and groove (C) 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.
- Ensure the oil holes on cylinder block and those on the corresponding bearing are aligned.

6. Install crankshaft to cylinder block.
   - While turning crankshaft by hand, check that it turns smoothly.
7. Install main bearing caps as per the following:
   - Align the identification number to the journal position to install.

⇦ : Engine front

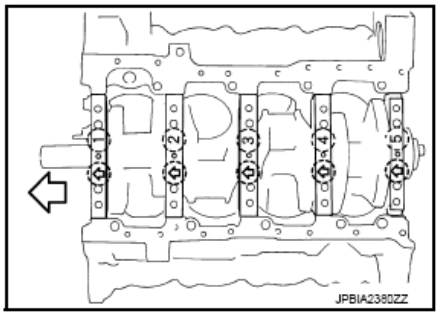


Fig. 212: Locating Main Bearing Caps Identification Numbers
Courtesy of NISSAN NORTH AMERICA, INC.

- Install it with the front mark (indicated by stamping) facing the front of engine.
- Using plastic hammer or similar tool, tap them lightly to seat them on the installation position.

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

8. Install each main bearing cap bolts as per the following:

CAUTION: If main bearing cap bolts and sub bolts are re-used, check their outer diameters before installation. Refer to "INSPECTION".

   a. Apply new engine oil to threads and seat surfaces of main bearing cap bolts and sub bolts.
   b. Tighten all bolts in order of (No. 1 - 30) temporarily.

⇦ : Engine front

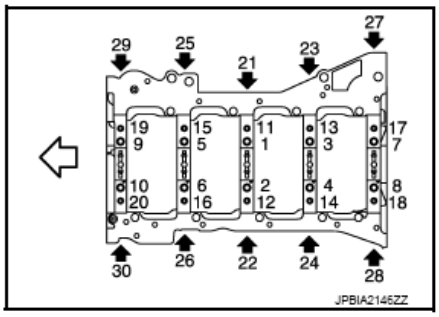


Fig. 213: Main Bearing Cap Mounting Bolts Tightening Sequence
Courtesy of NISSAN NORTH AMERICA, INC.

c. Tighten main bearing cap bolts (M12) in order of No. 1 - 10.

: **Torque Value: 53.9 N.m (5.5 kg-m, 40 ft-lb)**

d. Tighten main bearing cap sub bolts (M9) in order of No. 11 - 20.

: **Torque Value: 19.6 N.m (2.0 kg-m, 14 ft-lb)**

e. Tighten main bearing cap bolts (M12) in order of No. 1 - 10 (clockwise).

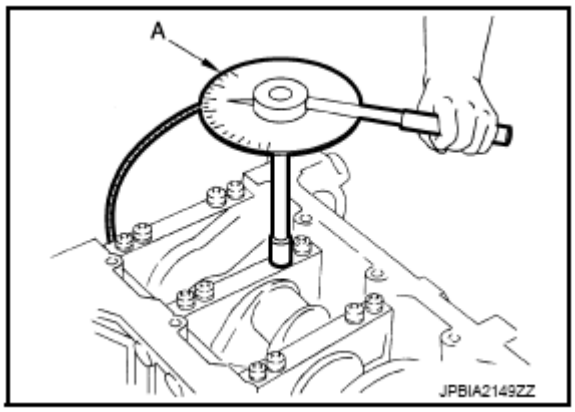


Fig. 214: Checking Tightening Angle Using Angle Wrench
Courtesy of NISSAN NORTH AMERICA, INC.

Angle tightening: 90 degrees

CAUTION: Use the angle wrench [SST: KV10112100 (BT8653-A)] (A) to check tightening angle. Never make judgment by visual inspection.

f. Tighten main bearing cap sub bolts (M9) in order of No. 11 - 20. (clockwise)

Angle tightening: 90 degrees

g. Tighten side bolts (M10) in order of No. 21 - 30.

Torque Value: 49.0 N.m (5.0 kg-m, 36 ft-lb)

- After installing bolts, check that crankshaft can be rotated smoothly by hand.
- Check the crankshaft end play. Refer to "**CYLINDER BLOCK**".

9. Install rear oil seal retainer.
   - Apply a continuous bead of liquid gasket with tube presser (commercial service tool) to rear oil seal retainer as shown in the figure below.

A : Protrusion
b : 4.0 - 5.6 mm (0.157 - 0.220 in)
c : ϕ3.4 - 4.4 mm (0.134 - 0.173 in)

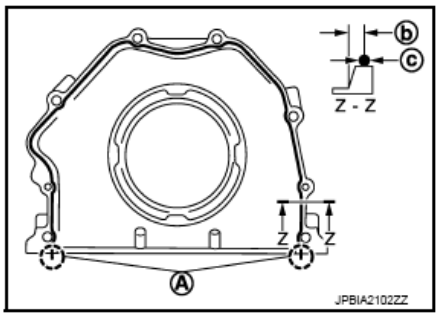


Fig. 215: Locating Sealant Application Area On Rear Oil Seal Retainer
Courtesy of NISSAN NORTH AMERICA, INC.

Use Genuine RTV Silicone Sealant or an equivalent. Refer to "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS ".

10. Install rear oil seal on rear oil seal retainer.

⇦ : Engine inside
⬅ : Engine outside

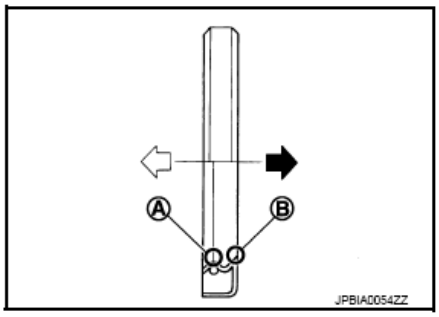


Fig. 216: Identifying Oil And Dust Seal Lips
Courtesy of NISSAN NORTH AMERICA, INC.

- Apply new engine oil to both oil seal lip (A) and dust seal lip (B).
- Install it so that each seal lip is oriented as shown in the figure below.

CAUTION: Be careful not to scratch or make burrs on circumference of oil seal.

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

B : Rear oil seal retainer rear end face
a : 0 - 0.5 mm (0 - 0.020 in)

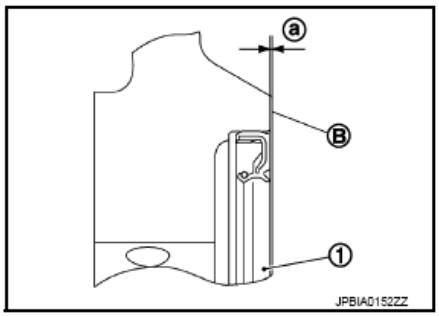


Fig. 217: Identifying Rear Oil Seal Installation Position
Courtesy of NISSAN NORTH AMERICA, INC.

- Using a suitable drift [outer diameter: 101 mm (3.98 in)].
- Check the garter spring is in position and seal lips are not inverted.

11. Install piston to connecting rod as per the following:
    - Assemble so that the front mark (A) on the piston head and the cylinder number (D) on connecting rod are positioned as shown in the figure below.

B : Oil hole
C : Front mark
⇦ : Engine front

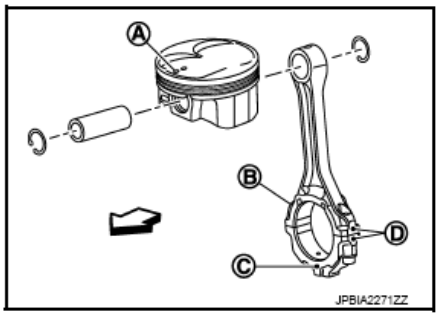


Fig. 218: Locating Piston To Connecting Rod Assembly Cylinder Number, Oil Hole And Front Mark
Courtesy of NISSAN NORTH AMERICA, INC.

a. Using snap ring pliers, install new snap ring to the groove of piston rear side.
    - Insert it fully into groove to install.
b. Install piston to connecting rod.
    - Using an industrial use dryer or similar tool, heat piston until piston pin can be pushed in by hand without excess force [approximately 60 to 70°C (140 to 158°F)]. From the front to the rear, insert piston pin into piston and connecting rod.
c. Install new snap ring to the groove of the piston front side.
    - Insert it fully into groove to install.
    - After installing, check that connecting rod moves smoothly.

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

CAUTION:

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

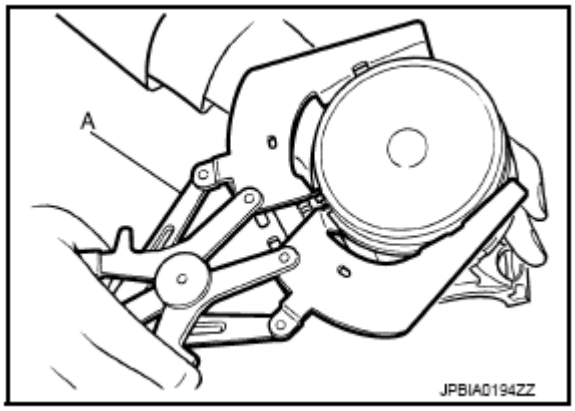


Fig. 219: Installing Piston Rings To Piston Using Ring Expander
Courtesy of NISSAN NORTH AMERICA, INC.

- If there is stamped mark on ring, mount it with marked side up.

  Stamped mark: Top ring (A): 1 N

  Second ring (B): 2 N

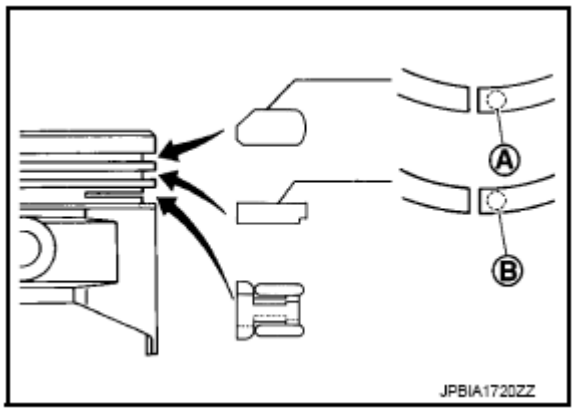


Fig. 220: Locating Top Ring And Second Ring Stamped Mark
Courtesy of NISSAN NORTH AMERICA, INC.

- Position each ring with the gap as shown in the figure below, referring to the piston front mark (D).

a : 90 degrees
b : 45 degrees
C : Top ring gap
E : Oil ring upper or lower rail gap (either of them)
F : Second ring and oil ring spacer gap

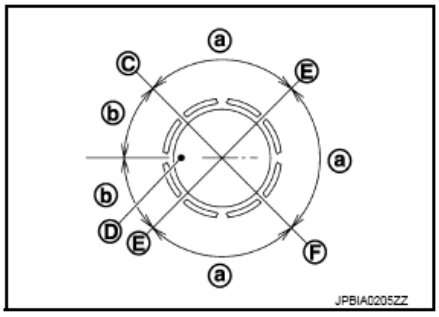


Fig. 221: Positioning Piston Ring Gaps
Courtesy of NISSAN NORTH AMERICA, INC.

- Check the piston ring side clearance. Refer to "**INSPECTION**".

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

CAUTION: Be careful not to drop connecting rod bearing, and to scratch the surface.

- 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 (B) with cutout (A) of connecting rods and connecting rod bearing caps to install.
- Ensure the oil hole (C) on connecting rod and that on the corresponding bearing are aligned.

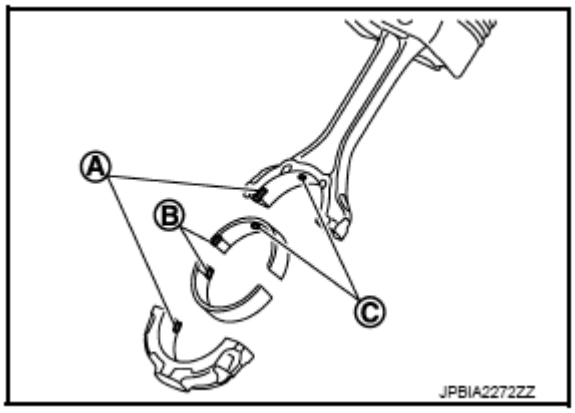


Fig. 222: Locating Connecting Rod Bearing Stopper Protrusion, Oil Hole And Cut-Out
Courtesy of NISSAN NORTH AMERICA, INC.

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 journal.
    - Match the cylinder position with the cylinder number on connecting rod to install.
    - Be sure that front mark on piston crown is facing the front of the engine.

- Using a piston ring compressor [SST: EM03470000 (J-8037)] (A) or suitable tool, install piston with the front mark on the piston crown facing the front of the engine.

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

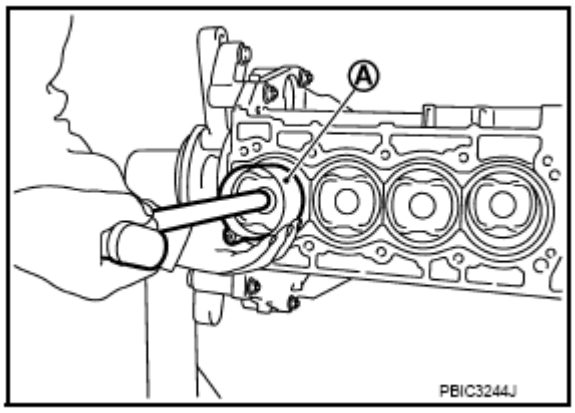


Fig. 223: Installing Piston And Connecting Rod Assembly To Crankshaft Using Tool
Courtesy of NISSAN NORTH AMERICA, INC.

15. Install connecting rod bearing cap.
    - Match the stamped cylinder number marks on connecting rod with those on connecting rod bearing cap to install.

A : Sample codes
B : Bearing stopper groove
C : Small-end diameter grade
D : Big-end diameter grade
E : Weight grade
F : Cylinder No.
G : Management code

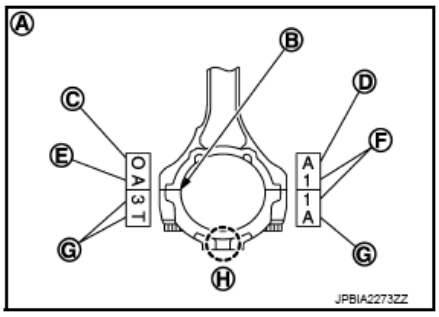


Fig. 224: Locating Stamped Cylinder Number Marks On Connecting Rod
Courtesy of NISSAN NORTH AMERICA, INC.

- Be sure that front mark (H) on connecting rod bearing cap is facing the front of the engine.

16. Tighten connecting rod bolts as per the following:
    a. Inspect the outer diameter of connecting rod bolt. Refer to "**INSPECTION**".
    b. Apply engine oil to the threads and seats of connecting rod bolts.
    c. Tighten connecting rod bolts.

: **Torque Value: 28.4 N.m (2.9 kg-m, 21 ft-lb)**

d. Completely loosen connecting rod bolts.

: **Torque Value: 0 N.m (0 kg-m, 0 ft-lb)**

e. Tighten connecting rod bolts.

: **Torque Value: 24.5 N.m (2.5 kg-m, 18 ft-lb)**

f. Tighten connecting rod bolts. (clockwise)

Angle tightening: 90 degrees

CAUTION: Always use the angle wrench [SST: KV10112100 (BT8653-A)]. Never make judgment by visual inspection.

- After tightening connecting rod bolts, check that crankshaft rotates smoothly.
- Check the connecting rod side clearance. Refer to "**INSPECTION**".

17. Install knock sensors.
    - Install knock sensors in the direction shown in the figure below.

⇦ : Engine front

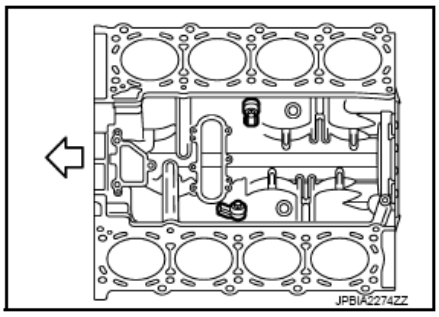


Fig. 225: Locating Knock Sensors
Courtesy of NISSAN NORTH AMERICA, INC.

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

CAUTION:
- **Never tighten mounting bolts while holding connector.**
- **If any impact by dropping is applied to knock sensor, replace it with new one.**

NOTE:
- **Check that there is no foreign material on the cylinder block mating surface and the back surface of knock sensor.**
- **Check that knock sensor does not interfere with other parts.**

18. Install oil filter (for VVEL ladder assembly).

19. Install drive plate.
    - Install drive plate (4) and reinforcement plate (3) as shown in the figure below.

2 : Pilot converter
A : Rounded
⇦ : Engine front

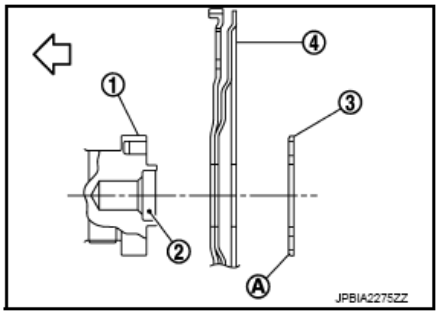


Fig. 226: Locating Drive Plate, Reinforcement Plate And Pilot Converter
Courtesy of NISSAN NORTH AMERICA, INC.

