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EM
C
D
E
F
G
H
I
J
K
L
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SECTION **EM**

ENGINE MECHANICAL

CONTENTS

PRECAUTIONS	3	INTAKE MANIFOLD COLLECTOR	17
Precautions for Battery Service	3	Removal and Installation	17
Precautions for Draining Engine Coolant	3	REMOVAL	17
Precautions for Disconnecting Fuel Piping	3	INSPECTION AFTER REMOVAL	19
Precautions for Removal and Disassembly	3	INSTALLATION	20
Precautions for Inspection, Repair and Replacement	3	INTAKE MANIFOLD	22
Precautions for Assembly and Installation	3	Removal and Installation	22
Parts Requiring Angle Tightening	4	REMOVAL	22
Precautions for Liquid Gasket	4	INSPECTION AFTER REMOVAL	22
REMOVAL OF LIQUID GASKET SEALING	4	INSTALLATION	23
LIQUID GASKET APPLICATION PROCEDURE....	4	EXHAUST MANIFOLD AND THREE WAY CATALYST	24
PREPARATION	6	Removal and Installation	24
Special Service Tools (SST)	6	REMOVAL	24
Commercial Service Tools	8	INSPECTION AFTER REMOVAL	26
NOISE, VIBRATION AND HARSHNESS (NVH)		INSTALLATION	26
TROUBLESHOOTING	11	OIL PAN AND OIL STRAINER	28
NVH Troubleshooting —Engine Noise	11	Removal and Installation	28
Use the Chart Below to Help You Find the Cause of the Symptom.	12	REMOVAL	28
DRIVE BELTS	13	INSPECTION AFTER REMOVAL	30
Checking Drive Belts	13	INSTALLATION	30
Tension Adjustment	13	INSPECTION AFTER INSTALLATION	33
ALTERNATOR AND POWER STEERING OIL PUMP BELT	14	IGNITION COIL	34
A/C COMPRESSOR BELT	14	Removal and Installation	34
Removal and Installation	14	REMOVAL	34
REMOVAL	14	INSTALLATION	34
INSTALLATION	14	SPARK PLUG (PLATINUM-TIPPED TYPE)	35
AIR CLEANER AND AIR DUCT	15	Removal and Installation	35
Removal and Installation	15	REMOVAL	35
REMOVAL	15	INSPECTION AFTER REMOVAL	35
INSTALLATION	15	INSTALLATION	36
Changing Air Cleaner Filter	16	FUEL INJECTOR AND FUEL TUBE	37
INSPECTION	16	Removal and Installation	37
REMOVAL	16	REMOVAL	38
INSTALLATION	16	INSTALLATION	39
		INSPECTION AFTER INSTALLATION	41
		ROCKER COVER	43
		Removal and Installation	43
		REMOVAL	43
		INSTALLATION	44

FRONT TIMING CHAIN CASE	46	Disassembly and Assembly	110
Removal and Installation	46	DISASSEMBLY	111
REMOVAL	46	ASSEMBLY	116
INSTALLATION	49	How to Select Piston and Bearing	123
INSPECTION AFTER INSTALLATION	54	DESCRIPTION	123
TIMING CHAIN	55	HOW TO SELECT PISTON	123
Removal and Installation	55	HOW TO SELECT CONNECTING ROD BEAR- ING	124
REMOVAL	56	HOW TO SELECT MAIN BEARING	125
INSPECTION AFTER REMOVAL	63	Inspection After Disassembly	128
INSTALLATION	64	CRANKSHAFT END PLAY	128
INSPECTION AFTER INSTALLATION	74	CONNECTING ROD SIDE CLEARANCE	128
CAMSHAFT	75	PISTON TO PISTON PIN OIL CLEARANCE	128
Removal and Installation	75	PISTON RING SIDE CLEARANCE	129
REMOVAL	76	PISTON RING END GAP	129
INSPECTION AFTER REMOVAL	77	CONNECTING ROD BEND AND TORSION	130
INSTALLATION	80	CONNECTING ROD BIG END DIAMETER	130
INSPECTION AFTER INSTALLATION	83	CONNECTING ROD BUSHING OIL CLEAR- ANCE	130
Valve Clearance	84	CYLINDER BLOCK DISTORTION	131
INSPECTION	84	MAIN BEARING HOUSING INNER DIAMETER	132
ADJUSTMENT	87	PISTON TO CYLINDER BORE CLEARANCE	132
OIL SEAL	88	CRANKSHAFT MAIN JOURNAL DIAMETER	133
Removal and Installation of Valve Oil Seal	88	CRANKSHAFT PIN JOURNAL DIAMETER	134
REMOVAL	88	CRANKSHAFT OUT-OF-ROUND AND TAPER	134
INSTALLATION	88	CRANKSHAFT RUNOUT	134
Removal and Installation of Front Oil Seal	89	CONNECTING ROD BEARING OIL CLEAR- ANCE	134
REMOVAL	89	MAIN BEARING OIL CLEARANCE	135
INSTALLATION	90	CRUSH HEIGHT OF MAIN BEARING	136
Removal and Installation of Rear Oil Seal	90	CRUSH HEIGHT OF CONNECTING ROD BEARING	136
REMOVAL	90	MAIN BEARING CAP BOLT OUTER DIAMETER	136
INSTALLATION	90	CONNECTING ROD BOLT OUTER DIAMETER	137
CYLINDER HEAD	92	FLYWHEEL DEFLECTION	137
On-Vehicle Service	92	MOVEMENT AMOUNT OF FLYWHEEL	137
CHECKING COMPRESSION PRESSURE	92	DRIVE PLATE (A/T MODELS)	138
Removal and Installation	93	OIL JET	138
REMOVAL	93	OIL JET RELIEF VALVE	138
INSPECTION AFTER REMOVAL	94	SERVICE DATA AND SPECIFICATIONS (SDS) ...	139
INSTALLATION	95	Standard and Limit	139
Disassembly and Assembly	96	GENERAL SPECIFICATIONS	139
DISASSEMBLY	97	DRIVE BELT	140
ASSEMBLY	97	INTAKE MANIFOLD COLLECTOR, INTAKE MANIFOLD AND EXHAUST MANIFOLD	140
Inspection After Disassembly	99	SPARK PLUG	140
VALVE DIMENSIONS	99	CAMSHAFT AND CAMSHAFT BEARING	141
VALVE GUIDE CLEARANCE	99	CYLINDER HEAD	143
VALVE GUIDE REPLACEMENT	99	CYLINDER BLOCK	146
VALVE SEAT CONTACT	101	PISTON, PISTON RING AND PISTON PIN	147
VALVE SEAT REPLACEMENT	101	CONNECTING ROD	148
VALVE SPRING SQUARENESS	102	CRANKSHAFT	149
VALVE SPRING DIMENSIONS AND VALVE SPRING PRESSURE LOAD	102	MAIN BEARING	150
CONNECTING ROD BEARING	151		
ENGINE ASSEMBLY	104		
Removal and Installation	104		
REMOVAL	105		
INSTALLATION	107		
INSPECTION AFTER INSTALLATION	108		
CYLINDER BLOCK	110		

PRECAUTIONS

PRECAUTIONS

PFP:00001

Precautions for Battery Service

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Before disconnecting the battery, lower both the driver and passenger windows. This will prevent any interference between the window edge and the vehicle when the door is opened/closed. During normal operation, the window slightly raises and lowers automatically to prevent any window to vehicle interference. The automatic window function will not work with the battery disconnected.

Precautions for Draining Engine Coolant

ABS00A05

Drain engine coolant when engine is cooled.

Precautions for Disconnecting Fuel Piping

ABS00A06

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

Precautions for Removal and Disassembly

ABS00A07

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

Precautions for Inspection, Repair and Replacement

ABS00A08

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

Precautions for Assembly and Installation

ABS00A09

- Use torque wrench to tighten bolts or nuts to specification.
- When tightening bolts and nuts, as a basic rule, equally tighten in several different steps starting with the ones in center, then ones on inside and outside diagonally in this order. If the order of tightening is specified, do exactly as specified.
- Replace with new gasket, packing, oil seal or O-ring.
- Dowel pins are used for several parts alignment. When replacing and reassembling parts with dowel pins, make sure that dowel pins are installed in the original position.
- Thoroughly wash, clean, and air-blow each part. Carefully check engine oil or engine coolant passages for any restriction and blockage.
- Avoid damaging sliding or mating surfaces. Completely remove foreign materials such as cloth lint or dust. Before assembly, oil sliding surfaces well.
- Release air within route when refilling after draining engine coolant.
- After repairing, start engine and increase engine speed to check engine coolant, fuel, engine oil, and exhaust systems for leakage.

PRECAUTIONS

Parts Requiring Angle Tightening

ABS00A0A

- Use angle wrench [SST: KV10112100 (BT8653-A)] for the final tightening of the following engine parts:
 - Cylinder head bolts
 - Main bearing cap bolts
 - Connecting rod cap bolts
 - Crankshaft pulley bolt (No angle wrench is required as the bolt flange is provided with notches for angular tightening)
- Do not use a torque value for final tightening.
- The torque value for these parts are for a preliminary step.
- Ensure thread and seat surfaces are clean and coated with engine oil.

Precautions for Liquid Gasket REMOVAL OF LIQUID GASKET SEALING

ABS00A0B

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

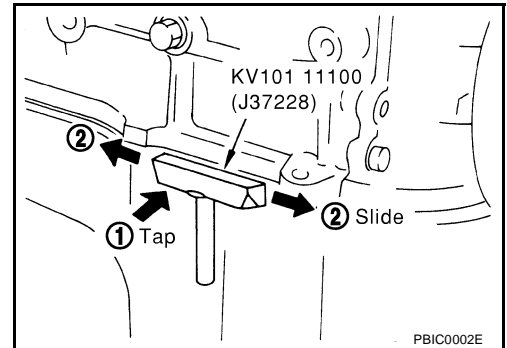
CAUTION:

Be careful not to damage the mating surfaces.

- In areas where seal cutter (SST) is difficult to use, use a plastic hammer to lightly tap (1) seal cutter where liquid gasket is applied. Use plastic hammer to slide seal cutter (2) by tapping on the side.

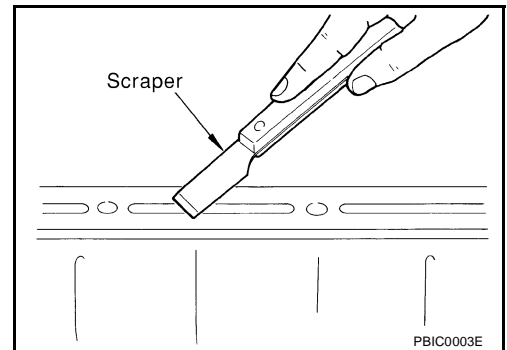
CAUTION:

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

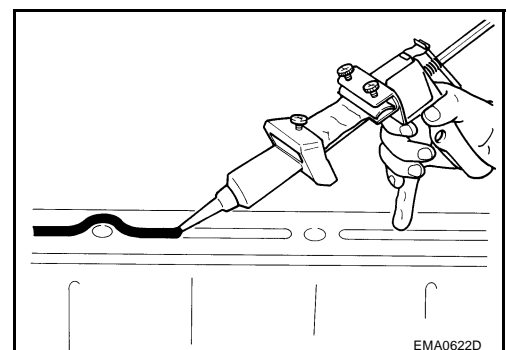


LIQUID GASKET APPLICATION PROCEDURE

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



3. Attach the liquid gasket tube to the tube presser [SST: WS39930000 (—)].
Use Genuine RTV Silicone Sealant or equivalent. Refer to [GI-46, "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS"](#).
4. Apply liquid gasket without breaks to the specified location with the specified dimensions.
 - If there is a groove for the liquid gasket application, apply gasket to the groove.

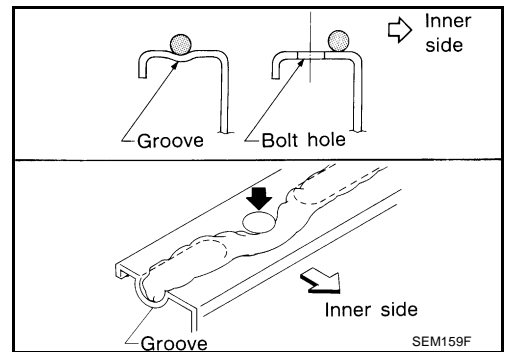


PRECAUTIONS

- As for bolt holes, normally apply liquid gasket inside the holes. Occasionally, it should be applied outside the holes. Make sure to read the text of this manual.
- Within five minutes of liquid gasket application, install the mating component.
- If liquid gasket protrudes, wipe it off immediately.
- Do not retighten mounting bolts and 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 manual, observe them.



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PREPARATION

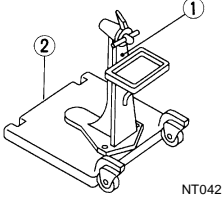
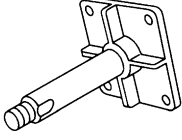
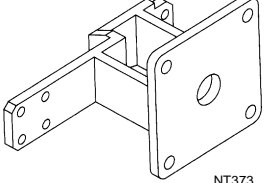
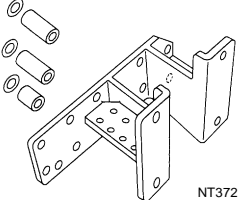
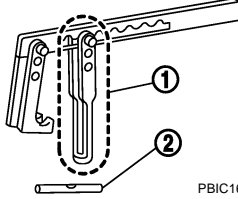
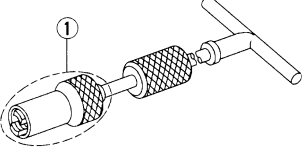
PREPARATION

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Special Service Tools (SST)

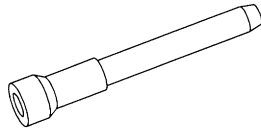
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The actual shapes of Kent-Moore tools may differ from those of special service tools illustrated here.

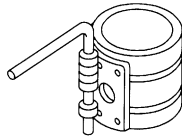
Tool number (Kent-Moore No.) Tool name	Description
ST0501S000 (—) Engine stand assembly 1. ST05011000 (—) Engine stand 2. ST05012000 (—) Base	Disassembling and assembling  NT042
KV10106500 (—) Engine stand shaft	 NT028
KV10117000 (J41262) Engine sub-attachment	KV10117000 has been replaced with KV10117001 (KV10117000 is no longer in production, but it is usable).  NT373
KV10117001 (—) Engine sub-attachment	Installing on the cylinder block  NT372
KV10116200 (J26336-A) Valve spring compressor 1. KV10115900 (J26336-20) Attachment 2. KV10109220 (—) Adaptor	Disassembling valve mechanism Part (1) is a component of KV10116200 (J26336-A), but part (2) is not so.  PBIC1650E
KV10107902 (J38959) Valve oil seal puller 1. KV10116100 Valve oil seal puller adapter	Removing valve oil seal  S-NT605

PREPARATION

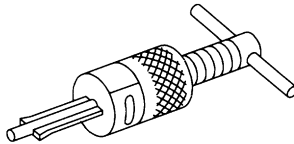
Tool number (Kent-Moore No.) Tool name	Description	
(J39386) Valve oil seal drift	Installing valve oil seal	A EM C
EM03470000 (J8037) Piston ring compressor	Installing piston assembly into cylinder bore	D E
ST16610001 (J23907) Pilot bushing puller	Removing crankshaft pilot bushing	F G H
KV10111100 (J37228) Seal cutter	Removing oil pan (lower and upper), front and rear timing chain case, etc.	I J
WS39930000 (—) Tube presser	Pressing the tube of liquid gasket	K L
KV10112100 (BT8653-A) Angle wrench	Tightening bolts for bearing cap, cylinder head, etc. in angle	M
KV10117100 (J3647-A) Heated oxygen sensor wrench	Loosening or tightening heated oxygen sensor For 22 mm (0.87 in) width hexagon nut	



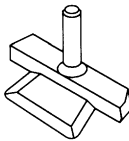
NT024



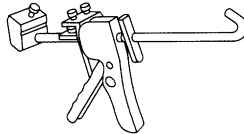
NT044



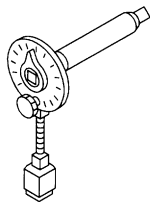
NT045



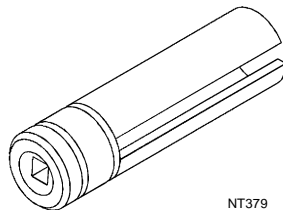
NT046



NT052

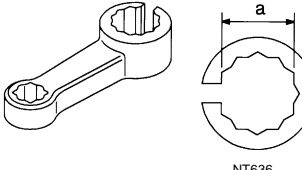
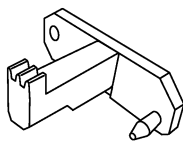



NT014



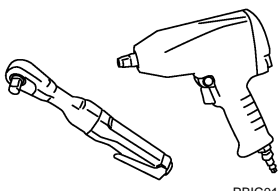
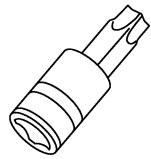
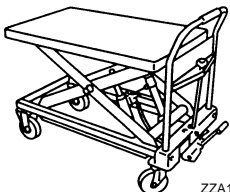
NT379

PREPARATION

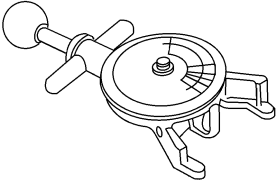
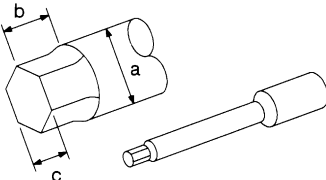
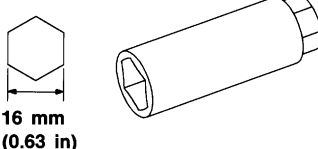

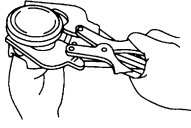
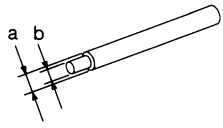
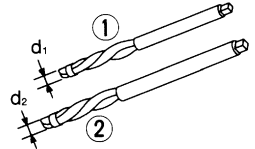
Tool number (Kent-Moore No.) Tool name	Description
KV10114400 (J38365) Heated oxygen sensor wrench 	Loosening or tightening air fuel ratio sensor a: 22 mm (0.87 in)
KV10117700 (J44716) Ring gear stopper 	Removing and installing crankshaft pulley
— (J-45488) Quick connector release 	Removing fuel tube quick connectors in engine room