    - When installing drive plate to crankshaft (1), be sure to correctly align crankshaft side dowel pin and drive plate side dowel pin hole.

CAUTION: If these are not aligned correctly, engine runs roughly and "MIL" illuminates.

    - Holding ring gear with the ring gear stopper [SST: KV10119200 (J-49277)].
    - Tighten the mounting bolts crosswise over several times.
20. Assemble in the reverse order of disassembly.

Inspection

CRANKSHAFT END PLAY

- Measure the clearance between thrust bearings and crankshaft arm when crankshaft is moved fully forward or backward with a dial indicator (A).

  Standard and limit: Refer to "CYLINDER BLOCK".

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

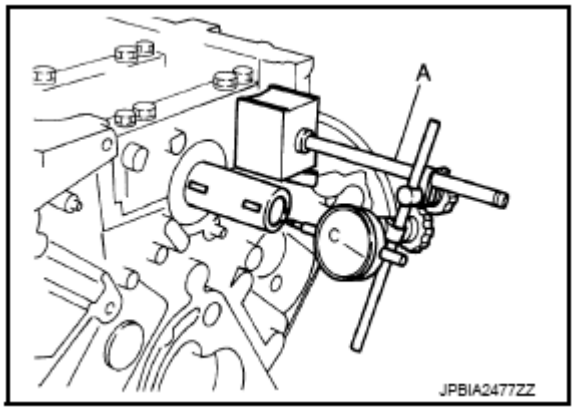


Fig. 227: Measuring Crankshaft End Play Using Dial Indicator
Courtesy of NISSAN NORTH AMERICA, INC.

CONNECTING ROD SIDE CLEARANCE

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

  Standard and limit: Refer to "CYLINDER BLOCK".

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

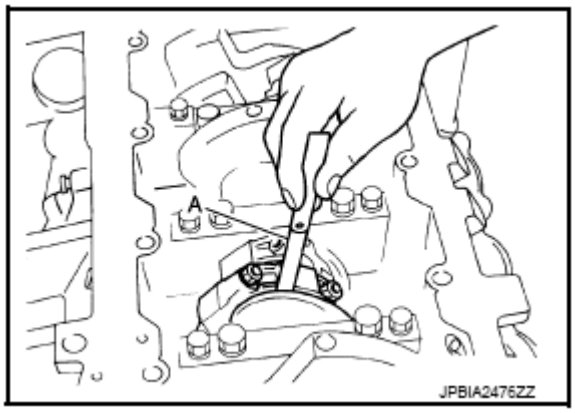


Fig. 228: Measuring Side Clearance Between Connecting Rod And Crankshaft Arm Using Feeler Gauge
Courtesy of NISSAN NORTH AMERICA, INC.

PISTON TO PISTON PIN OIL CLEARANCE

Piston Pin Hole Diameter

Measure the inner diameter of piston pin hole with an inside micrometer (A).

Standard: Refer to "CYLINDER BLOCK".

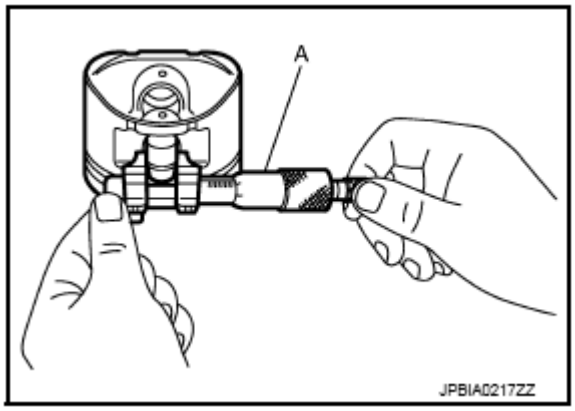


Fig. 229: Measuring Inner Diameter Of Piston Pin Hole Using Inside Micrometer
Courtesy of NISSAN NORTH AMERICA, INC.

Piston Pin Outer Diameter

Measure the outer diameter of piston pin with a micrometer (A).

Standard: Refer to "CYLINDER BLOCK".

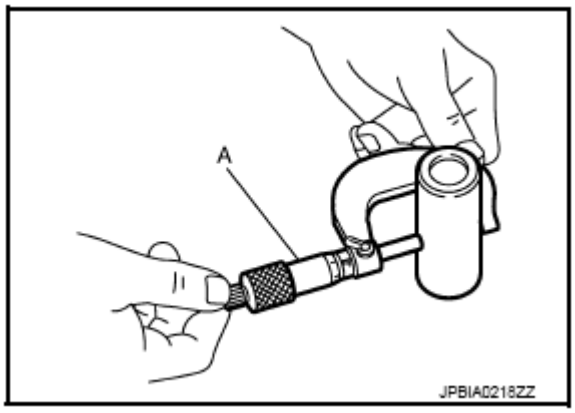


Fig. 230: Measuring Outer Diameter Of Piston Pin Using Micrometer
Courtesy of NISSAN NORTH AMERICA, INC.

Piston to Piston Pin Oil Clearance

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

Standard: Refer to "CYLINDER BLOCK".

- If the calculated value is out of the standard, replace piston and piston pin assembly.
- When replacing piston and piston pin assembly, refer to "**DESCRIPTION**".

NOTE: Piston is available together with piston pin as assembly.

PISTON RING SIDE CLEARANCE

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

A : OK
B : NG

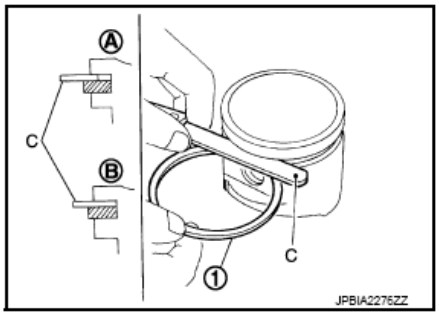


Fig. 231: Checking Piston Ring Side Clearance Using Feeler Gauge
Courtesy of NISSAN NORTH AMERICA, INC.

Standard and limit: Refer to "CYLINDER BLOCK".

- If the measured value exceeds the limit, replace piston ring, and measure again. If it still exceeds the limit, replace piston also.

PISTON RING END GAP

- Check that the cylinder bore inner diameter is within the specification.
- Lubricate with new engine oil to piston (1) and piston ring (2), and then insert piston ring until middle of cylinder with piston, and measure the piston ring end gap with a feeler gauge (B).

A : Press-fit

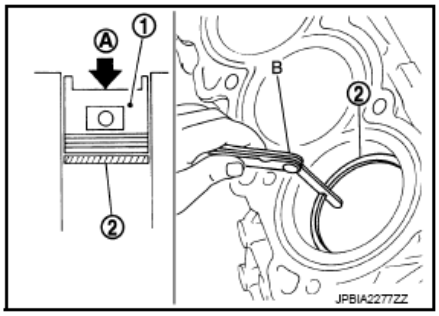


Fig. 232: Checking Piston Ring End Gap Using Feeler Gauge
Courtesy of NISSAN NORTH AMERICA, INC.

Standard and limit: Refer to "CYLINDER BLOCK".

- If the measured value exceeds the limit, replace piston ring, and measure again. If it still exceeds the limit, re-bore cylinder and use oversize piston and piston rings.

CONNECTING ROD BEND AND TORSION

- Check with a connecting rod aligner.

A : Bend
B : Torsion
C : Feeler gauge

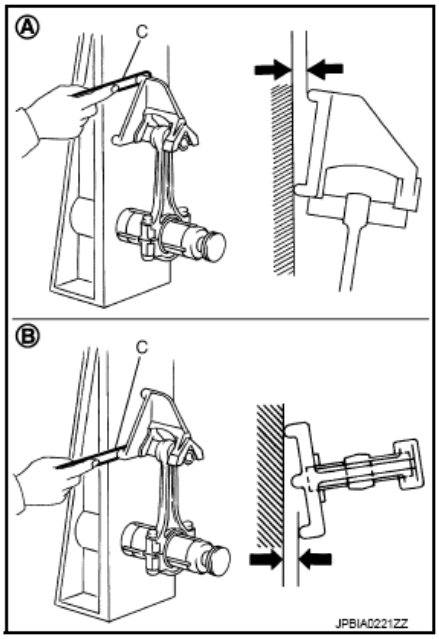


Fig. 233: Checking Connecting Rod Bend And Torsion Using Connecting Rod Aligner
Courtesy of NISSAN NORTH AMERICA, INC.

Bend limit: Refer to "CYLINDER BLOCK".

Torsion limit

- 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 tighten connecting rod bolts to the specified torque. Refer to "**DISASSEMBLY AND ASSEMBLY**" for the tightening procedure.

1 : Connecting rod

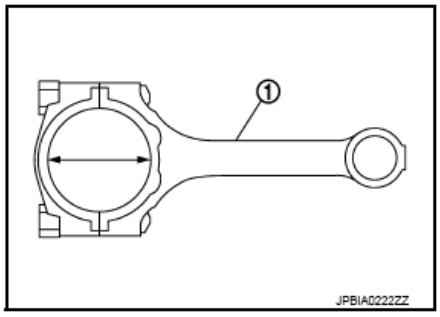


Fig. 234: Identifying Connecting Rod Big End Diameter
Courtesy of NISSAN NORTH AMERICA, INC.

- Measure the inner diameter of connecting rod big end with an inside micrometer.

Standard: Refer to "CYLINDER BLOCK".

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

CONNECTING ROD BUSHING OIL CLEARANCE

Connecting Rod Bushing Inner Diameter

Measure the inner diameter of connecting rod bushing with an inside micrometer (A).

Standard: Refer to "CYLINDER BLOCK".

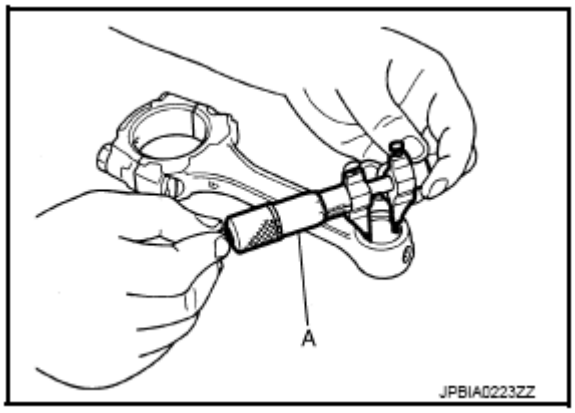


Fig. 235: Measuring Inner Diameter Of Connecting Rod Bushing Using Inside Micrometer
Courtesy of NISSAN NORTH AMERICA, INC.

Piston Pin Outer Diameter

Measure the outer diameter of piston pin with a micrometer (A).

Standard: Refer to "CYLINDER BLOCK".

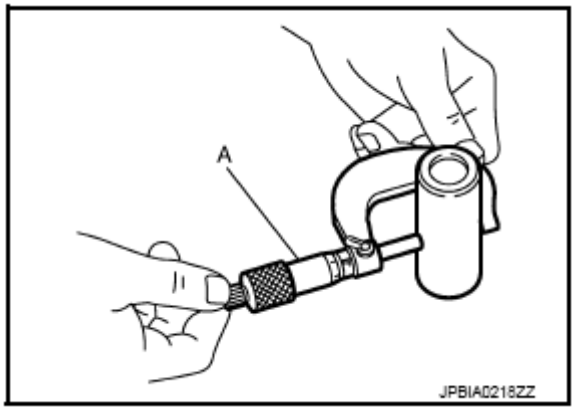


Fig. 236: Measuring Outer Diameter Of Piston Pin Using Micrometer
Courtesy of NISSAN NORTH AMERICA, INC.

Connecting Rod Bushing Oil Clearance

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

Standard and limit: Refer to "CYLINDER BLOCK".

- 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 "**DESCRIPTION**".
- If replacing connecting rod assembly, refer to "**CONNECTING ROD BEARING**" to select the connecting rod bearing.

CYLINDER BLOCK DISTORTION

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

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

- Measure the distortion on the cylinder block upper face at some different points in six directions (C, D, E, F, G and H) with a straightedge (A) and a feeler gauge (B).

  Limit: Refer to "CYLINDER BLOCK".

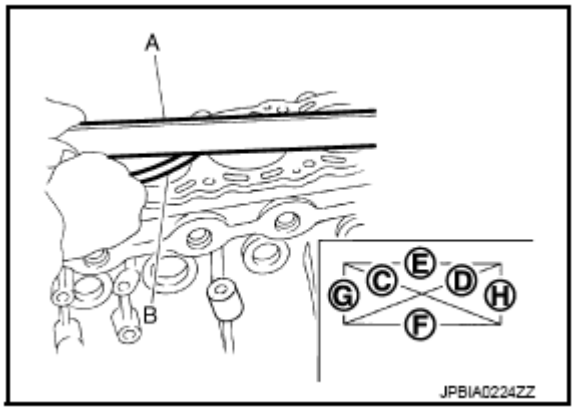


Fig. 237: Measuring Distortion On Cylinder Block Upper Face Using Straightedge And Feeler Gauge
Courtesy of NISSAN NORTH AMERICA, INC.

- If it exceeds the limit, replace cylinder block.

MAIN BEARING HOUSING INNER DIAMETER

- Install main bearing cap (2) without installing main bearings, and tighten main bearing cap bolts to the

specified torque. Refer to "**DISASSEMBLY AND ASSEMBLY**" for the tightening procedure.

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

  Standard: Refer to "CYLINDER BLOCK".

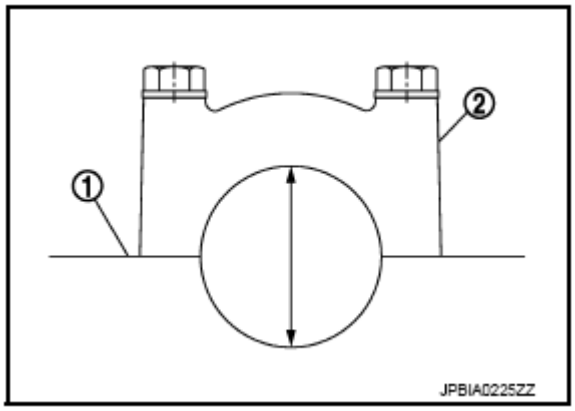


Fig. 238: Identifying Main Bearing Housing Inner Diameter
Courtesy of NISSAN NORTH AMERICA, INC.

- If out of the standard, replace cylinder block (1) and main bearing cap as assembly.

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

PISTON TO CYLINDER BORE CLEARANCE

Cylinder Bore inner Diameter

- Using a bore gauge, measure cylinder bore for wear, out-of-round and taper at six different points on each cylinder. [(A) and (B) directions at (C), (D) and (E)] is in longitudinal direction of engine.

  f: 10 mm (0.39 in)

  g: 60 mm (2.36 in)

  h: 120 mm (4.72 in)

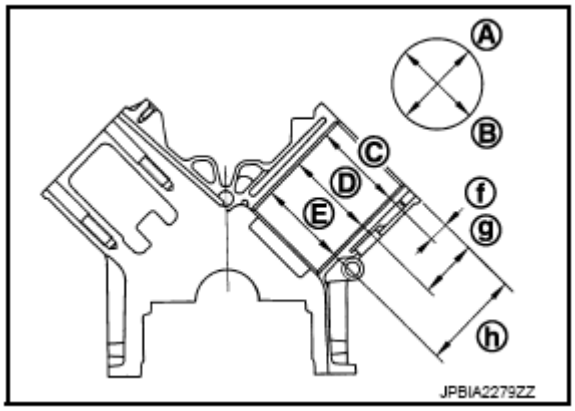


Fig. 239: Locating Cylinder Bore Wear, Out-Of-Round And Taper Measuring Points
Courtesy of NISSAN NORTH AMERICA, INC.

Wear limit:

Out-of-round (Difference between "A" and "B"): Refer to "CYLINDER BLOCK".

Taper limit (Difference between "C" and "E"):

- 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.
- Oversize piston is provided. When using oversize piston, re-bore cylinder so that the clearance of the piston-to-cylinder bore satisfies the standard.

CAUTION: When using oversize piston, use oversize pistons for all cylinders with oversize piston rings.

Oversize (O/S): 0.2 mm (0.008 in)

Piston Skirt Diameter

Measure the outer diameter of piston skirt with a micrometer (A).

Measure point

: Refer to "CYLINDER BLOCK".