Commercial Service Tools

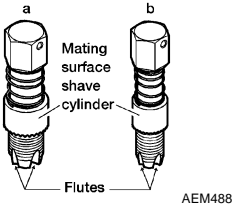

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(Kent-Moore No.) Tool name	Description
Power tool 	Loosening bolts and nuts
TORX socket 	Removing and installing flywheel or drive plate Size: T55
Manual lift table caddy 	Removing and installing engine

PREPARATION

(Kent-Moore No.) Tool name	Description	A
(BT3373-F) Belt tension gauge  AMA126	Checking drive belt tension	EM C
(J24239-01) Cylinder head bolt wrench  NT583	Loosening and tightening cylinder head bolt, and used with angle wrench [SST: KV10112100 (BT8653-A)] a: 13 (0.51) dia. b: 12 (0.47) c: 10 (0.39) Unit: mm (in)	D E
Spark plug wrench  NT047	Removing and installing spark plug	F G
Valve seat cutter set  NT048	Finishing valve seat dimensions	H I J
Piston ring expander  NT030	Removing and installing piston ring	K L
Valve guide drift  NT015	Removing and installing valve guide Intake & Exhaust: a = 9.5 mm (0.374 in) dia. b = 5.5 mm (0.217 in) dia.	M
Valve guide reamer  NT016	Reaming valve guide with (1) or hole for oversize valve guide with (2) Intake & Exhaust: d1 = 6.0 mm (0.236 in) dia. d2 = 10.2 mm (0.402 in) dia.	

PREPARATION

(Kent-Moore No.) Tool name	Description
(J-43897-18) (J-43897-12) Oxygen sensor thread cleaner	 <p>Reconditioning the exhaust system threads before installing a new heated oxygen sensor and air fuel ratio sensor (Use with anti-seize lubricant shown below.) a = J-43897-18 [18 mm (0.71 in) dia.] for zirconia heated oxygen sensor b = J-43897-12 [12 mm (0.47 in) dia.] for titania heated oxygen sensor</p>
Anti-seize lubricant (Permatex 133AR or equivalent meeting MIL specification MIL-A-907)	 <p>Lubricating heated oxygen sensor and air fuel ratio sensor thread cleaning tool when reconditioning exhaust system threads</p>

NOISE, VIBRATION AND HARSHNESS (NVH) TROUBLESHOOTING

NOISE, VIBRATION AND HARSHNESS (NVH) TROUBLESHOOTING

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NVH Troubleshooting —Engine Noise

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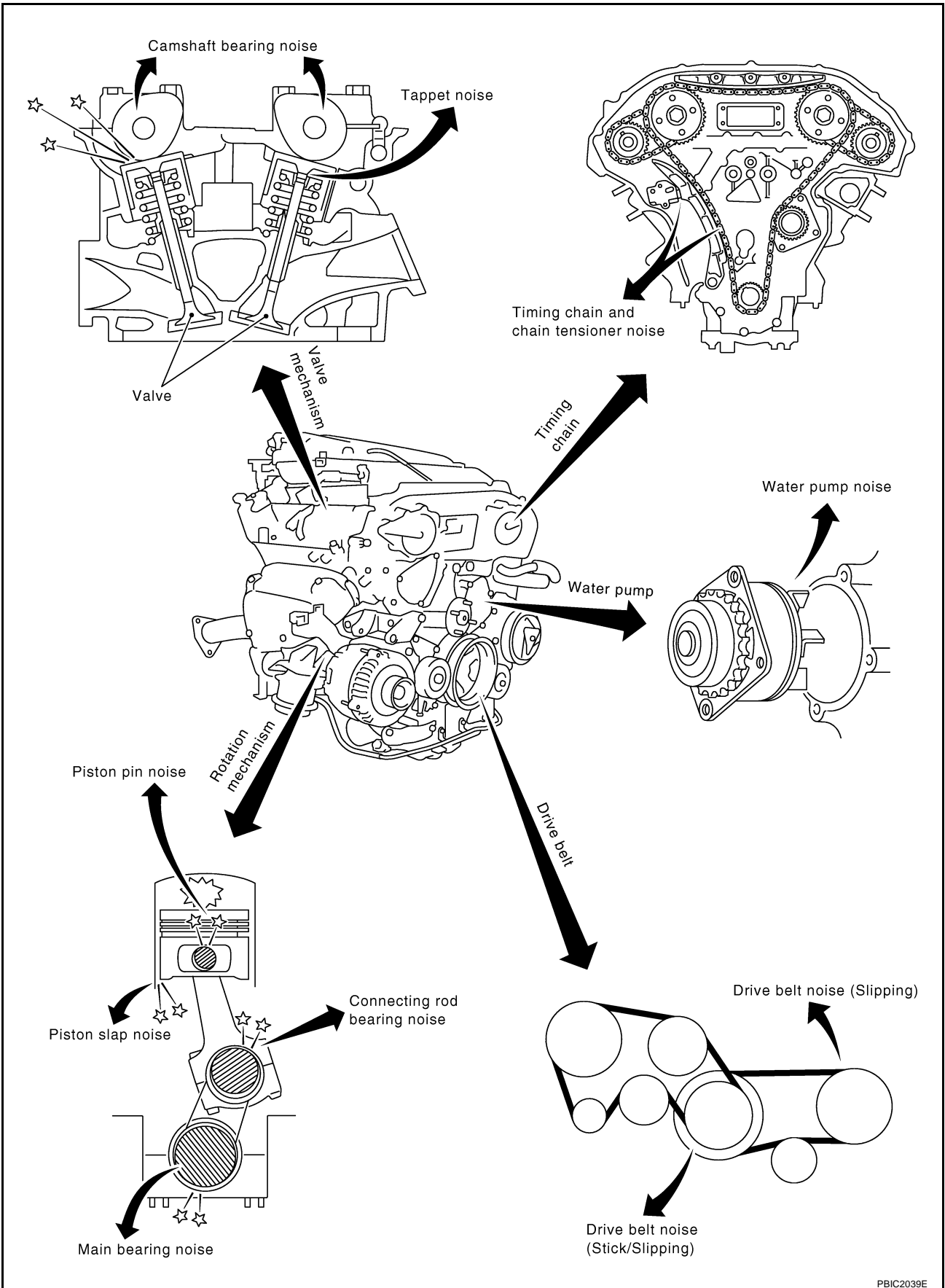
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PBIC2039E

NOISE, VIBRATION AND HARSHNESS (NVH) TROUBLESHOOTING

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

ABS00A0F

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

If necessary, repair or replace these parts.

Location of noise	Type of noise	Operating condition of engine						Source of noise	Check item	Reference page
		Before warm-up	After warm-up	When starting	When idling	When racing	While driving			
Top of engine Rocker cover Cylinder head	Ticking or clicking	C	A	—	A	B	—	Tappet noise	Valve clearance	EM-84
	Rattle	C	A	—	A	B	C	Camshaft bearing noise	Camshaft runout Camshaft journal oil clearance	EM-77 EM-77
Crankshaft pulley Cylinder block (Side of engine) Oil pan	Slap or knock	—	A	—	B	B	—	Piston pin noise	Piston to piston pin oil clearance Connecting rod bushing oil clearance	EM-128 EM-130
	Slap or rap	A	—	—	B	B	A	Piston slap noise	Piston to cylinder bore clearance Piston ring side clearance Piston ring end gap Connecting rod bend and torsion	EM-132 EM-129 EM-129 EM-130
	Knock	A	B	C	B	B	B	Connecting rod bearing noise	Connecting rod bushing oil clearance Connecting rod bearing oil clearance	EM-130 EM-134
	Knock	A	B	—	A	B	C	Main bearing noise	Main bearing oil clearance Crankshaft runout	EM-135 EM-134
Front of engine Timing chain cover	Tapping or ticking	A	A	—	B	B	B	Timing chain and chain tensioner noise	Timing chain cracks and wear Timing chain tensioner operation	EM-63 EM-55
Front of engine	Squeaking or fizzing	A	B	—	B	—	C	Drive belts (Sticking or slipping)	Drive belts deflection	EM-13
	Creaking	A	B	A	B	A	B	Drive belts (Slipping)	Idler pulley bearing operation	
	Squall Creak	A	B	—	B	A	B	Water pump noise	Water pump operation	CO-23

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

DRIVE BELTS

DRIVE BELTS

PF02117

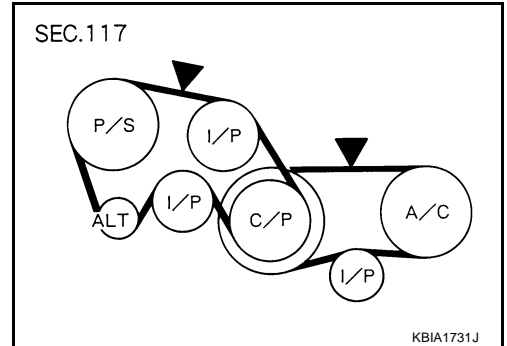
Checking Drive Belts

ABS00A0G

WARNING:

Be sure to perform when the engine is stopped.

- Inspect belts for cracks, fraying, wear and oil. If necessary, replace.
- Inspect drive belt deflection or tension at a point on the belt mid-way between pulleys.
 - Inspection should be done only when engine is cold, or over 30 minutes after engine is stopped.
 - Measure the belt tension with belt tension gauge (commercial service tool: BT3373-F or equivalent) at points marked ▼ shown in the figure.
 - When measuring deflection, apply 98 N (10 kg, 22 lb) at the ▼ marked point.
 - Adjust if belt deflection exceeds the limit or if belt tension is not within specifications.