Standard

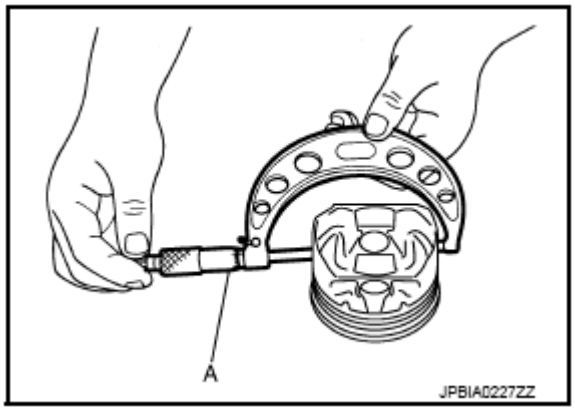


Fig. 240: Measuring Outer Diameter Of Piston Skirt Using Micrometer
Courtesy of NISSAN NORTH AMERICA, INC.

Piston-to-Cylinder Bore Clearance

Calculate by piston skirt diameter and cylinder bore inner diameter [direction (B), position (D)].

A: Direction A

C: Position C

E: Position E

f: 10 mm (0.39 in)

g: 60 mm (2.36 in)

h: 125 mm (4.92 in)

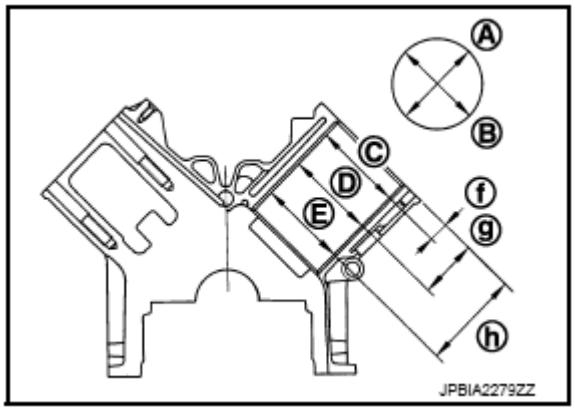


Fig. 241: Locating Piston-To-Cylinder Bore Clearance Measurement Positions
Courtesy of NISSAN NORTH AMERICA, INC.

(Clearance) = (Cylinder bore inner diameter) - (Piston skirt diameter).

Standard and limit: Refer to "CYLINDER BLOCK".

- If the calculated value exceeds the limit, replace piston and piston pin assembly. Refer to "**CYLINDER BLOCK**".

Re-boring Cylinder Bore

1. Cylinder bore size is determined by adding piston to cylinder bore clearance to piston skirt diameter.

   Re-bored size calculation: D = A + B - C

   where,

   A. **Piston skirt diameter as measured**
   B. **Piston to cylinder bore clearance (standard value)**
   C. **Honing allowance 0.02 mm (0.0008 in)**
   D. **Bored diameter**
2. Install main bearing cap, and tighten to the specified torque. Otherwise, cylinder bores may be distorted in final assembly.
3. Cut cylinder bores.

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

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

   NOTE: Perform measurement after cylinder bore cools down.

CRANKSHAFT MAIN JOURNAL DIAMETER

- Measure the outer diameter of crankshaft main journals with a micrometer.

  Standard: Refer to "CYLINDER BLOCK".

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

CRANKSHAFT PIN JOURNAL DIAMETER

- Measure the outer diameter of crankshaft pin journal with a micrometer (A).

  Standard: Refer to "CYLINDER BLOCK".

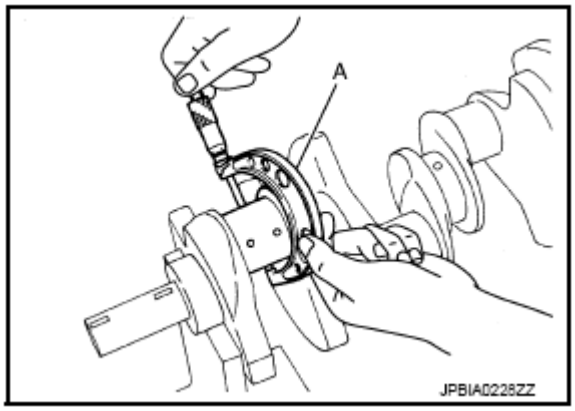


Fig. 242: Measuring Outer Diameter Of Crankshaft Pin Journal Using Micrometer
Courtesy of NISSAN NORTH AMERICA, INC.

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

CRANKSHAFT OUT-OF-ROUND AND TAPER

- Measure the dimensions at four different points as shown in the figure below, on each main journal and pin journal with a micrometer.
- Out-of-round is indicated by the difference in the dimensions between (d) and (c) at (a) and (b).
- Taper is indicated by the difference in the dimensions between.

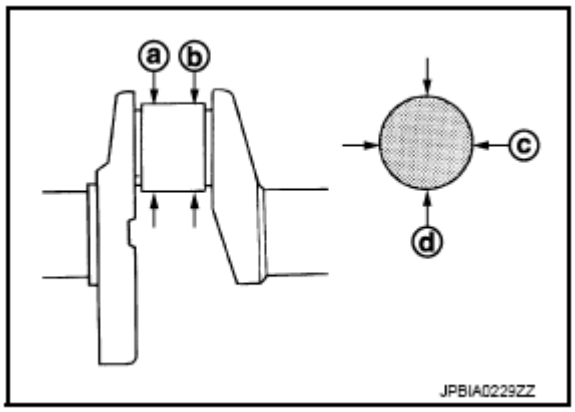


Fig. 243: Identifying Crankshaft Out-Of-Round And Taper Measurement Points
Courtesy of NISSAN NORTH AMERICA, INC.

Out-of-round (Difference between "c" and "d"): Refer to "CYLINDER BLOCK".

Taper (Difference between "a" and "b")

- 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 the main bearing and/or connecting rod bearing. Refer to "**MAIN BEARING**" and/or "**CONNECTING ROD BEARING**".

CRANKSHAFT RUNOUT

- Place V-block on precise flat table, and support the journals on both ends of crankshaft.
- Place a dial indicator straight up on the No. 3 journal.
- While rotating crankshaft, read the movement of the pointer on a dial indicator. (Total indicator reading)

Standard and limit: Refer to "CYLINDER BLOCK".

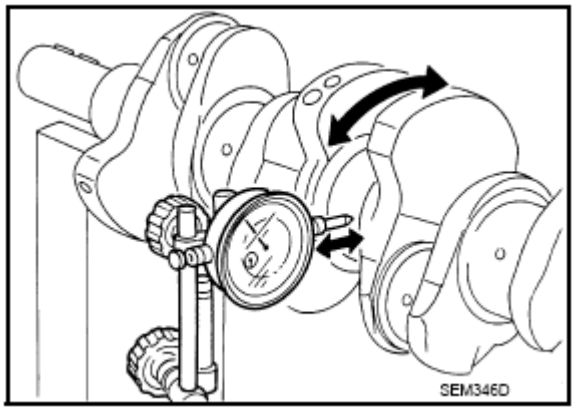


Fig. 244: Measuring Crankshaft Runout Using Dial Indicator
Courtesy of NISSAN NORTH AMERICA, INC.

- If it exceeds the limit, replace crankshaft.

CONNECTING ROD BEARING OIL CLEARANCE

Method by Calculation

- Install connecting rod bearings (1) to connecting rod (2) and connecting rod cap, and tighten connecting rod bolts to the specified torque. Refer to "**DISASSEMBLY AND ASSEMBLY**" for the tightening procedure.

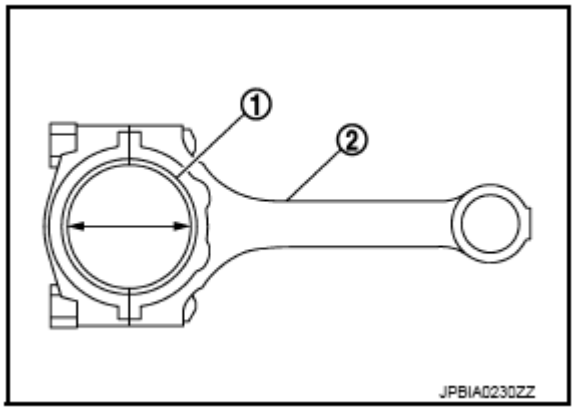


Fig. 245: Identifying Connecting Rod Bearing And Connecting Rod
Courtesy of NISSAN NORTH AMERICA, INC.

- Measure the inner diameter of connecting rod bearing with an inside micrometer.

  (Oil clearance) = (Connecting rod bearing inner diameter) - (Crankshaft pin journal diameter)

  Standard and limit: Refer to "CONNECTING ROD BEARING".

- If the 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 "**DESCRIPTION**".

Method of Using Plastigage

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

CAUTION: Never rotate crankshaft.

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

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

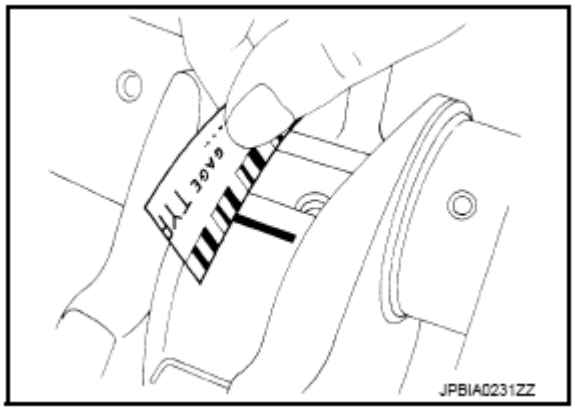


Fig. 246: Measuring Plastigage Width Using Scale On Plastigage Bag
Courtesy of NISSAN NORTH AMERICA, INC.

MAIN BEARING OIL CLEARANCE

Method by Calculation

- Install main bearings (3) to cylinder block (1) and main bearing cap (2), and tighten main bearing cap bolts to the specified torque. Refer to "**DISASSEMBLY AND ASSEMBLY**" for the tightening procedure.
- Measure the inner diameter of main bearing with a bore gauge.

  (Oil clearance) = (Main bearing inner diameter) - (Crankshaft main journal diameter)

  Standard and limit: Refer to "MAIN BEARING".

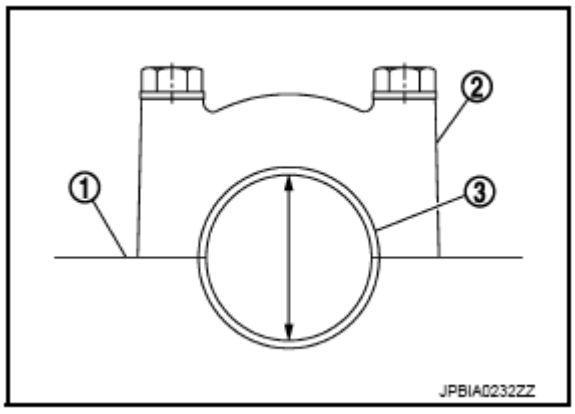


Fig. 247: Identifying Main Bearing Inner Diameter
Courtesy of NISSAN NORTH AMERICA, INC.

- If the calculated value exceeds the limit, select proper main bearing according to main bearing inner diameter and crankshaft main journal diameter to obtain the specified bearing oil clearance. Refer to "**DESCRIPTION**".

Method of Using Plastigage

- Remove engine oil and dust on crankshaft journal and the surfaces of each bearing completely.
- Cut a plastigage slightly shorter than the bearing width, and place it in crankshaft axial direction, avoiding oil holes.
- Install main bearing to cylinder block and main bearing cap, and tighten main bearing cap bolts with main bearing cap to the specified torque. Refer to "**DISASSEMBLY AND ASSEMBLY**" for the tightening procedure.

CAUTION: Never rotate crankshaft.

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

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

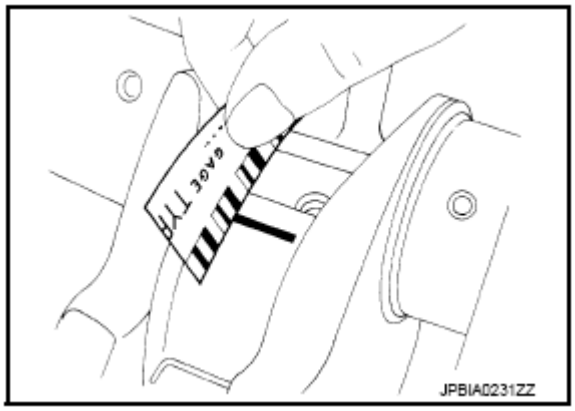


Fig. 248: Measuring Plastigage Width Using Scale On Plastigage Bag
Courtesy of NISSAN NORTH AMERICA, INC.

MAIN BEARING CRUSH HEIGHT

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

A : Crush height

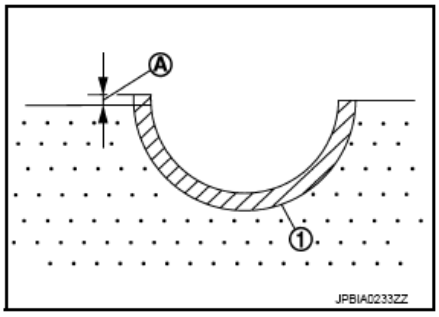


Fig. 249: Identifying Main Bearing Crush Height
Courtesy of NISSAN NORTH AMERICA, INC.

Standard: There must be crush height.

- If the standard is not met, replace main bearings.

CONNECTING ROD BEARING CRUSH HEIGHT

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

A : Crush height

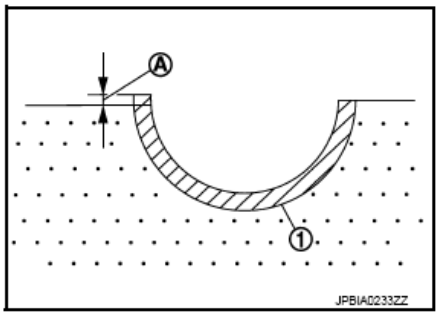


Fig. 250: Identifying Connecting Rod Bearing Crush Height
Courtesy of NISSAN NORTH AMERICA, INC.

Standard: There must be crush height.

- If the standard is not met, replace connecting rod bearings.

MAIN BEARING CAP BOLT OUTER DIAMETER

- Measure the outer diameters (A), (B) at two positions as shown in the figure below.

c : 20 mm (0.79 in)
d : 50 mm (1.97 in)
e : 22 mm (0.87 in)

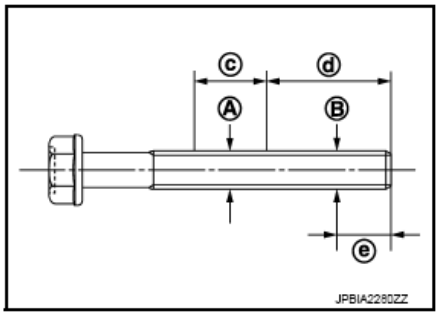


Fig. 251: Locating Main Bearing Cap Bolt Outer Diameter Measurement Points
Courtesy of NISSAN NORTH AMERICA, INC.

- If reduction appears in (A) range, regard it (B).

  Limit [(B) - (A)]: 0.18 mm (0.0071 in)

- If it exceeds the limit (large difference in dimensions), replace main bearing cap bolts with new one.

MAIN BEARING CAP SUB BOLT OUTER DIAMETER

- Measure the outer diameters (A), (B) at two positions as shown in the figure below.

c : 20 mm (0.79 in)
d : 50 mm (1.97 in)
e : 9 mm (0.35 in)

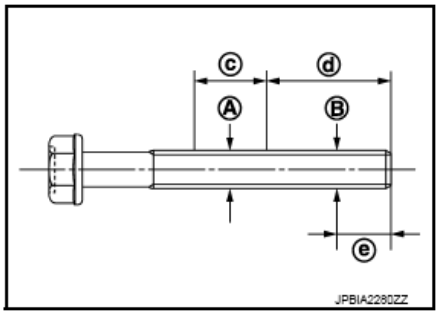


Fig. 252: Locating Main Bearing Cap Sub Bolt Outer Diameter Measurement Points
Courtesy of NISSAN NORTH AMERICA, INC.

- If reduction appears in (A) range, regard it (B).

  Limit [(B) - (A)]: 0.13 mm (0.0051 in)

- If it exceeds the limit (large difference in dimensions), replace main bearing cap sub bolts with new one.

CONNECTING ROD BOLT OUTER DIAMETER

1. Measure the outer diameters [(a), (b) and (c)] at the position shown in the figure below.

a : Value at the end of the smaller diameter of the bolt
b : Value at the end of the smaller diameter of the bolt [opposite side of (a)]
c : Value of the smallest diameter of the smaller of the bolt

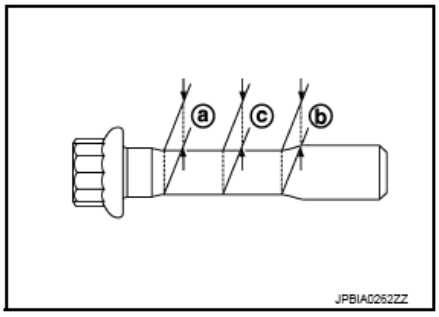


Fig. 253: Locating Connecting Rod Bolt Outer Diameter Measurement Points
Courtesy of NISSAN NORTH AMERICA, INC.