CAUTION:

- When checking belt deflection or tension immediately after installation, first adjust it to the specified value. Then, after turning the crankshaft two turns or more, re-adjust to the specified value to avoid variation in deflection between pulleys.
- Tighten idler pulley lock nut by hand and measure the deflection or tension without looseness.

Belt deflection and tension

	Deflection adjustment		Unit: mm (in)	Tension adjustment* ¹		Unit: N (kg, lb)
	Used belt			Used belt		
	Limit	After adjustment	New belt	Limit	After adjustment	New belt
Alternator and power steering oil pump belt	7 (0.28)	4 - 5 (0.16 - 0.20)	3.5 - 4.5 (0.138 - 0.177)	294 (30, 66)	730 - 818 (74.5 - 83.5, 164 - 184)	838 - 926 (85.5 - 94.5, 188 - 208)
A/C compressor belt	12 (0.47)	9 - 10 (0.35 - 0.39)	8 - 9 (0.31 - 0.35)	196 (20, 44)	348 - 436 (35.5 - 44.5, 78 - 98)	470 - 559 (48 - 57, 106 - 126)
Applied pushing force	98 N (10 kg, 22 lb)			—		

*1 : If belt tension gauge cannot be installed at check points shown, check drive belt tension at different location on the belt.

Tension Adjustment

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

CAUTION:

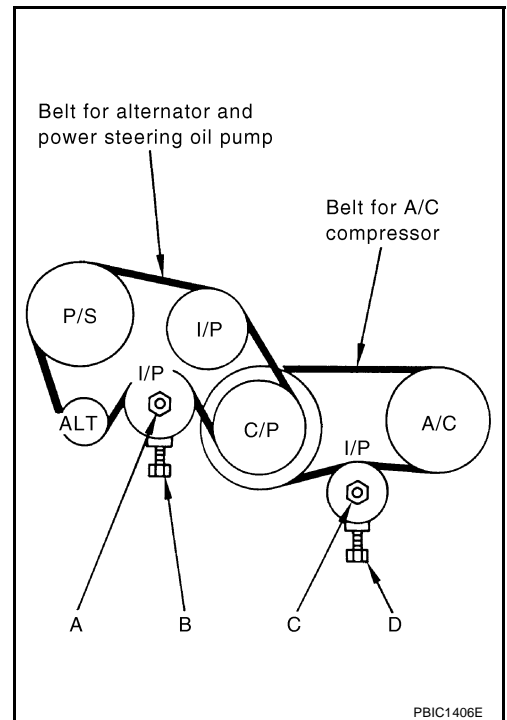
- When belt is replaced with a new one, adjust it to value for “New belt” to accommodate for insufficient adaptability with pulley grooves.
- When deflection or tension of belt being used exceeds “Limit”, adjust it to value for “After adjustment”.
- When checking belt deflection or tension immediately after installation, first adjust it to the specified value. Then, after turning crankshaft two turns or more, re-adjust to the specified value to avoid variation in deflection between pulleys.
- When installing belt, make sure that it is correctly engaged with pulley groove.
- Keep oil and water away from belt.
- Do not twist or bend belt excessively.

DRIVE BELTS

ALTERNATOR AND POWER STEERING OIL PUMP BELT

1. Remove undercover with power tool.
2. Loosen idler pulley lock nut (A) and adjust tension by turning adjusting bolt (B).
 - For specified belt tension, refer to [EM-13, "Checking Drive Belts"](#).
3. Tighten nut (A).

: 34.8 N-m (3.5 kg-m, 26 ft-lb)



A/C COMPRESSOR BELT

1. Remove undercover with power tool.
2. Loosen idler pulley lock nut (C) and adjust tension by turning adjusting bolt (D).
 - For specified belt tension, refer to [EM-13, "Checking Drive Belts"](#).
3. Tighten nut (C).

: 34.8 N-m (3.5 kg-m, 26 ft-lb)

Removal and Installation

REMOVAL

1. Remove undercover with power tool.
2. Remove alternator and power steering oil pump belt. Refer to [EM-14, "ALTERNATOR AND POWER STEERING OIL PUMP BELT"](#).
3. Remove A/C compressor belt. Refer to [EM-14, "A/C COMPRESSOR BELT"](#).

CAUTION:

Grease is applied to idler pulley adjusting bolt. Be careful to keep grease away from belt.

INSTALLATION

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

CAUTION:

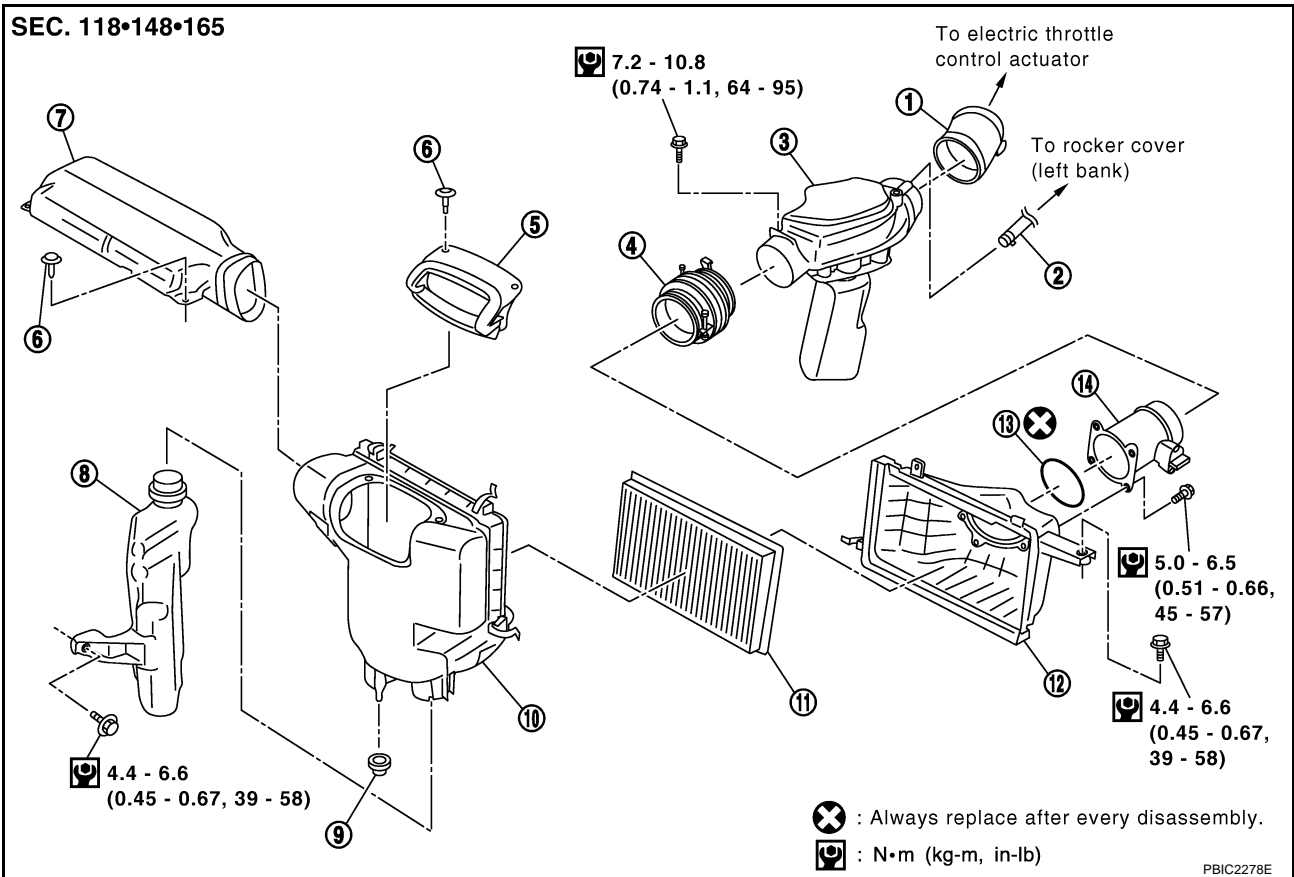
- Make sure belt is correctly engaged with the pulley groove.
 - Check for engine oil and engine coolant are not adhered to belt and each pulley groove.
2. Adjust belt tension. Refer to [EM-13, "Tension Adjustment"](#).
 3. Tighten each adjusting bolt and nut to the specified torque.
 4. Make sure that tension of each belt is within the standard.

AIR CLEANER AND AIR DUCT

PFP:16500

Removal and Installation

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- | | | |
|----------------------|--------------------------|----------------------|
| 1. Air hose | 2. PCV hose | 3. Air duct |
| 4. Air hose | 5. Power duct | 6. Clip |
| 7. Air duct (inlet) | 8. Resonator | 9. Grommet |
| 10. Air cleaner case | 11. Air cleaner filter | 12. Air cleaner case |
| 13. O-ring | 14. Mass air flow sensor | |

REMOVAL

- Remove engine cover with power tool. Refer to [EM-17, "INTAKE MANIFOLD COLLECTOR"](#).
 - This work is unnecessary when parts located forward of mass air flow sensor are removed/installed.
- Remove air duct (inlet).
- Disconnect harness connector from mass air flow sensor.
- Disconnect PCV hose.
- Remove air cleaner case/mass air flow sensor assembly and air duct disconnecting their joints.
 - Add marks as necessary for easier installation.
- Remove mass air flow sensor from air cleaner case.

CAUTION:

Handle mass air flow sensor with care.

- Do not shock it.
- Do not disassemble it.
- Do not touch its sensor.

- Remove resonator in fender, lifting left fender protector.

INSTALLATION

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

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

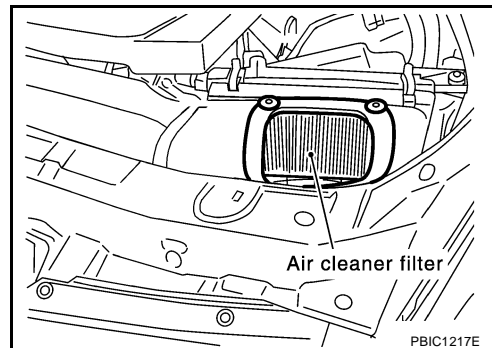
AIR CLEANER AND AIR DUCT

- To position air cleaner case, refer to [EM-16, "Changing Air Cleaner Filter"](#).

Changing Air Cleaner Filter INSPECTION

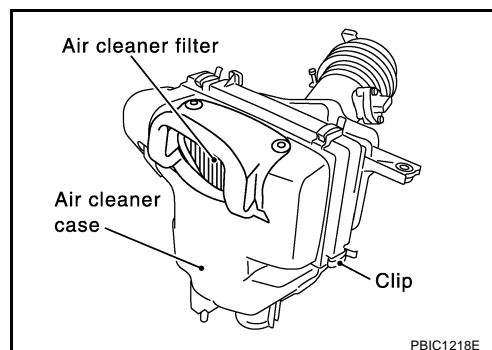
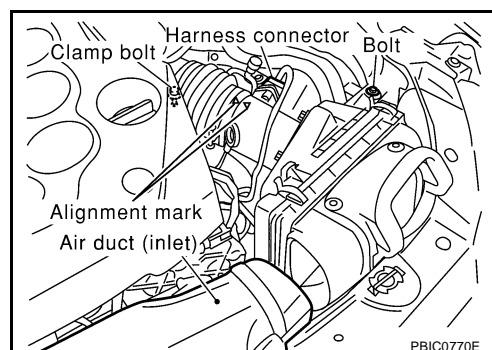
ABS00A0K

- Check status (fouling, damage, etc.) of air cleaner filter at power duct hole.



REMOVAL

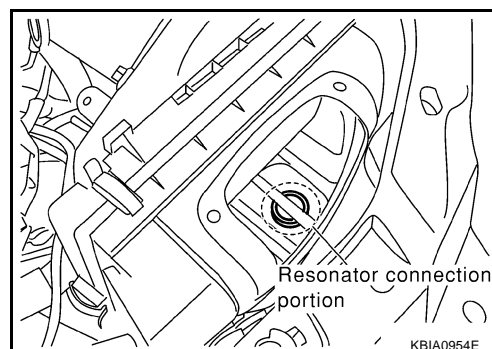
1. Remove air duct (inlet) from air cleaner case.
 2. Disconnect harness connector from mass air flow sensor.
 3. Loosen clamp bolts of air hose.
 4. Remove mounting bolts for air cleaner case. Remove air cleaner case/mass air flow sensor/air hose assembly.
5. Unfasten clips and open air cleaner case, and remove air cleaner filter.



INSTALLATION

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

- If grommet at bottom of air cleaner case comes off together with air cleaner case, fix it to vehicle before installation.
- Look at internal bottom face through power duct hole, and position air cleaner case with resonator upper end circle and air cleaner case round hole aligned. Then push air cleaner case straight down.
- At this time, check by hand if protrusion at bottom of air cleaner case has been inserted into grommet on vehicle side.
- Clip power duct with bulge on reverse side of lower end engaged with air cleaner case.



INTAKE MANIFOLD COLLECTOR

PFP:14003

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INTAKE MANIFOLD COLLECTOR

Removal and Installation

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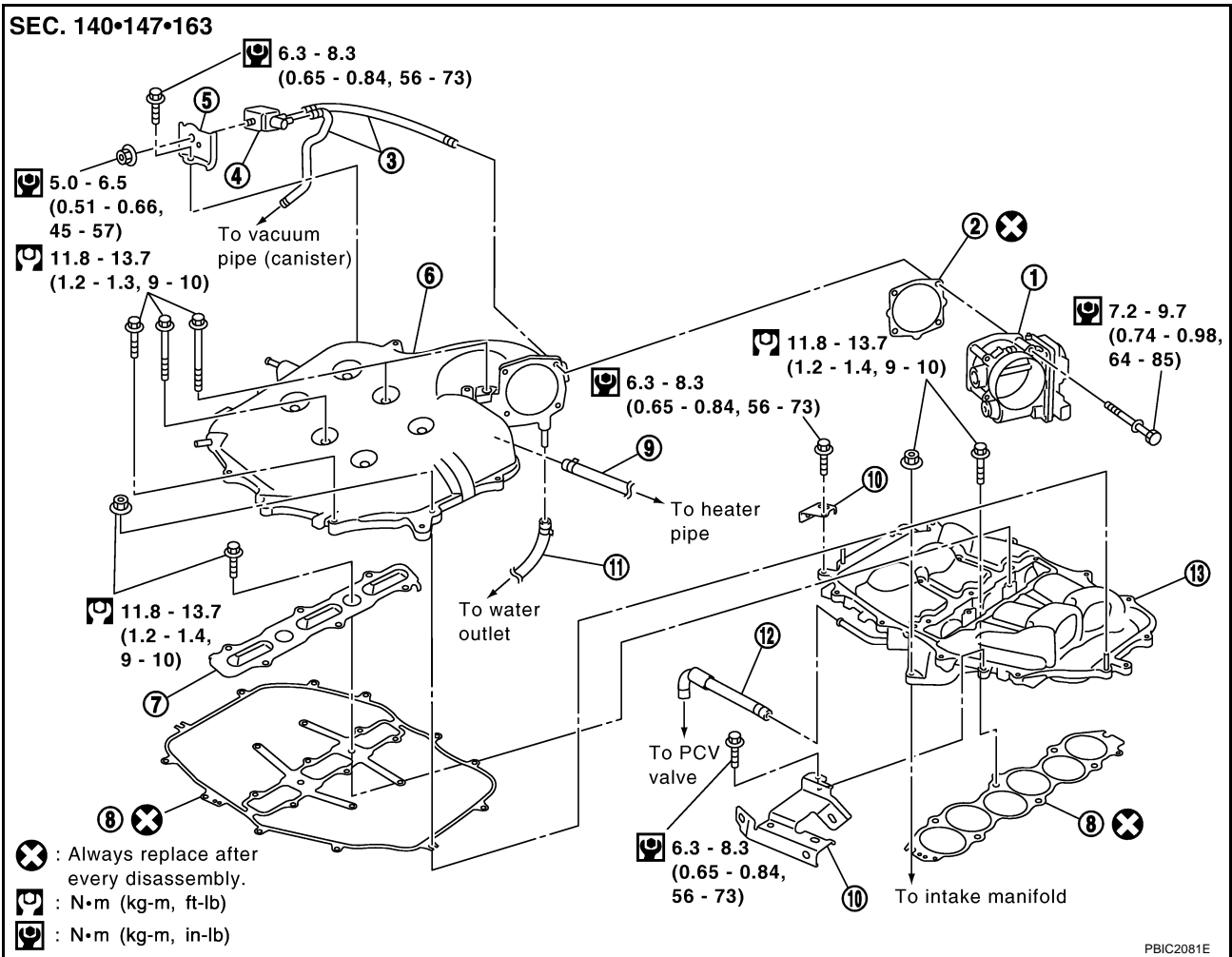
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|--|----------------|--------------------------------------|
| 1. Electric throttle control actuator | 2. Gasket | 3. Vacuum hose |
| 4. EVAP canister purge volume control solenoid valve | 5. Bracket | 6. Intake manifold collector (upper) |
| 7. Intake manifold collector cover | 8. Gasket | 9. Water hose |
| 10. Bracket | 11. Water hose | 12. PCV hose |
| 13. Intake manifold collector (lower) | | |

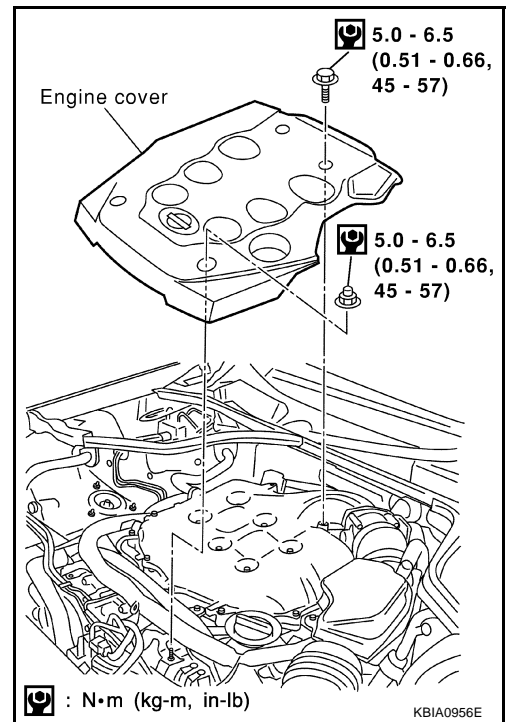
REMOVAL

WARNING:

- To avoid the danger of being scalded, do not drain the engine coolant when the engine is hot.
- Gasket for intake manifold collector (upper) is secured together with mounting bolt for intake manifold collector (lower). Thus, even when only gasket for upper side is replaced, gasket for lower side must be also replaced.