2. Obtain a mean value (d) of (a) and (b).
3. Subtract (c) from (d).

Limit [(d) - (c)]: 0.09 mm (0.0035 in)

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

DRIVE PLATE

- Check drive plate and signal plate (A) for deformation or damage.

B : Ring gear
⇦ : Engine front

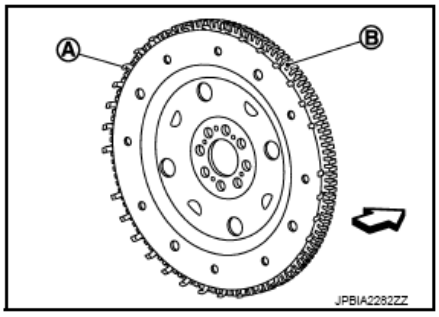


Fig. 254: Identifying Drive Plate And Signal Plate
Courtesy of NISSAN NORTH AMERICA, INC.

CAUTION:
- **Never disassemble drive plate.**
- **Never place drive plate with signal plate facing down.**
- **When handling signal plate, take care not to damage or scratch it.**
- **Handle signal plate in a manner that prevents it from becoming magnetized.**

- If damage is found, replace drive plate.

OIL JET

- Check nozzle for deformation and damage.
- Blow compressed air from nozzle, and check for clogs.
- Using a clean plastic stick, press check valve in oil jet relief valve. Check that valve moves smoothly with proper reaction force.
- If it is not satisfied, clean or replace oil jet.

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 match of connecting rod big end diameter grade (inner diameter of housing) and crankshaft pin outer diameter.
Between cylinder block and piston	Piston and piston pin assembly (Piston is available together with piston pin as assembly.)	Piston grade (piston skirt diameter)	Piston grade = cylinder bore grade (inner diameter of bore)

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

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.

A : Bearing housing grade No. 1
B : Bearing housing grade No. 2
C : Bearing housing grade No. 3
D : Bearing housing grade No. 4
E : Bearing housing grade No. 5
F : Cylinder bore grade No. 1
G : Cylinder bore grade No. 2
H : Cylinder bore grade No. 3
I : Cylinder bore grade No. 4
J : Cylinder bore grade No. 5
K : Cylinder bore grade No. 6
L : Cylinder bore grade No. 7
M : Cylinder bore grade No. 8
⇦ : Engine front

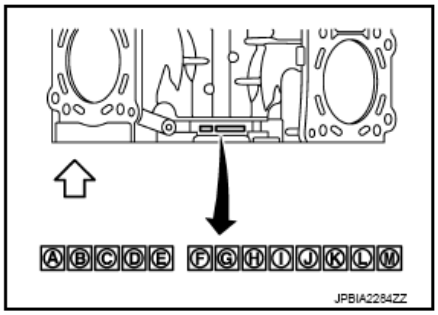


Fig. 255: Locating Housing Grade And Bore Grade On Cylinder Block
Courtesy of NISSAN NORTH AMERICA, INC.

NOTE: Piston is available with piston pin as a set for the service part.

WHEN CYLINDER BLOCK IS REUSED

1. Measure the cylinder bore inner diameter. Refer to "**CYLINDER BLOCK**".
2. Determine the bore grade by comparing the measurement with the values under the cylinder bore inner diameter of the "**PISTON SELECTION TABLE**".

A : Bank 2
B : Bank 1
C : Front mark
D : Piston grade number
E : Piston pin grade number
F : Identification code

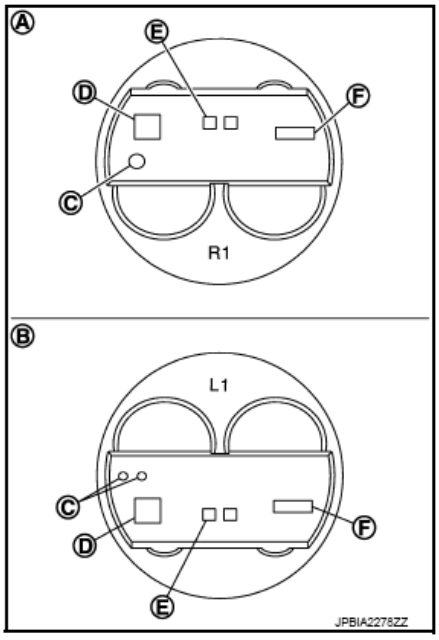


Fig. 256: Locating Piston Grade Number, Piston Pin Grade Number, Identification Code And Front Mark

Courtesy of NISSAN NORTH AMERICA, INC.

3. Select piston of the same grade.

PISTON SELECTION TABLE

Unit: mm (in)			
Grade	**1**	**2**	**3**
Cylinder bore inner diameter	95.500 - 95.510 (3.7598 - 3.7602)	95.510 - 95.520 (3.7602 - 3.7606)	95.520 - 95.530 (3.7606 - 3.7610)
Piston skirt diameter	95.480 - 95.490 (3.7590 - 3.7594)	95.490 - 95.500 (3.7594 - 3.7598)	95.500 - 95.510 (3.7598 - 3.7602)

NOTE: Piston is available together with piston pin as assembly.

Connecting Rod Bearing

WHEN NEW CONNECTING ROD AND CRANKSHAFT ARE USED

1. Apply connecting rod big end diameter grade stamped (D) on connecting rod side face to the row in the "**CONNECTING ROD BEARING SELECTION TABLE**".

A : Sample codes
B : Bearing stopper groove
C : Small-end diameter grade
E : Weight grade
F : Cylinder No.
G : Management code
H : Front mark

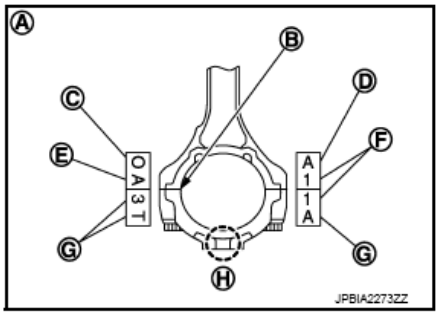
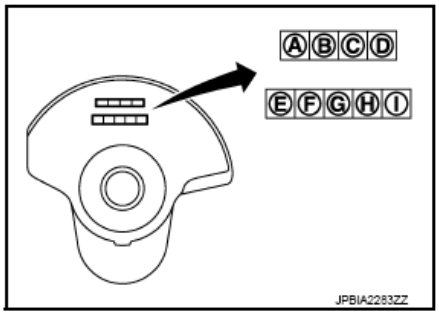


Fig. 257: Locating Connecting Rod Big End Diameter Grade Stamped On Connecting Rod
Courtesy of NISSAN NORTH AMERICA, INC.

2. Apply crankshaft pin journal diameter grade stamped on crankshaft front side to the column in the "**CONNECTING ROD BEARING SELECTION TABLE**"



A : Pin diameter grade No. 1
B : Pin diameter grade No. 2
C : Pin diameter grade No. 3
D : Pin diameter grade No. 4
E : Journal diameter grade No. 1
F : Journal diameter grade No. 2
G : Journal diameter grade No. 3
H : Journal diameter grade No. 4
I : Journal diameter grade No. 5

Fig. 258: Locating Crankshaft Pin Journal Diameter Grade Stamped On Crankshaft
Courtesy of NISSAN NORTH AMERICA, INC.

3. Read the symbol at the cross point of selected row and column in the "**CONNECTING ROD BEARING SELECTION TABLE**".
4. Apply the symbol obtained to the "**CONNECTING ROD BEARING GRADE TABLE**" to select connecting rod bearing.

WHEN CONNECTING ROD AND CRANKSHAFT ARE REUSED

1. Measure connecting rod big end diameter and crankshaft pin journal diameter. Refer to "**INSPECTION**".
2. Correspond the measured dimension in connecting rod big end diameter row of "**CONNECTING ROD BEARING SELECTION TABLE**".
3. Correspond the measured dimension in crankshaft pin journal diameter column of "**CONNECTING ROD BEARING SELECTION TABLE**".
4. Follow from step 3 in "**WHEN NEW CONNECTING ROD AND CRANKSHAFT ARE USED**".

CONNECTING ROD BEARING SELECTION TABLE

Crankshaft pin journal diameter Unit: mm (in) / Connecting rod big end diameter Unit: mm (in)		Mark	A	B	C	D	E	F	G	H	J	K	L	M	N
Mark	Axle diameter	Hole diameter	57.000 - 57.001 (2.2441 - 2.2441)	57.001 - 57.002 (2.2441 - 2.2442)	57.002 - 57.003 (2.2442 - 2.2442)	57.003 - 57.004 (2.2442 - 2.2442)	57.004 - 57.005 (2.2442 - 2.2443)	57.005 - 57.006 (2.2443 - 2.2443)	57.006 - 57.007 (2.2443 - 2.2444)	57.007 - 57.008 (2.2444 - 2.2444)	57.008 - 57.009 (2.2444 - 2.2444)	57.009 - 57.010 (2.2444 - 2.2445)	57.010 - 57.011 (2.2445 - 2.2445)	57.011 - 57.012 (2.2445 - 2.2446)	57.012 - 57.013 (2.2446 - 2.2446)
A	53.974 - 53.973 (2.1250 - 2.1249)		0	0	0	0	0	0	1	1	1	1	1	1	2
B	53.973 - 53.972 (2.1249 - 2.1249)		0	0	0	0	0	1	1	1	1	1	1	2	2
C	53.972 - 53.971 (2.1249 - 2.1248)		0	0	0	0	1	1	1	1	1	1	2	2	2
D	53.971 - 53.970 (2.1248 - 2.1248)		0	0	0	1	1	1	1	1	1	2	2	2	2
E	53.970 - 53.969 (2.1248 - 2.1248)		0	0	1	1	1	1	1	1	2	2	2	2	2
F	53.969 - 53.968 (2.1248 - 2.1247)		0	1	1	1	1	1	1	2	2	2	2	2	2
G	53.968 - 53.967 (2.1247 - 2.1247)		1	1	1	1	1	1	2	2	2	2	2	2	3
H	53.967 - 53.966 (2.1247 - 2.1246)		1	1	1	1	1	2	2	2	2	2	2	3	3
J	53.966 - 53.965 (2.1246 - 2.1246)		1	1	1	1	2	2	2	2	2	2	3	3	3
K	53.965 - 53.964 (2.1246 - 2.1246)		1	1	1	2	2	2	2	2	2	3	3	3	3
L	53.964 - 53.963 (2.1246 - 2.1245)		1	1	2	2	2	2	2	2	3	3	3	3	3
M	53.963 - 53.962 (2.1245 - 2.1245)		1	2	2	2	2	2	2	3	3	3	3	3	3
N	53.962 - 53.961 (2.1245 - 2.1244)		2	2	2	2	2	2	3	3	3	3	3	3	4
P	53.961 - 53.960 (2.1244 - 2.1244)		2	2	2	2	2	3	3	3	3	3	3	4	4
R	53.960 - 53.959 (2.1244 - 2.1244)		2	2	2	2	3	3	3	3	3	3	4	4	4
S	53.959 - 53.958 (2.1244 - 2.1243)		2	2	2	3	3	3	3	3	3	4	4	4	4
T	53.958 - 53.957 (2.1243 - 2.1243)		2	2	3	3	3	3	3	3	4	4	4	4	4
U	53.957 - 53.956 (2.1243 - 2.1242)		2	3	3	3	3	3	3	4	4	4	4	4	4

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Fig. 259: Connecting Rod Bearing Selection Chart
Courtesy of NISSAN NORTH AMERICA, INC.

CONNECTING ROD BEARING GRADE TABLE

Connecting rod bearing grade table: Refer to "CONNECTING ROD BEARING".

UNDERSIZE BEARING 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 to use undersize bearings, keep the fillet R (A) [1.5 - 1.7 mm (0.059 - 0.067 in)].

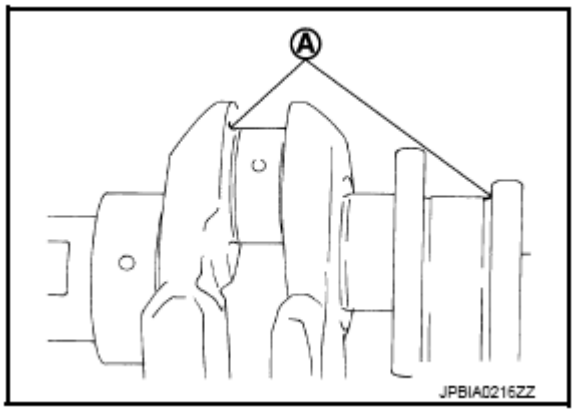

Fig. 260: Locating Fillet Radius Areas
Courtesy of NISSAN NORTH AMERICA, INC.

Bearing undersize table: Refer to "CONNECTING ROD BEARING".

Main Bearing

WHEN NEW CYLINDER BLOCK AND CRANKSHAFT ARE USED

1. "MAIN BEARING SELECTION TABLE" rows correspond to bearing housing grade on rear side of cylinder block.

A : Bearing housing grade No. 1
B : Bearing housing grade No. 2
C : Bearing housing grade No. 3
D : Bearing housing grade No. 4
E : Bearing housing grade No. 5
F : Cylinder bore grade No. 1
G : Cylinder bore grade No. 2
H : Cylinder bore grade No. 3
I : Cylinder bore grade No. 4
J : Cylinder bore grade No. 5
K : Cylinder bore grade No. 6
L : Cylinder bore grade No. 7
M : Cylinder bore grade No. 8
⇦ : Engine front

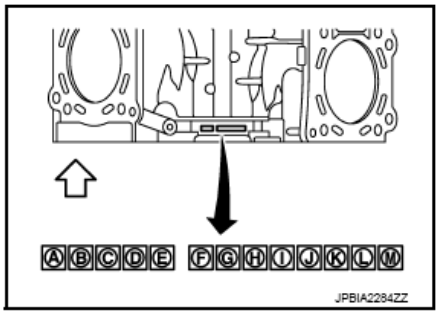

Fig. 261: Identifying Housing Grade And Bore Grade On Main Bearing
Courtesy of NISSAN NORTH AMERICA, INC.

2. "MAIN BEARING SELECTION TABLE" columns correspond to journal diameter grade on front side of crankshaft.

A : Pin diameter grade No. 1
B : Pin diameter grade No. 2
C : Pin diameter grade No. 3
D : Pin diameter grade No. 4
E : Journal diameter grade No. 1
F : Journal diameter grade No. 2
G : Journal diameter grade No. 3
H : Journal diameter grade No. 4
I : Journal diameter grade No. 5

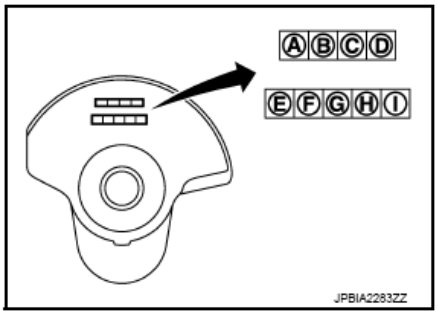

Fig. 262: Identifying Diameter Grade On Main Bearing
Courtesy of NISSAN NORTH AMERICA, INC.

3. Select main bearing grade at the point where selected row and column meet in "MAIN BEARING SELECTION TABLE".

CAUTION:
- **Initial clearance for No. 1, 5 journal and No. 2, 3, 4 journal is different. Use two different selection table for each part.**
- **No. 1, 5 journal and No. 2, 3, 4 journal have the same signs but different measures. Never confuse.**

4. Apply sign at crossing in above step 3 to "MAIN BEARING GRADE TABLE".

NOTE:
- **"MAIN BEARING GRADE TABLE" applies to all journals.**
- **Service parts are available as a set of both upper and lower.**

WHEN CYLINDER BLOCK AND CRANKSHAFT ARE REUSED

1. Measure cylinder block main bearing housing inner diameter and crankshaft main journal diameter. Refer to "**INSPECTION**".
2. Correspond the measured dimension in "Cylinder block main bearing housing inner diameter" row of "MAIN BEARING SELECTION TABLE".
3. Correspond the measured dimension in "Crankshaft main journal diameter" column of "MAIN BEARING SELECTION TABLE".
4. Follow from step 3 in "**WHEN NEW CYLINDER BLOCK AND CRANKSHAFT ARE USED**".

MAIN BEARING SELECTION TABLE (No. 1 and 5 Journal)

Cylinder block main bearing housing inner diameter / Crankshaft main journal diameter		I.D. mark	A	B	C	D	E	F	G	H	J	K	L	M	N	P	R	S	T	U	V	W	X	Y	4	7
		Hole diameter Unit: mm (in)	68.944 - 68.945 (2.7143 - 2.7144)	68.945 - 68.946 (2.7144 - 2.7144)	68.946 - 68.947 (2.7144 - 2.7144)	68.947 - 68.948 (2.7144 - 2.7145)	68.948 - 68.949 (2.7145 - 2.7145)	68.949 - 68.950 (2.7145 - 2.7146)	68.950 - 68.951 (2.7146 - 2.7146)	68.951 - 68.952 (2.7146 - 2.7146)	68.952 - 68.953 (2.7146 - 2.7147)	68.953 - 68.954 (2.7147 - 2.7147)	68.954 - 68.955 (2.7147 - 2.7148)	68.955 - 68.956 (2.7148 - 2.7148)	68.956 - 68.957 (2.7148 - 2.7148)	68.957 - 68.958 (2.7148 - 2.7149)	68.958 - 68.959 (2.7149 - 2.7149)	68.959 - 68.960 (2.7149 - 2.7150)	68.960 - 68.961 (2.7150 - 2.7150)	68.961 - 68.962 (2.7150 - 2.7150)	68.962 - 68.963 (2.7150 - 2.7151)	68.963 - 68.964 (2.7151 - 2.7151)	68.964 - 68.965 (2.7151 - 2.7152)	68.965 - 68.966 (2.7152 - 2.7152)	68.966 - 68.967 (2.7152 - 2.7152)	68.967 - 68.968 (2.7152 - 2.7153)
I.D. mark	Axle diameter Unit: mm (in)																									
G	63.964 - 63.963 (2.5183 - 2.5182)		1	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45	5
H	63.963 - 63.962 (2.5182 - 2.5182)		1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45	5	5
J	63.962 - 63.961 (2.5182 - 2.5181)		12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45	5	5	5
K	63.961 - 63.960 (2.5181 - 2.5181)		12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45	5	5	5	56
L	63.960 - 63.959 (2.5181 - 2.5181)		12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45	5	5	5	56	56
M	63.959 - 63.958 (2.5181 - 2.5180)		2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45	5	5	5	56	56	56
N	63.958 - 63.957 (2.5180 - 2.5180)		2	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45	5	5	5	56	56	56	6
P	63.957 - 63.956 (2.5180 - 2.5179)		2	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45	5	5	5	56	56	56	6	6
R	63.956 - 63.955 (2.5179 - 2.5179)		23	23	23	3	3	3	34	34	34	4	4	4	45	45	45	5	5	5	56	56	56	6	6	6
S	63.955 - 63.954 (2.5179 - 2.5179)		23	23	3	3	3	34	34	34	4	4	4	45	45	45	5	5	5	56	56	56	6	6	6	67
T	63.954 - 63.953 (2.5179 - 2.5178)		23	3	3	3	34	34	34	4	4	4	45	45	45	5	5	5	56	56	56	6	6	6	67	67
U	63.953 - 63.952 (2.5178 - 2.5178)		3	3	3	34	34	34	4	4	4	45	45	45	5	5	5	56	56	56	6	6	6	67	67	67
V	63.952 - 63.951 (2.5178 - 2.5178)		3	3	34	34	34	4	4	4	45	45	45	5	5	5	56	56	56	6	6	6	67	67	67	7
W	63.951 - 63.950 (2.5178 - 2.5177)		3	34	34	34	4	4	4	45	45	45	5	5	5	56	56	56	6	6	6	67	67	67	7	7
X	63.950 - 63.949 (2.5177 - 2.5177)		34	34	34	4	4	4	45	45	45	5	5	5	56	56	56	6	6	6	67	67	67	7	7	7
Y	63.949 - 63.948 (2.5177 - 2.5176)		34	34	4	4	4	45	45	45	5	5	5	56	56	56	6	6	6	67	67	67	7	7	7	78
1	63.948 - 63.947 (2.5176 - 2.5176)		34	4	4	4	45	45	45	5	5	5	56	56	56	6	6	6	67	67	67	7	7	7	78	78
2	63.947 - 63.946 (2.5176 - 2.5176)		4	4	4	45	45	45	5	5	5	56	56	56	6	6	6	67	67	67	7	7	7	78	78	78
3	63.946 - 63.945 (2.5176 - 2.5175)		4	4	45	45	45	5	5	5	56	56	56	6	6	6	67	67	67	7	7	7	78	78	78	8
4	63.945 - 63.944 (2.5175 - 2.5175)		4	45	45	45	5	5	5	56	56	56	6	6	6	67	67	67	7	7	7	78	78	78	8	8
5	63.944 - 63.943 (2.5175 - 2.5174)		45	45	45	5	5	5	56	56	56	6	6	6	67	67	67	7	7	7	78	78	78	8	8	8
6	63.943 - 63.942 (2.5174 - 2.5174)		45	45	5	5	5	56	56	56	6	6	6	67	67	67	7	7	7	78	78	78	8	8	8	X
7	63.942 - 63.941 (2.5174 - 2.5174)		45	5	5	5	56	56	56	6	6	6	67	67	67	7	7	7	78	78	78	8	8	8	X	X
9	63.941 - 63.940 (2.5174 - 2.5173)		5	5	5	56	56	56	6	6	6	67	67	67	7	7	7	78	78	78	8	8	8	X	X	X

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Fig. 263: Main Bearing Selection Chart (No. 1 And 5 Journal)
Courtesy of NISSAN NORTH AMERICA, INC.

MAIN BEARING SELECTION TABLE (No. 2, 3 and 4 Journal)

Crankshaft main journal diameter / Cylinder block main bearing housing inner diameter		I.D. mark	A	B	C	D	E	F	G	H	J	K	L	M	N	P	R	S	T	U	V	W	X	Y	4	7
		Hole diameter Unit: mm (in)	68.944 - 68.945 (2.7143 - 2.7144)	68.945 - 68.946 (2.7144 - 2.7144)	68.946 - 68.947 (2.7144 - 2.7144)	68.947 - 68.948 (2.7144 - 2.7145)	68.948 - 68.949 (2.7145 - 2.7145)	68.949 - 68.950 (2.7145 - 2.7146)	68.950 - 68.951 (2.7146 - 2.7146)	68.951 - 68.952 (2.7146 - 2.7146)	68.952 - 68.953 (2.7146 - 2.7147)	68.953 - 68.954 (2.7147 - 2.7147)	68.954 - 68.955 (2.7147 - 2.7148)	68.955 - 68.956 (2.7148 - 2.7148)	68.956 - 68.957 (2.7148 - 2.7148)	68.957 - 68.958 (2.7148 - 2.7149)	68.958 - 68.959 (2.7149 - 2.7149)	68.959 - 68.960 (2.7149 - 2.7150)	68.960 - 68.961 (2.7150 - 2.7150)	68.961 - 68.962 (2.7150 - 2.7150)	68.962 - 68.963 (2.7150 - 2.7151)	68.963 - 68.964 (2.7151 - 2.7151)	68.964 - 68.965 (2.7151 - 2.7152)	68.965 - 68.966 (2.7152 - 2.7152)	68.966 - 68.967 (2.7152 - 2.7152)	68.967 - 68.968 (2.7152 - 2.7153)
I.D. mark	Axle diameter Unit: mm (in)																									
A	63.964 - 63.963 (2.5183 - 2.5182)		0	0	01	01	01	1	1	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4
B	63.963 - 63.962 (2.5182 - 2.5182)		0	01	01	01	1	1	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4
C	63.962 - 63.961 (2.5182 - 2.5181)		01	01	01	1	1	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4
D	63.961 - 63.960 (2.5181 - 2.5181)		01	01	1	1	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45
E	63.960 - 63.959 (2.5181 - 2.5181)		01	1	1	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45
F	63.959 - 63.958 (2.5181 - 2.5180)		1	1	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45
G	63.958 - 63.957 (2.5180 - 2.5180)		1	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45	5
H	63.957 - 63.956 (2.5180 - 2.5179)		1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45	5	5
J	63.956 - 63.955 (2.5179 - 2.5179)		12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45	5	5	5
K	63.955 - 63.954 (2.5179 - 2.5179)		12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45	5	5	5	56
L	63.954 - 63.953 (2.5179 - 2.5178)		12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45	5	5	5	56	56
M	63.953 - 63.952 (2.5178 - 2.5178)		2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45	5	5	5	56	56	56
N	63.952 - 63.951 (2.5178 - 2.5178)		2	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45	5	5	5	56	56	56	6
P	63.951 - 63.950 (2.5178 - 2.5177)		2	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45	5	5	5	56	56	56	6	6
R	63.950 - 63.949 (2.5177 - 2.5177)		23	23	23	3	3	3	34	34	34	4	4	4	45	45	45	5	5	5	56	56	56	6	6	6
S	63.949 - 63.948 (2.5177 - 2.5176)		23	23	3	3	3	34	34	34	4	4	4	45	45	45	5	5	5	56	56	56	6	6	6	67
T	63.948 - 63.947 (2.5176 - 2.5176)		23	3	3	3	34	34	34	4	4	4	45	45	45	5	5	5	56	56	56	6	6	6	67	67
U	63.947 - 63.946 (2.5176 - 2.5176)		3	3	3	34	34	34	4	4	4	45	45	45	5	5	5	56	56	56	6	6	6	67	67	67
V	63.946 - 63.945 (2.5176 - 2.5175)		3	3	34	34	34	4	4	4	45	45	45	5	5	5	56	56	56	6	6	6	67	67	67	7
W	63.945 - 63.944 (2.5175 - 2.5175)		3	34	34	34	4	4	4	45	45	45	5	5	5	56	56	56	6	6	6	67	67	67	7	7
X	63.944 - 63.943 (2.5175 - 2.5174)		34	34	34	4	4	4	45	45	45	5	5	5	56	56	56	6	6	6	67	67	67	7	7	7
Y	63.943 - 63.942 (2.5174 - 2.5174)		34	34	4	4	4	45	45	45	5	5	5	56	56	56	6	6	6	67	67	67	7	7	7	78
1	63.942 - 63.941 (2.5174 - 2.5174)		34	4	4	4	45	45	45	5	5	5	56	56	56	6	6	6	67	67	67	7	7	7	78	78
2	63.941 - 63.940 (2.5174 - 2.5173)		4	4	4	45	45	45	5	5	5	56	56	56	6	6	6	67	67	67	7	7	7	78	78	78

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Fig. 264: Main Bearing Selection Chart (No. 2, 3 And 4 Journal)
Courtesy of NISSAN NORTH AMERICA, INC.

MAIN BEARING GRADE TABLE (ALL JOURNALS)

Main bearing grade table (All journals): Refer to "MAIN BEARING".

UNDERSIZE BEARING USAGE GUIDE

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

CAUTION: In grinding crankshaft main journal to use undersize bearings, keep the fillet R (A) [1.5 - 1.7 mm (0.059 - 0.067 in)].

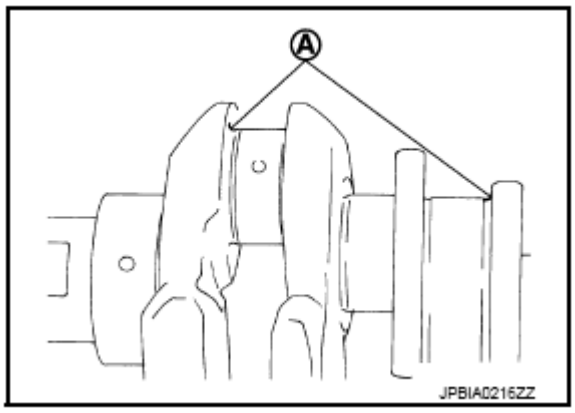


Fig. 265: Locating Fillet Radius Areas
Courtesy of NISSAN NORTH AMERICA, INC.

Bearing undersize table: Refer to "MAIN BEARING".

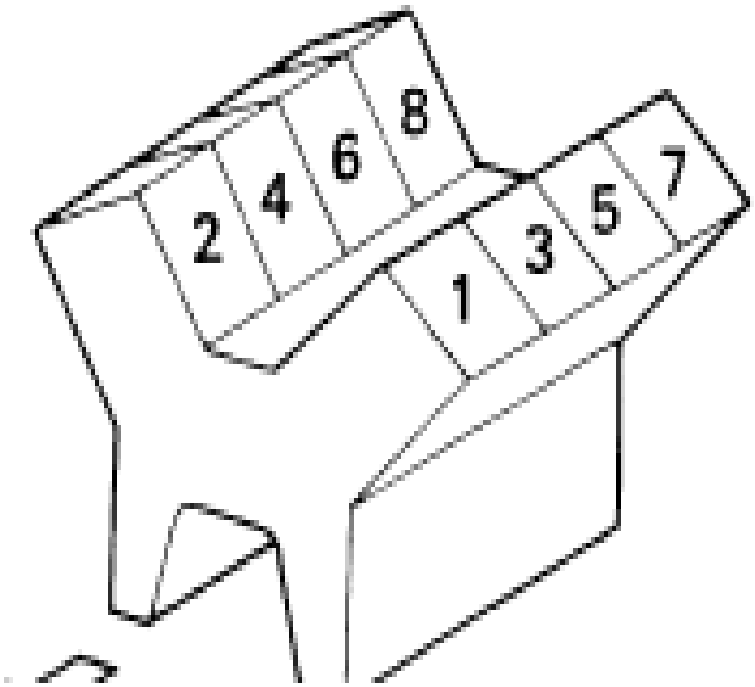
SERVICE DATA AND SPECIFICATIONS (SDS)

SERVICE DATA AND SPECIFICATIONS (SDS)

General Specification

GENERAL SPECIFICATIONS

Cylinder arrangement		V-8
Displacement cm^3 (cu in)		5, 026 (306.69)
Bore and stroke mm (in)		95.5 x 87.7 (3.76 x 3.453)
Valve arrangement		DOHC
Firing order		1-8-7-3-6-5-4-2
Number of piston rings	Compression	2
	Oil	1
Number of main bearings		5
Compression ratio		10.9
Compression pressure kPa (kg/cm^2 , psi)/200 RPM	Standard	1, 667 (17, 242)
	Minimum	1, 226 (12.5, 178)
	Differential limit between cylinders	98 (1.0, 14)

Cylinder number	

		Unit: degree
Valve timing	Intake valve open (BTDC)	-66 - 61
	Intake valve close (ABDC)	-71 - 84
	Exhaust valve open (BBDC)	32 - 62
	Exhaust valve close (ATDC)	-2 - 28

Drive Belts

DRIVE BELT

Tension of drive belts	Belt tension is not necessary, as it is automatically adjusted by drive belt auto-tensioner.