INTAKE MANIFOLD COLLECTOR

1. Remove engine cover with power tool.



2. Drain engine coolant, or when water hose is disconnected, attach plug to prevent engine coolant leakage. Refer to [CO-10, "Changing Engine Coolant"](#).

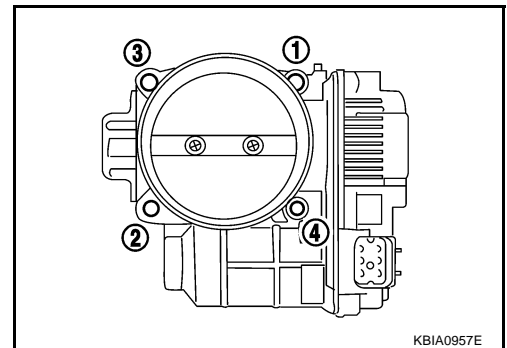
CAUTION:

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

3. Remove air cleaner case and air duct. Refer to [EM-15, "AIR CLEANER AND AIR DUCT"](#).
4. Remove electric throttle control actuator as follows:
 - a. Disconnect harness connector.
 - b. Loosen bolts in reverse order as shown in the figure.

CAUTION:

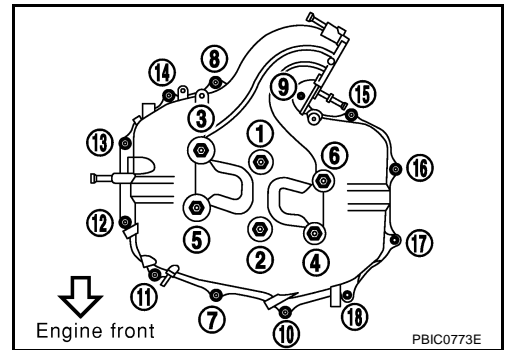
- Handle carefully to avoid any shock to electric throttle control actuator.
- Do not disassemble.



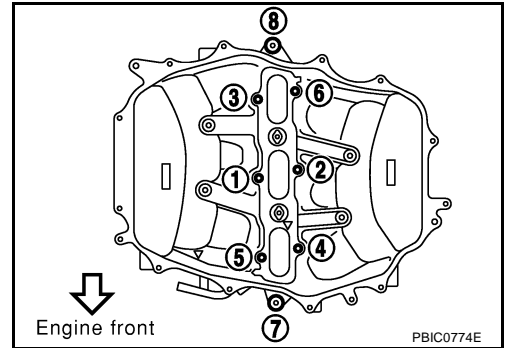
5. Remove fuel sub-tube mounting bolt to disconnect from rear of intake manifold collector (lower). Refer to [EM-37, "FUEL INJECTOR AND FUEL TUBE"](#).
6. Disconnect vacuum hose and water hose from intake manifold collector (upper).
7. Remove EVAP canister purge volume control solenoid valve bracket mounting bolt from intake manifold collector (upper).

INTAKE MANIFOLD COLLECTOR

8. Loosen bolts in reverse order as shown in the figure to remove intake manifold collector (upper) with power tool.



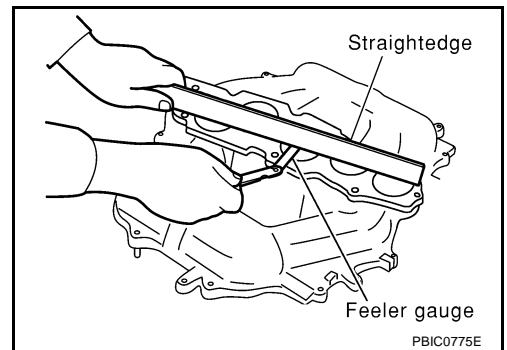
9. Remove PCV hose [between intake manifold collector (lower) and rocker cover (right bank)].
10. Loosen bolts in reverse order as shown in the figure, and remove the intake manifold collector cover, gasket, intake manifold collector (lower) and gasket with power tool.



INSPECTION AFTER REMOVAL

Surface Distortion

- Check the surface distortion of both the intake manifold collector (upper and lower) mating surfaces with straightedge and feeler gauge.
Limit : 0.1 mm (0.004 in)
- If it exceeds the limit, replace intake manifold collector (upper and/or lower).



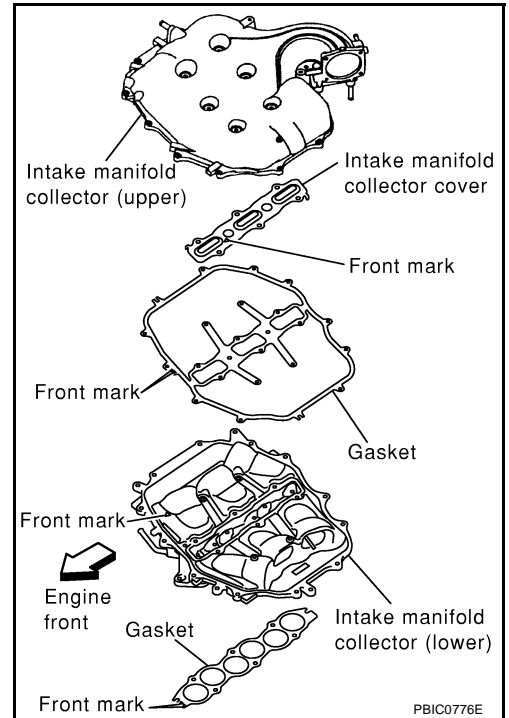
INTAKE MANIFOLD COLLECTOR

INSTALLATION

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

Indication of Part Installation Direction

Referring to front marks, install parts shown in the figure.

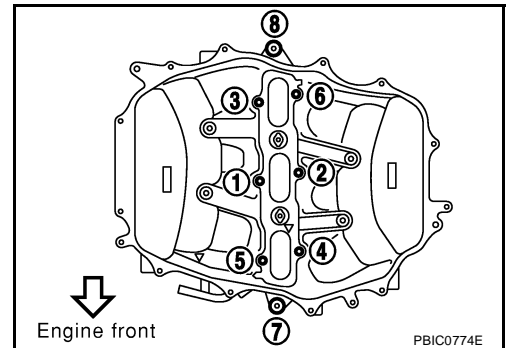


Intake Manifold Collector (Lower)

Tighten in numerical order as shown in the figure.

NOTE:

Tighten mounting bolts to secure gasket (lower), intake manifold collector (lower), gasket (upper), and intake manifold collector cover.



Intake Manifold Collector (Upper)

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

: 4.9 - 6.9 N·m (0.5 - 0.7 kg·m, 44 - 61 in·lb)

- Shank length under bolt head varies with bolt location. Install bolts while referring to numbers shown below and in the figure. (Bolt length does not include pilot portion.)

Bolt

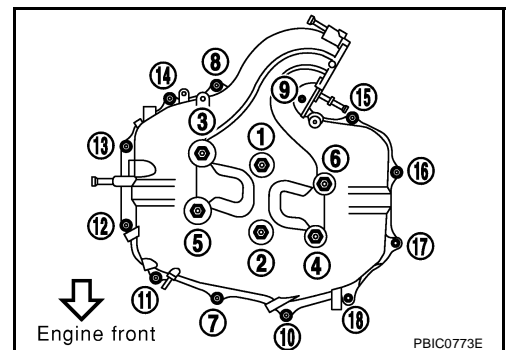
M6 × 25 mm (0.98 in) : 7, 8, 10, 11, 13, 14, 15, 16, 18

M6 × 45 mm (1.77 in) : 2, 4, 5

M6 × 60 mm (2.36 in) : 1, 3, 6, 9

M6 Nut : 12, 17

- Tighten in numerical order as shown in the figure.



Water Hose

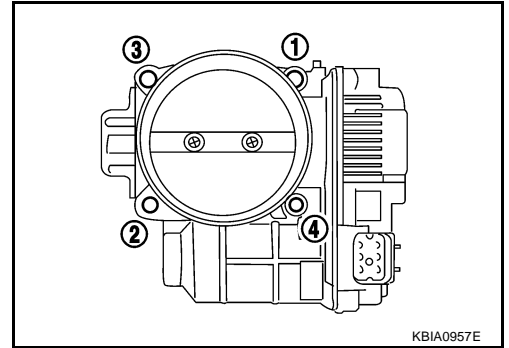
- Insert hose by 27 to 32 mm (1.06 to 1.26 in) from connector end.

INTAKE MANIFOLD COLLECTOR

- Clamp hose at location of 3 to 7 mm (0.12 to 0.28 in) from hose end.

Electric Throttle Control Actuator

- Install gasket with three protrusions for installation check facing any direction other than upward.
- Tighten in numerical order as shown in the figure.
- Perform the “Throttle Valve Closed Position Learning” when harness connector of electric throttle control actuator is disconnected. Refer to [EC-88, "Throttle Valve Closed Position Learning"](#) .
- Perform the “Idle Air Volume Learning” and “Throttle Valve Closed Position Learning” when electric throttle control actuator is replaced. Refer to [EC-89, "Idle Air Volume Learning"](#) .