Spark Plug

SPARK PLUG

		Unit: mm (in)
Make		**DENSO**
Standard type		FXE22HR11
Gap	Standard	1.1 (0.043)
	Limit	1.4 (0.055)

Exhaust Manifold

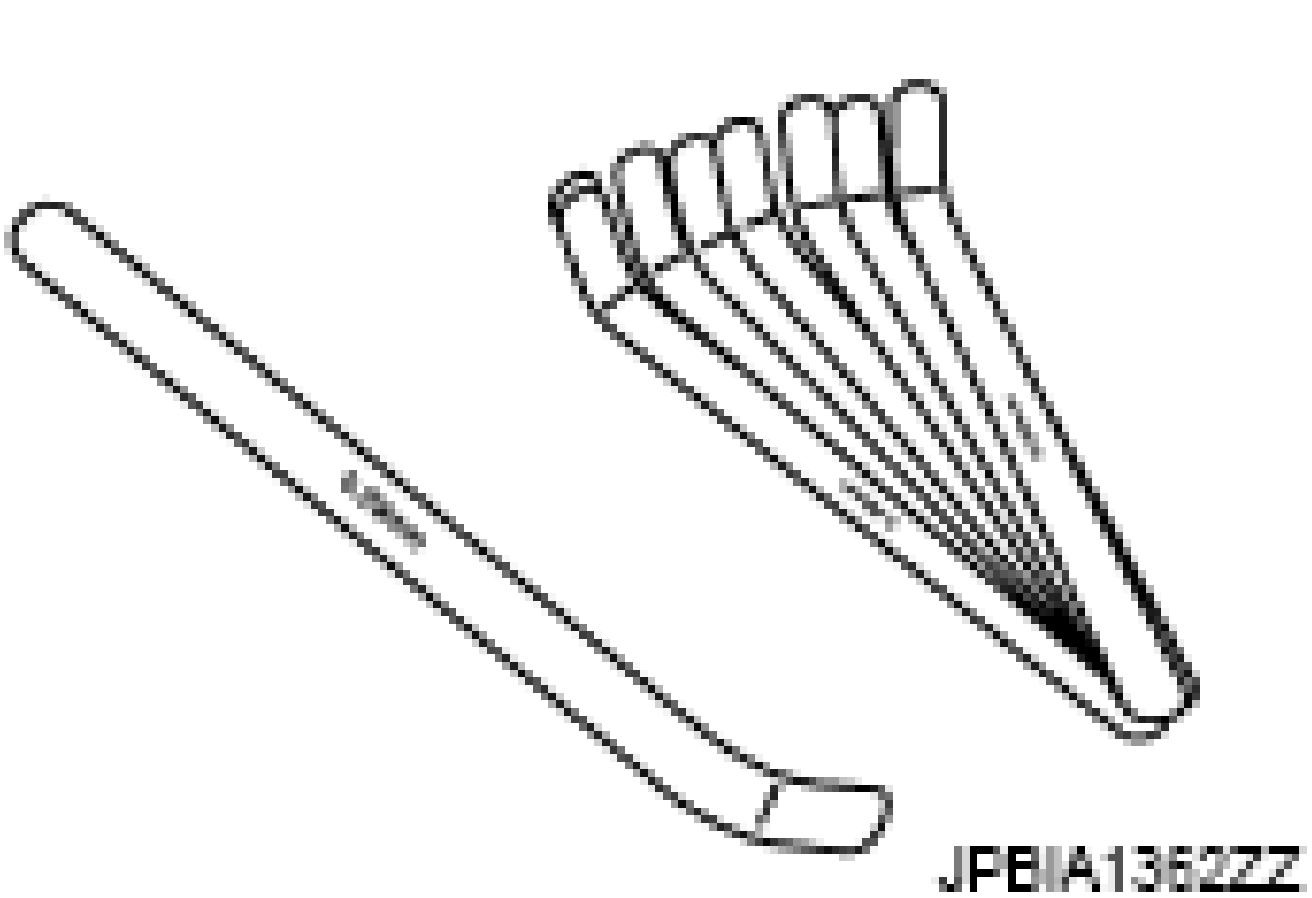
EXHAUST MANIFOLD

		Unit: mm (in)
Items		**Limit**
Surface distortion	Exhaust manifold	0.7 (0.028)

Camshaft

CAMSHAFT (EXH)

			Unit: mm (in)
Items		**Standard**	**Limit**
Camshaft (EXH) journal oil clearance	No. 1	0.045 - 0.086 (0.0018 - 0.0034)	0.150 (0.0059)
	No. 2, 3, 4, 5	0.030 - 0.071 (0.0012 - 0.0028)	
VVEL ladder assembly bracket inner diameter (EXH side)		26.000 - 26.021 (1.0236 - 0.0244)	-
Camshaft (EXH) journal diameter	No. 1	25.935 - 25.955 (1.0211 - 1.0218)	-
	No. 2, 3, 4, 5	25.950 - 25.970 (1.0217 - 1.0224)	-
Camshaft (EXH) end play		0.115 - 0.188 (0.0045 - 0.0074)	0.24 (0.0094)
Camshaft (EXH) cam height "A"		45.475 - 45.665 (1.7904 - 1.7978)	44.275 (1.7431)
Camshaft (EXH) runout [TIR(1)]		Less than 0.02 mm (0.0008)	0.05 (0.002)
Camshaft sprocket (EXH) runout [TIR(1)]		-	0.2 (0.0079)



(1) Total indicator reading

CAMSHAFT (INT)

		Unit: mm (in)
Items	**Standard**	**Limit**
Drive shaft end play	0.115 - 0.188 (0.0045 - 0.0074)	0.24 (0.0094)
Camshaft sprocket (INT) runout [TIR(1)]	-	0.15 (0.0059)
(1) Total indicator reading		

VALVE LIFTER

	Unit: mm (in)
Items	**Standard**
Valve lifter outer diameter	33.980 - 33.990 (1.3378 - 1.3382)
Valve lifter hole diameter	34.000 - 34.016 (1.3386 - 1.3392)
Valve lifter clearance	0.010 - 0.036 (0.0004 - 0.0014)

VALVE CLEARANCE

Unit: mm (in)

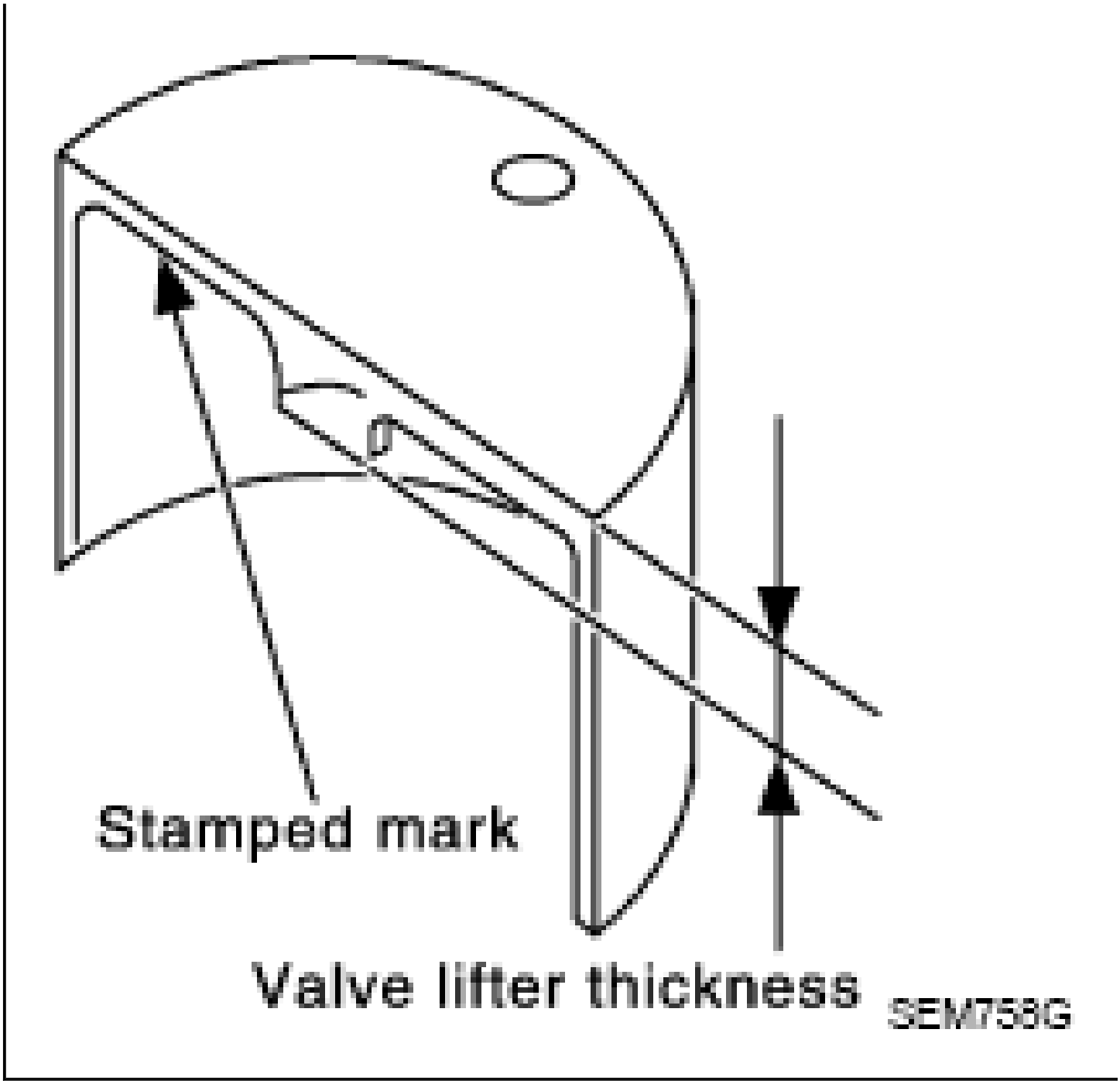
Items	Cold	Hot(1) (reference data)
Intake	0.26 - 0.34 (0.010 - 0.013)	0.304 - 0.416 (0.012 - 0.016)
Exhaust	0.29 - 0.37 (0.011 - 0.015)	0.308 - 0.432 (0.012 - 0.017)

(1) Approximately 80°C (176°F)

AVAILABLE VALVE LIFTER

Unit: mm (in)

Identification (stamped) mark	Thickness
788P	7.88 (0.3102)
790P	7.90 (0.3110)
792P	7.92 (0.3118)
794P	7.94 (0.3126)
796P	7.96 (0.3134)
798P	7.98 (0.3142)
800P	8.00 (0.3150)
802P	8.02 (0.3157)
804P	8.04 (0.3165)
806P	8.06 (0.3173)
808P	8.08 (0.3181)
810P	8.10 (0.3189)
812P	8.12 (0.3197)
814P	8.14 (0.3205)
816P	8.16 (0.3213)
818P	8.18 (0.3220)
820P	8.20 (0.3228)
822P	8.22 (0.3236)
824P	8.24 (0.3244)
826P	8.26 (0.3252)
828P	8.28 (0.3260)
830P	8.30 (0.3268)
832P	8.32 (0.3276)
834P	8.34 (0.3283)
836P	8.36 (0.3291)
838P	8.38 (0.3299)
840P	8.40 (0.3307)



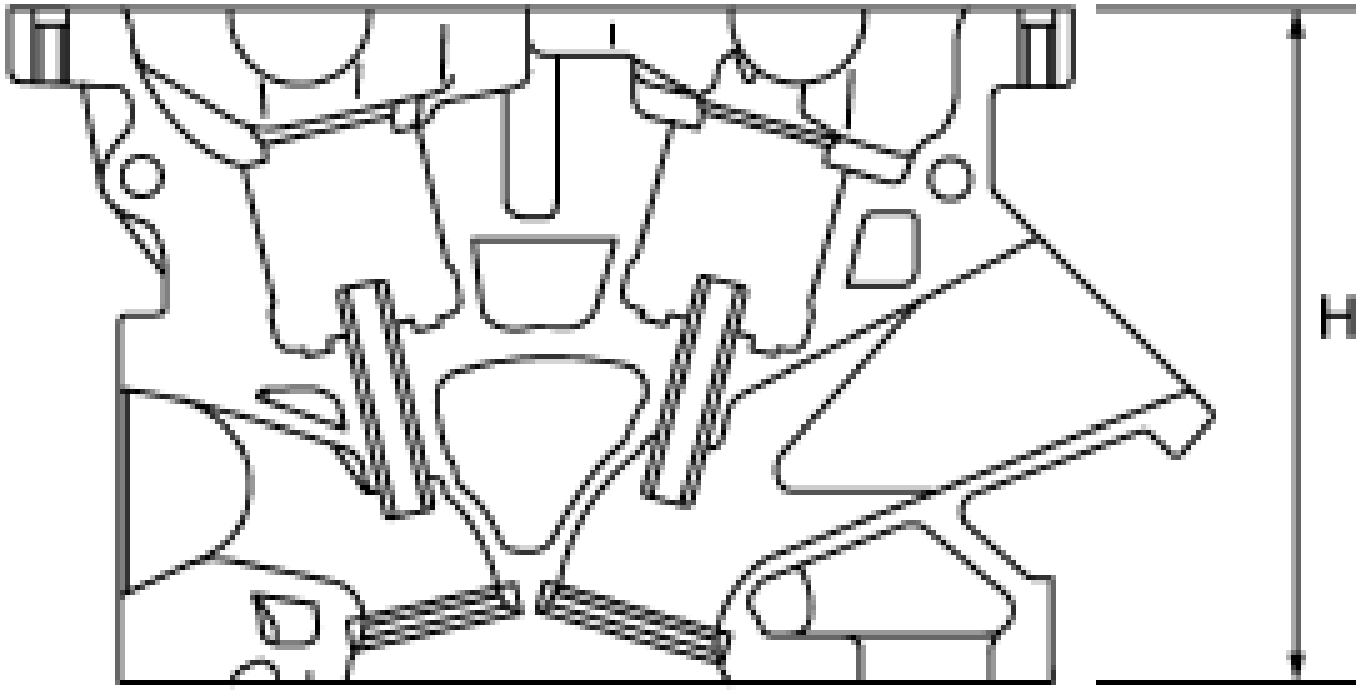
Cylinder Head

CYLINDER HEAD

Unit: mm (in)

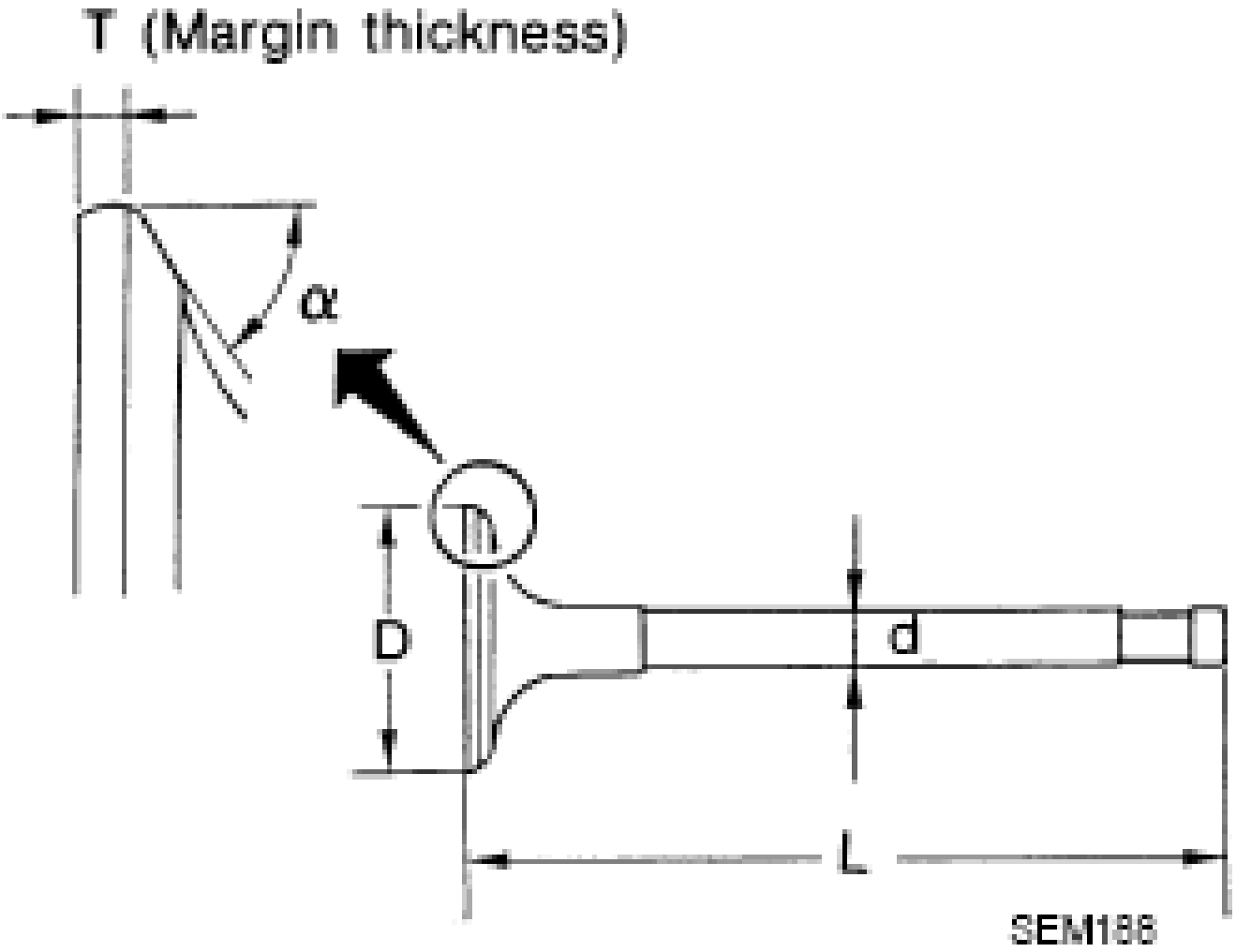
Items	Standard	Limit
Head surface distortion	Less than 0.03 (0.0012)	0.1 (0.004)

Normal cylinder head height "H"	126.4 (4.98)	-



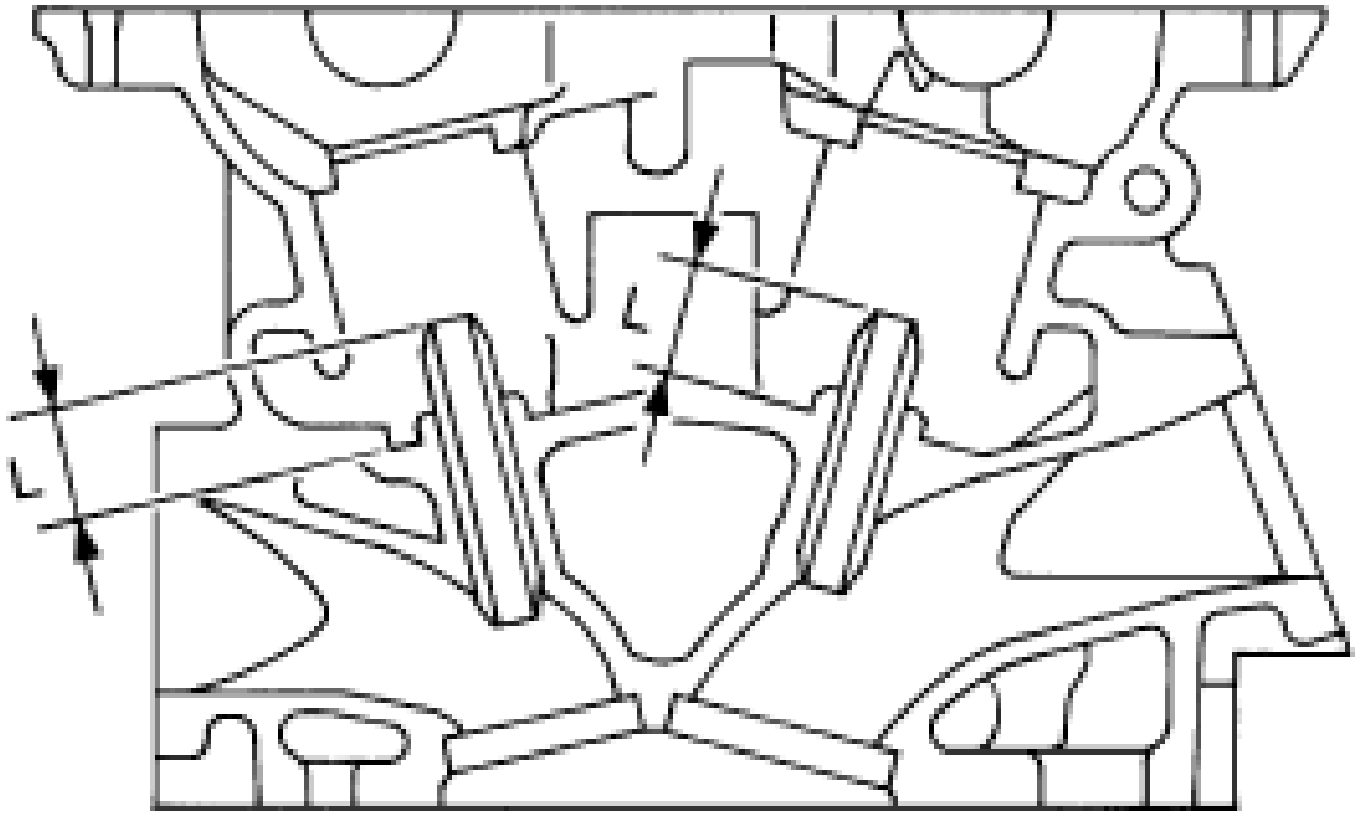
VALVE DIMENSIONS

Unit: mm (in)



Valve head diameter "D"	Intake	36.6 - 36.9 (1.441 - 1.453)
	Exhaust	30.2 - 30.5 (1.189 - 1.201)
Valve length "L"	Intake	100.11 (3.94)
	Exhaust	94.67 (3.7272)
Valve stem diameter "d"	Intake	5.965 - 5.980 (0.2348 - 0.2354)
	Exhaust	5.955 - 5.970 (0.2344 - 0.2350)
Valve seat angle "a"	Intake	45°15' - 45°45'
	Exhaust	
Valve margin "T"	Intake	1.1 (0.043)
	Exhaust	1.3 (0.051)
Valve margin "T" limit		0.5 (0.020)
Valve stem end surface grinding limit		0.2 (0.008)

Unit: mm (in)



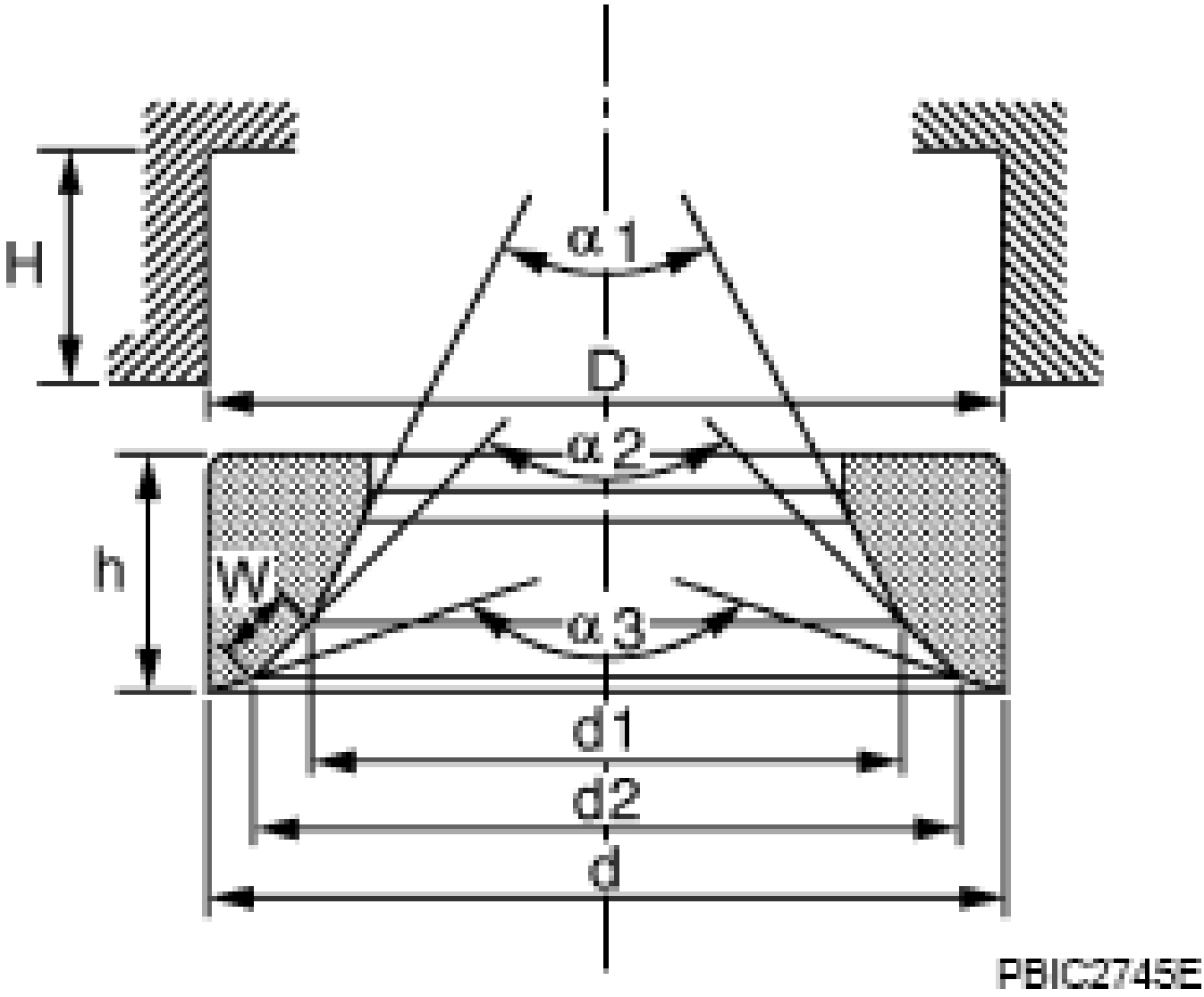
SEM950E

Items		Standard	Oversize (Service) [0.2 (0.008)] (1)
Valve guide	Outer diameter	10.023 - 10.034 (0.3946 - 0.3950)	10.223 - 10.234 (0.4025 - 0.4029)(1)
	Inner diameter (Finished size)	6.000 - 6.018 (0.2362 - 0.2369)	
Cylinder head valve guide hole diameter		9.975 - 9.996 (0.3927 - 0.3935)	10.175 - 10.196 (0.4006 - 0.4014)(1)
Interference fit of valve guide		0.027 - 0.059 (0.0011 - 0.0023)	
Items		Standard	Limit
Valve guide clearance	Intake	0.020 - 0.053 (0.0008 - 0.0021)	0.08 (0.003)
	Exhaust	0.030 - 0.063 (0.0012 - 0.0025)	0.09 (0.004)
Projection length "L"	Intake	12.6 - 12.8 (0.496 - 0.504)	
	Exhaust	11.9 - 12.1 (0.469 - 0.476)	

(1) Parts settings are for exhaust side only

VALVE SEAT

Unit: mm (in)



Items		Standard	Oversize (Service) [0.5 (0.02)] (4)
Cylinder head seat recess diameter "D"	Intake	38.000 - 38.016 (1.4961 - 1.4967)	-
	Exhaust	31.600 - 31.616 (1.2441 - 1.2447)	32.100 - 32.116 (1.2638 - 1.2644) (4)
Valve seat outer diameter "d"	Intake	38.097 - 38.113 (1.4999 - 1.5005)	-
	Exhaust	31.680 - 31.696 (1.2472 - 1.2479)	32.180 - 32.196 (1.2669 - 1.2676)

			(4)
Valve seat interference fit	Intake	0.081 - 0.113 (0.0032 - 0.0044)	
	Exhaust	0.064 - 0.096 (0.0025 - 0.0038)	
Diameter "d1"(1)	Intake	34.6 (1.362)	
	Exhaust	27.7 (1.091)	
Diameter "d2"(2)	Intake	35.9 - 36.4 (1.413 - 1.433)	
	Exhaust	29.3 - 29.8 (1.154 - 1.173)	
Angle "a1"		59 - 61°	
Angle "a2"		88°45' - 90°15'	
Angle "a3"		119 - 121°	
Contacting width "W"(3)	Intake	1.0 - 1.4 (0.039 - 0.055)	
	Exhaust	1.2 - 1.6 (0.047 - 0.063)	
Height "h"	Intake	5.9 - 6.0 (0.232 - 0.236)	-
	Exhaust	5.9 - 6.0 (0.232 - 0.236)	4.9 - 5.0 (0.1949 - 0.1988)(4)
Depth "H"		6.0 (0.236)	

(1) Diameter made by intersection point of conic angles "a1" and "a2"

(2) Diameter made by intersection point of conic angles "a2" and "a3"

(3) Machining data

(4) Parts settings are for exhaust side only

VALVE SPRING

Item		Standard	
		Intake	Exhaust
Free height		48.69 mm (1.9169 in)	47.35 mm (1.8642 in)
Pressure	Installation	162 - 192 N (16.5 - 19.6 kg, 36 - 43 lb) at 42.40 mm (1.6693 in)	163 - 191 N (16.6 - 19.5 kg, 37 - 43 lb) at 35.45 mm (1.3957 in)
	Valve open	609 - 695 N (62.1 - 70.9 kg, 137 - 156 lb) at 28.83 mm (1.1350 in)	370 - 426 N (37.7 - 43.5 kg, 83 - 96 lb) at 25.65 mm (1.0098 in)
Identification color		Yellow	Pink

Item	Limit	
	Intake	Exhaust
Out-of-square	2.1 mm (0.083 in)	2.0 mm (0.079 in)

Cylinder Block

CYLINDER BLOCK

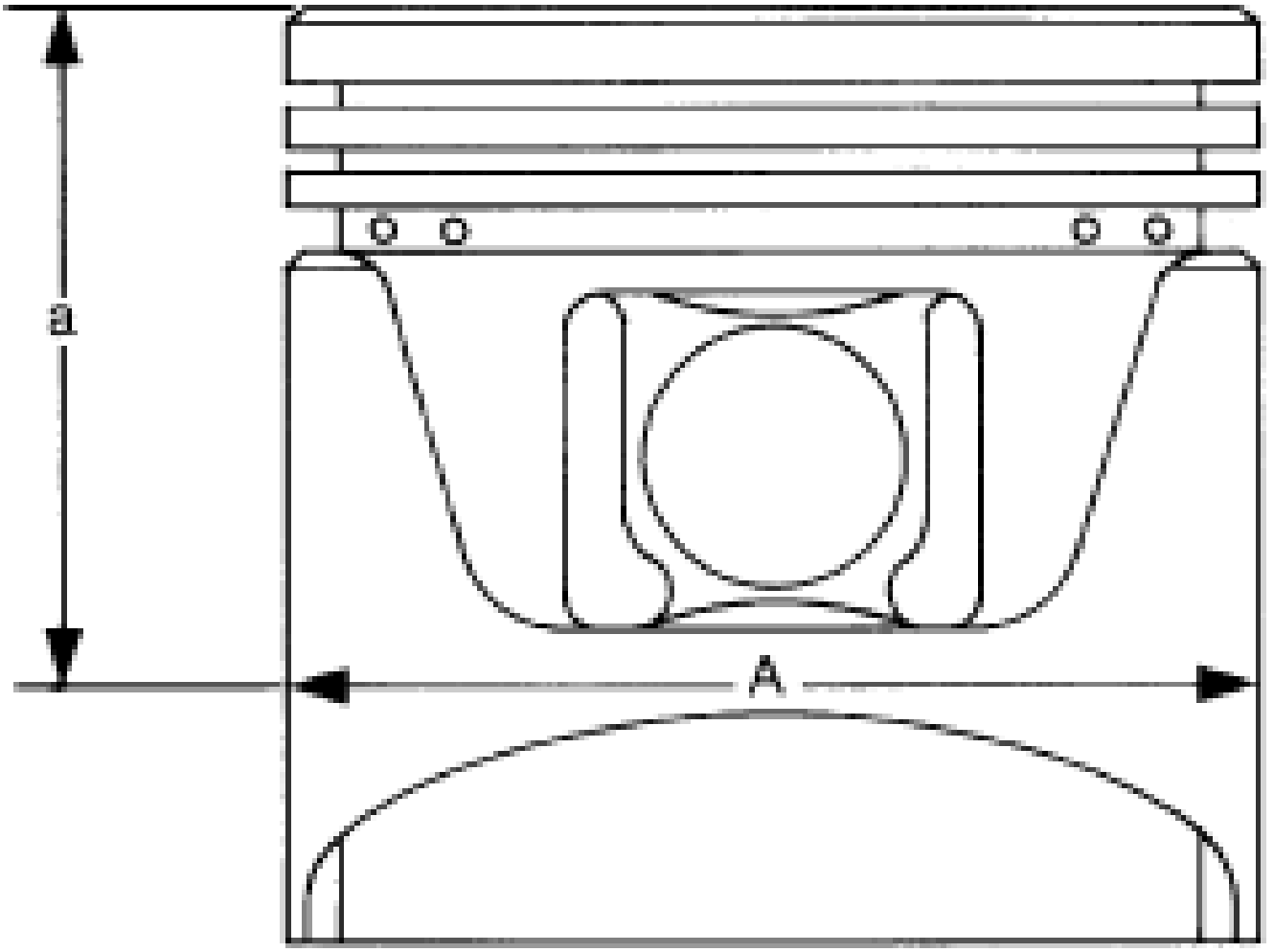
		Unit: mm (in)
Surface flatness	**Limit**	**0.1 (0.004)**

Main bearing housing inner diameter		Standard		68.944 - 68.968 (2.7143 - 2.7153)
Cylinder bore	Inner diameter	Standard	Grade No. 1	95.500 - 95.510 (3.7598 - 3.7602)
			Grade No. 2	95.510 - 95.520 (3.7602 - 3.7606)
			Grade No. 3	95.520 - 95.530 (3.7606 - 3.7610)
		Wear limit		0.2 (0.008)
Out-of-round		Limit		0.015 (0.0006)
Taper				0.010 (0.0004)
Main bearing housing inner diameter grade (Without bearing)			Grade No. A	68.944 - 68.945 (2.7143 - 2.7144)
			Grade No. B	68.945 - 68.946 (2.7144 - 2.7144)
			Grade No. C	68.946 - 68.947 (2.7144 - 2.7144)
			Grade No. D	68.947 - 68.948 (2.7144 - 2.7145)
			Grade No. E	68.948 - 68.949 (2.7145 - 2.7145)
			Grade No. F	68.949 - 68.950 (2.7145 - 2.7146)
			Grade No. G	68.950 - 68.951 (2.7146 - 2.7146)
			Grade No. H	68.951 - 68.952 (2.7146 - 2.7146)
			Grade No. J	68.952 - 68.953 (2.7146 - 2.7147)
			Grade No. K	68.953 - 68.954 (2.7147 - 2.7147)
			Grade No. L	68.954 - 68.955 (2.7147 - 2.7148)
			Grade No. M	68.955 - 68.956 (2.7148 - 2.7148)
			Grade No. N	68.956 - 68.957 (2.7148 - 2.7148)
			Grade No. P	68.957 - 68.958 (2.7148 - 2.7149)
			Grade No. R	68.958 - 68.959 (2.7149 - 2.7149)
			Grade No. S	68.959 - 68.960 (2.7149 - 2.7150)
			Grade No. T	68.960 - 68.961 (2.7150 - 2.7150)