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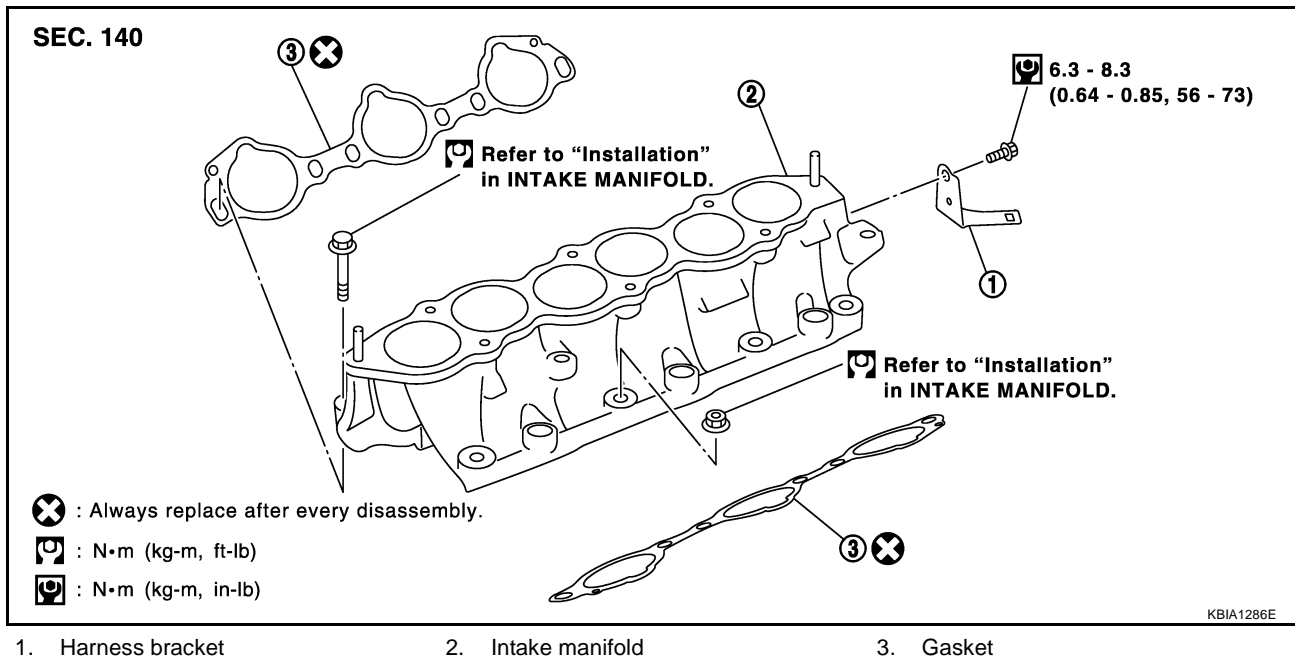
INTAKE MANIFOLD

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INTAKE MANIFOLD

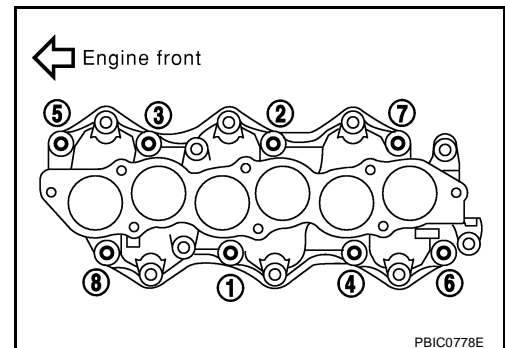
Removal and Installation

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REMOVAL

1. Release fuel pressure. Refer to [EC-91, "FUEL PRESSURE RELEASE"](#).
2. Remove intake manifold collectors (upper and lower). Refer to [EM-17, "INTAKE MANIFOLD COLLECTOR"](#).
3. Remove fuel tube and fuel injector assembly. Refer to [EM-37, "FUEL INJECTOR AND FUEL TUBE"](#).
4. Loosen bolts and nuts in reverse order as shown in the figure to remove intake manifold.



5. Remove intake manifold gaskets.

CAUTION:

Cover engine openings to avoid entry of foreign materials.

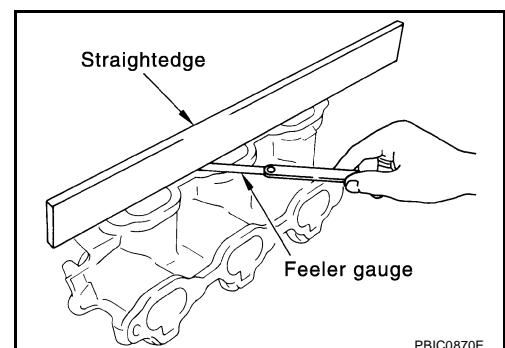
INSPECTION AFTER REMOVAL

Surface Distortion

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

Limit : 0.1 mm (0.04 in)

- If it exceeds the limit, replace intake manifold.




INTAKE MANIFOLD

INSTALLATION

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

Intake Manifold

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

 : **9.8 - 11.8 N·m (1.0 - 1.2 kg·m, 87 - 104 in·lb)**

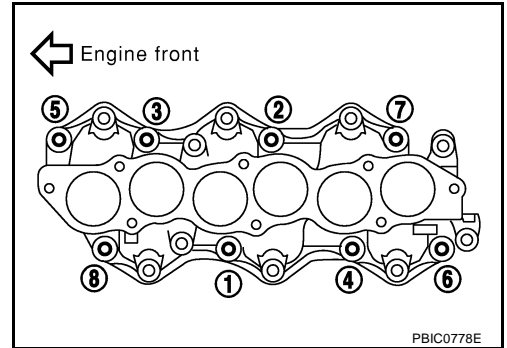
- Tighten all mounting bolts and nuts to the specified torque in two or more steps in numerical order shown in the figure.

 **1st step**

: **4.9 - 9.8 N·m (0.5 - 1.0 kg·m, 4 - 7 ft·lb)**

 **2nd step and after**

: **26.5 - 31.4 N·m (2.7 - 3.2 kg·m, 20 - 23 ft·lb)**



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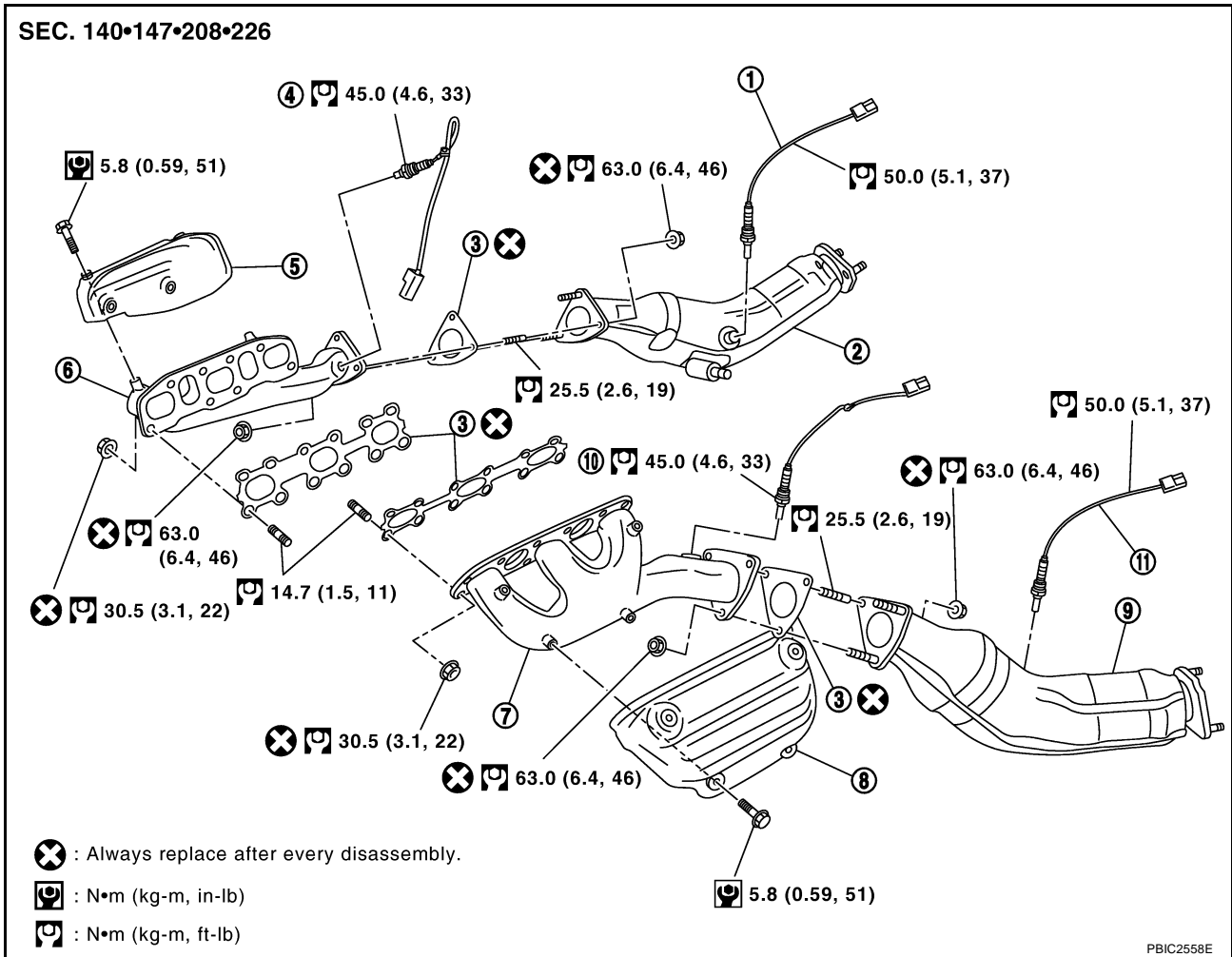
EXHAUST MANIFOLD AND THREE WAY CATALYST