		Grade No. U	68.961 - 68.962 (2.7150 - 2.7150)
		Grade No. V	68.962 - 68.963 (2.7150 - 2.7151)
		Grade No. W	68.963 - 68.964 (2.7151 - 2.7151)
		Grade No. X	68.964 - 68.965 (2.7151 - 2.7152)
		Grade No. Y	68.965 - 68.966 (2.7152 - 2.7152)
		Grade No. 4	68.966 - 68.967 (2.7152 - 2.7152)
		Grade No. 7	68.967 - 68.968 (2.7152 - 2.7153)
Difference in inner diameter between cylinders	Standard		Less than 0.03 (0.0012)

AVAILABLE PISTON

Unit: mm (in)



Items		Standard	Oversize (Service) [0.2 (0.008)]
Piston skirt diameter "A"	Grade No. 1	95.480 - 95.490 (3.7590 - 3.7594)	-
	Grade No. 2	95.490 - 95.500 (3.7594 - 3.7598)	-
	Grade No. 3	95.500 - 95.510 (3.7598 - 3.7602)	-
	Service	-	95.680 - 95.710 (3.7669 - 3.7681)
Items		Standard	Limit
"a" dimension		38.8 (1.528)	-
Piston pin hole diameter		21.993 - 21.999 (0.8659 - 0.8661)	-
Piston to cylinder bore clearance		0.010 - 0.030 (0.0004 - 0.0012)	0.08 (0.0031)

PISTON RING

Unit: mm (in)

Items		Standard	Limit
Side clearance	Top	0.040 - 0.080 (0.0016 - 0.0031)	0.11 (0.0043)
	2nd	0.030 - 0.070 (0.0012 - 0.0028)	0.10 (0.0039)
	Oil ring	0.055 - 0.155 (0.0022 - 0.0061)	0.19 (0.0075)
End gap	Top	0.23 - 0.33 (0.0091 - 0.0130)	0.55 (0.0217)
	2nd	0.33 - 0.48 (0.0130 - 0.0189)	0.67 (0.0264)
	Oil (rail ring)	0.17 - 0.47 (0.0067 - 0.0185)	0.82 (0.0323)

PISTON PIN

Unit: mm (in)

Items	Standard	Limit
Piston pin outer diameter	21.989 - 21.995 (0.8657 - 0.8659)	-
Piston to piston pin oil clearance	0.002 - 0.006 (0.0001 - 0.0002)	-
Connecting rod bushing oil clearance	0.005 - 0.017 (0.0002 - 0.0007)	0.030 (0.0012)

CONNECTING ROD

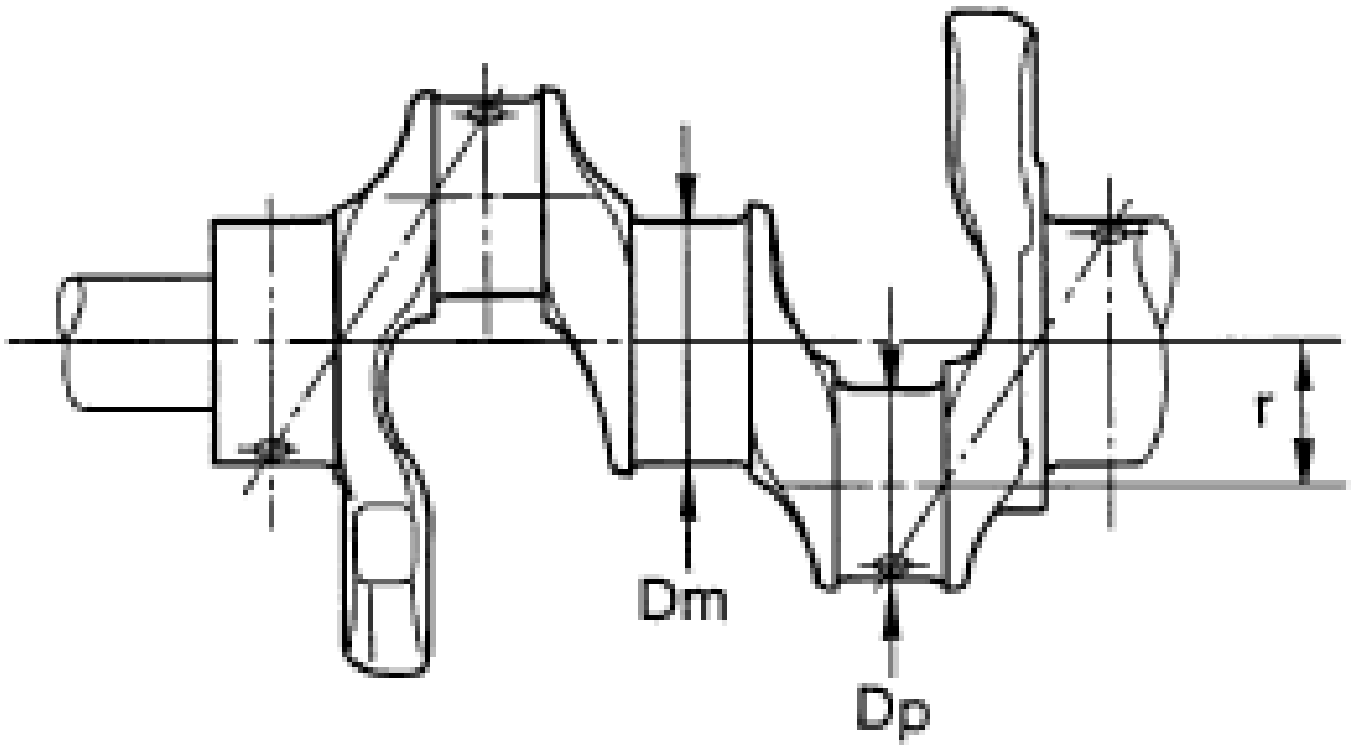
Unit: mm (in)

Items	Standard	Limit
Center distance	157.68 - 157.78 (6.21 - 6.21)	-
Bend [per 100 (3.94)]	-	0.15 (0.0059)
Torsion [per 100 (3.94)]	-	0.30 (0.0118)
Connecting rod bushing inner diameter(1)	22.000 - 22.006 (0.8661 - 0.8664)	-
Connecting rod big end diameter (Without bearing)	Grade No. A	57.000 - 57.001 (2.2441 - 2.2441)
	Grade No. B	57.001 - 57.002 (2.2441 - 2.2442)
	Grade No. C	57.002 - 57.003 (2.2442 - 2.2442)
	Grade No. D	57.003 - 57.004 (2.2442 - 2.2442)
	Grade No. E	57.004 - 57.005 (2.2442 - 2.2443)
	Grade No. F	57.005 - 57.006 (2.2443 - 2.2443)
	Grade No. G	57.006 - 57.007 (2.2443 - 2.2444)
	Grade No. H	57.007 - 57.008 (2.2444 - 2.2444)

	Grade No. J	57.008 - 57.009 (2.2444 - 2.2444)
	Grade No. K	57.009 - 57.010 (2.2444 - 2.2445)
	Grade No. L	57.010 - 57.011 (2.2445 - 2.2445)
	Grade No. M	57.011 - 57.012 (2.2445 - 2.2446)
	Grade No. N	57.012 - 57.013 (2.2446 - 2.2446)
Side clearance	0.20 - 0.35 (0.0079 - 0.0138)	0.40 (0.0157)
(1) After installing in connecting rod		

CRANKSHAFT

Unit: mm (in)



SEM645

		Grade No. G	63.964 - 63.963 (2.5183 - 2.5182) 63.963 - 63.962 (2.5182 -

Main journal diameter. "Dm" grade (No. 1 and 5 journal)	Standard	Grade No. H	2.5182)
		Grade No. J	63.962 - 63.961 (2.5182 - 2.5181)
		Grade No. K	63.961 - 63.960 (2.5181 - 2.5181)
		Grade No. L	63.960 - 63.959 (2.5181 - 2.5181)
		Grade No. M	63.959 - 63.958 (2.5181 - 2.5180)
		Grade No. N	63.958 - 63.957 (2.5180 - 2.5180)
		Grade No. P	63.957 - 63.956 (2.5180 - 2.5179)
		Grade No. R	63.956 - 63.955 (2.5179 - 2.5179)
		Grade No. S	63.955 - 63.954 (2.5179 - 2.5179)
		Grade No. T	63.954 - 63.953 (2.5179 - 2.5178)
		Grade No. U	63.953 - 63.952 (2.5178 - 2.5178)
		Grade No. V	63.952 - 63.951 (2.5178 - 2.5178)
		Grade No. W	63.951 - 63.950 (2.5178 - 2.5177)
		Grade No. X	63.950 - 63.949 (2.5177 - 2.5177)
		Grade No. Y	63.949 - 63.948 (2.5177 - 2.5176)
		Grade No. 1	63.948 - 63.947 (2.5176 - 2.5176)
		Grade No. 2	63.947 - 63.946 (2.5176 - 2.5176)
		Grade No. 3	63.946 - 63.945 (2.5176 - 2.5175)
		Grade No. 4	63.945 - 63.944 (2.5175 - 2.5175)
		Grade No. 5	63.944 - 63.943 (2.5175 - 2.5174)
		Grade No. 6	63.943 - 63.942 (2.5174 - 2.5174)
		Grade No. 7	63.942 - 63.941 (2.5174 - 2.5174)
		Grade No. 9	63.941 - 63.940 (2.5174 - 2.5173)

Main journal diameter. "Dm" grade (No. 2, 3 and 4 journal)	Standard	Grade No. A	63.963 - 63.964 (2.5182 - 2.5183)
		Grade No. B	63.962 - 63.963 (2.5182 - 2.5182)
		Grade No. C	63.961 - 63.962 (2.5181 - 2.5182)
		Grade No. D	63.960 - 63.961 (2.5181 - 2.5181)
		Grade No. E	63.959 - 63.960 (2.5181 - 2.5181)
		Grade No. F	63.958 - 63.959 (2.5180 - 2.5181)
		Grade No. G	63.957 - 63.958 (2.5180 - 2.5180)
		Grade No. H	63.956 - 63.957 (2.5179 - 2.5180)
		Grade No. J	63.955 - 63.956 (2.5179 - 2.5179)
		Grade No. K	63.954 - 63.955 (2.5179 - 2.5179)
		Grade No. L	63.953 - 63.954 (2.5178 - 2.5179)
		Grade No. M	63.952 - 63.953 (2.5178 - 2.5178)
		Grade No. N	63.951 - 63.952 (2.5178 - 2.5178)
		Grade No. P	63.950 - 63.951 (2.5177 - 2.5178)
		Grade No. R	63.949 - 63.950 (2.5177 - 2.5177)
		Grade No. S	63.948 - 63.949 (2.5176 - 2.5177)
		Grade No. T	63.947 - 63.948 (2.5176 - 2.5176)
		Grade No. U	63.946 - 63.947 (2.5176 - 2.5176)
		Grade No. V	63.945 - 63.946 (2.5175 - 2.5176)
		Grade No. W	63.944 - 63.945 (2.5175 - 2.5175)
		Grade No. X	63.943 - 63.944 (2.5174 - 2.5175)
		Grade No. Y	63.942 - 63.943 (2.5174 - 2.5174)
		Grade No. 1	63.941 - 63.942 (2.5174 - 2.5174)

		Grade No. 2	63.940 - 63.941 (2.5173 - 2.5174)
Pin journal diameter. "Dp" grade	Standard	Grade No. A	53.974 - 53.973 (2.1250 - 2.1249)
		Grade No. B	53.973 - 53.972 (2.1249 - 2.1249)
		Grade No. C	53.972 - 53.971 (2.1249 - 2.1248)
		Grade No. D	53.971 - 53.970 (2.1248 - 2.1248)
		Grade No. E	53.970 - 53.969 (2.1248 - 2.1248)
		Grade No. F	53.969 - 53.968 (2.1248 - 2.1247)
		Grade No. G	53.968 - 53.967 (2.1247 - 2.1247)
		Grade No. H	53.967 - 53.966 (2.1247 - 2.1246)
		Grade No. J	53.966 - 53.965 (2.1246 - 2.1246)
		Grade No. K	53.965 - 53.964 (2.1246 - 2.1246)
		Grade No. L	53.964 - 53.963 (2.1246 - 2.1245)
		Grade No. M	53.963 - 53.962 (2.1245 - 2.1245)
		Grade No. N	53.962 - 53.961 (2.1245 - 2.1244)
		Grade No. P	53.961 - 53.960 (2.1244 - 2.1244)
		Grade No. R	53.960 - 53.959 (2.1244 - 2.1244)
		Grade No. S	53.959 - 53.958 (2.1244 - 2.1243)
		Grade No. T	53.958 - 53.957 (2.1243 - 2.1243)
		Grade No. U	53.957 - 53.956 (2.1243 - 2.1242)
Center distance "r"			43.81 - 43.89 (1.7248 - 1.7279)
Taper	Limit		0.0025 (0.0001)
Out-of-round			0.0025 (0.0001)
Crankshaft runout [TIR(1)]	Standard		Less than 0.05 (0.002)
	Limit		0.10 (0.0039)
Crankshaft end play	Standard		0.10 - 0.26 (0.0039 - 0.0102)
	Limit		0.30 (0.012)

(1) Total indicator reading

Main Bearing

MAIN BEARING

Grade number		Thickness mm (in)	Width mm (in)	Identification color	Remarks
0		2.483 - 2.486 (0.0978 - 0.0979)	19.9 - 20.1 (0.783 - 0.791)	Black	Grade is the same for upper and lower bearings.
1		2.486 - 2.489 (0.0979 - 0.0980)		Brown	
2		2.489 - 2.492 (0.0980 - 0.0981)		Green	
3		2.492 - 2.495 (0.0981 - 0.0982)		Yellow	
4		2.495 - 2.498 (0.0982 - 0.0983)		Blue	
5		2.498 - 2.501 (0.0983 - 0.0985)		Pink	
6		2.501 - 2.504 (0.0985 - 0.0986)		Purple	
7		2.504 - 2.507 (0.0986 - 0.0987)		White	
8		2.507 - 2.510 (0.0987 - 0.0988)		Red	
01	UPR	2.483 - 2.486 (0.0978 - 0.0979)		Black	Grade and color are different for upper and lower bearings.
	LWR	2.486 - 2.489 (0.0979 - 0.0980)		Brown	
12	UPR	2.486 - 2.489 (0.0979 - 0.0980)		Brown	
	LWR	2.489 - 2.492 (0.0980 - 0.0981)		Green	
23	UPR	2.489 - 2.492 (0.0980 - 0.0981)		Green	
	LWR	2.492 - 2.495 (0.0981 - 0.0982)		Yellow	
34	UPR	2.492 - 2.495 (0.0981 - 0.0982)		Yellow	
	LWR	2.495 - 2.498 (0.0982 - 0.0983)		Blue	
45	UPR	2.495 - 2.498 (0.0982 - 0.0983)		Blue	

	LWR	2.498 - 2.501 (0.0983 - 0.0985)		Pink	
56	UPR	2.498 - 2.501 (0.0983 - 0.0985)		Pink	
	LWR	2.501 - 2.504 (0.0985 - 0.0986)		Purple	
67	UPR	2.501 - 2.504 (0.0985 - 0.0986)		Purple	
	LWR	2.504 - 2.507 (0.0986 - 0.0987)		White	
78	UPR	2.504 - 2.507 (0.0986 - 0.0987)		White	
	LWR	2.507 - 2.510 (0.0987 - 0.0988)		Red	

UNDERSIZE

		Unit: mm (in)
Items	**Thickness**	**Main journal diameter**
0.25 (0.0098)	2.618 - 2.626 (0.1031 - 0.1034)	Grind so that bearing clearance is the specified value.

MAIN BEARING OIL CLEARANCE

		Unit: mm (in)
Items	**Standard**	**Limit**
Main bearing oil clearance	0.035 - 0.045 (0.0014 - 0.0018)(1)	0.065 (0.0026)
(1) Actual clearance		

Connecting Rod Bearing

CONNECTING ROD BEARING

Grade number	Thickness mm (in)	Width mm (in)	Identification color (mark)
0	1.497 - 1.500 (0.0589 - 0.0591)	18.1 - 18.3 (0.713 - 0.720)	Red
1	1.500 - 1.503 (0.0591 - 0.0592)		Black
2	1.503 - 1.506 (0.0592 - 0.0593)		Brown
3	1.506 - 1.509 (0.0593 - 0.0594)		Green
4	1.509 - 1.512 (0.0594 - 0.0595)		Yellow

UNDERSIZE

		Unit: mm (in)
Items	**Thickness**	**Pin journal diameter**

0.25 (0.0098)	1.626 - 1.634 (0.0640 - 0.0643)	Grind so that bearing clearance is the specified value.

CONNECTING ROD BEARING OIL CLEARANCE

Unit: mm (in)

Items	Standard	Limit
Connecting rod bearing oil clearance	0.040 - 0.053 (0.0016 - 0.0021)(1)	0.070 (0.0028)

(1) Actual clearance