PF14004

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EXHAUST MANIFOLD AND THREE WAY CATALYST

Removal and Installation



- | | | |
|--------------------------------------|--|-----------------------------------|
| 1. Heated oxygen sensor 2 (bank 1) | 2. Three way catalyst (right bank) | 3. Gasket |
| 4. Air fuel ratio sensor 1 (bank 1) | 5. Exhaust manifold cover (right bank) | 6. Exhaust manifold (right bank) |
| 7. Exhaust manifold (left bank) | 8. Exhaust manifold cover (left bank) | 9. Three way catalyst (left bank) |
| 10. Air fuel ratio sensor 1 (bank 2) | 11. Heated oxygen sensor 2 (bank 2) | |

REMOVAL

1. Remove engine cover with power tool. Refer to [EM-17, "INTAKE MANIFOLD COLLECTOR"](#).
2. Remove air cleaner case and air duct. Refer to [EM-15, "AIR CLEANER AND AIR DUCT"](#).
3. Remove undercover with power tool.
4. Drain engine coolant. Refer to [CO-10, "Changing Engine Coolant"](#).

CAUTION:

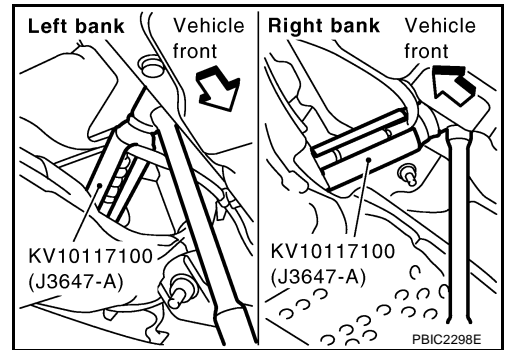
- Perform this step when engine is cold.
- Do not spill engine coolant on drive belts.

EXHAUST MANIFOLD AND THREE WAY CATALYST

5. Disconnect harness connector and remove heated oxygen sensor 2 on both banks using heated oxygen sensor wrench (SST).

CAUTION:

- Be careful not to damage heated oxygen sensor 2.
- Discard any heated oxygen sensor 2 which has been dropped from a height of more than 0.5 m (19.7 in) onto a hard surface such as a concrete floor; replace with a new sensor.



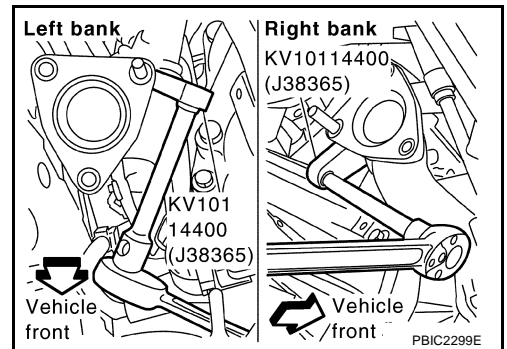
6. Remove exhaust mounting bracket between three way catalyst (right and left bank) and transmission. Refer to [EX-3. "EXHAUST SYSTEM"](#).

7. Remove three way catalyst.

8. Disconnect harness connector and remove air fuel ratio sensor 1 on both banks using heated oxygen sensor wrench (SST).

CAUTION:

- Be careful not to damage heated oxygen sensor 1.
- Discard any heated oxygen sensor 1 which has been dropped from a height of more than 0.5 m (19.7 in) onto a hard surface such as a concrete floor; replace with a new sensor.



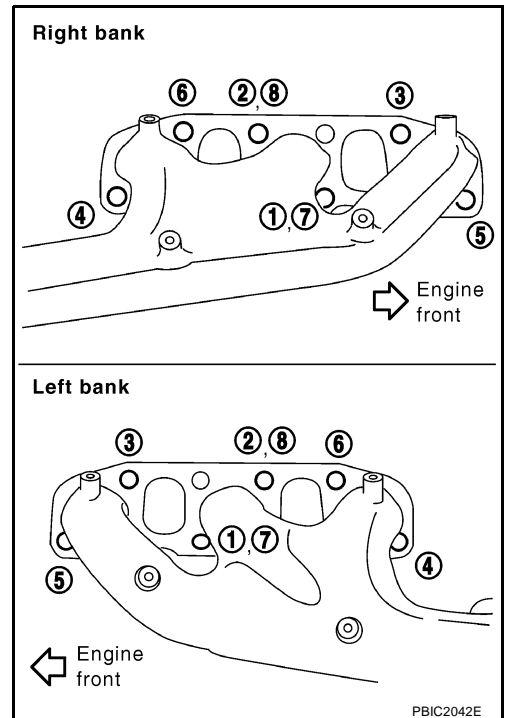
9. Remove water pipe and heater pipe on both right and left side. Refer to [CO-30. "WATER OUTLET AND WATER PIPING"](#).

10. Remove exhaust manifold cover.

11. Loosen nuts in reverse order as shown in the figure to remove exhaust manifold with power tool.

NOTE:

Disregard the numerical order No. 7 and No. 8 in removal.



12. Remove exhaust manifold gaskets.

EXHAUST MANIFOLD AND THREE WAY CATALYST

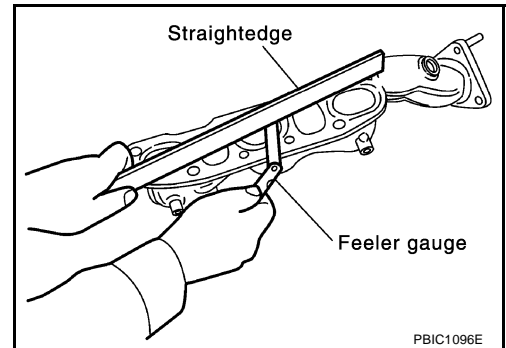
INSPECTION AFTER REMOVAL

Surface Distortion

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

Limit : 0.3 mm (0.012 in)

- If it exceeds the limit, replace exhaust manifold.

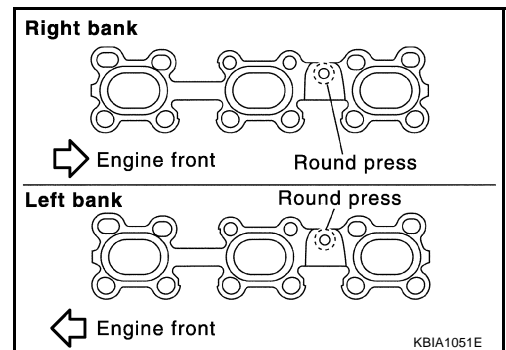


INSTALLATION

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

Exhaust Manifold Gasket

- Install in direction shown below. (Follow same procedure for both banks.)
- Locate thick side of port connecting part on right side from technician's view.
- Locate round press in thick side of port connecting part above center level line of port.



Exhaust Manifold

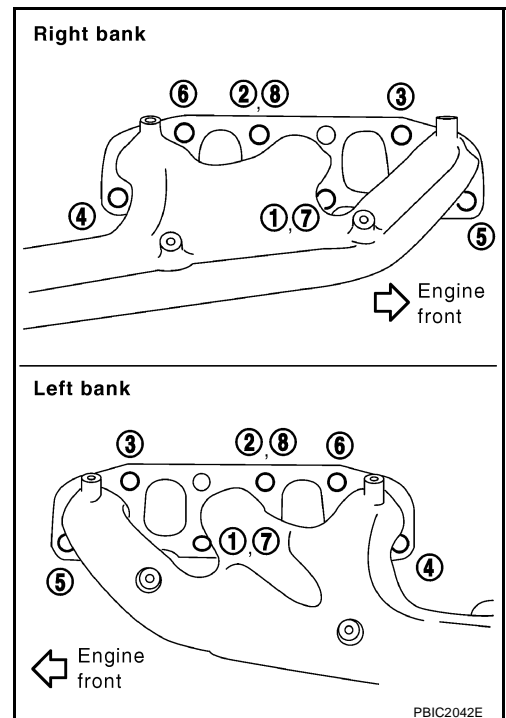
- If stud bolts were removed, install them and tighten to the specified torque below.

: **14.7 N-m (1.5 kg-m, 11 ft-lb)**

- Install exhaust manifold in numerical order as shown in the figure.

NOTE:

Tighten nuts No. 1 and No. 2 in two steps. The numerical order No. 7 and No. 8 shows second step.



EXHAUST MANIFOLD AND THREE WAY CATALYST

Air Fuel Ratio Sensor and Heated Oxygen Sensor

CAUTION:

- Before installing a new air fuel ratio sensor or a new heated oxygen sensor, clean exhaust system threads using heated oxygen sensor thread cleaner tool (commercial service tool: J-43897-18 or J-43897-12) and apply anti-seize lubricant (commercial service tool).
- Do not over torque the air fuel ratio sensor and the heated oxygen sensor. Doing so may cause damage to the air fuel ratio sensor or the heated oxygen sensor, resulting in the “MIL” coming on.

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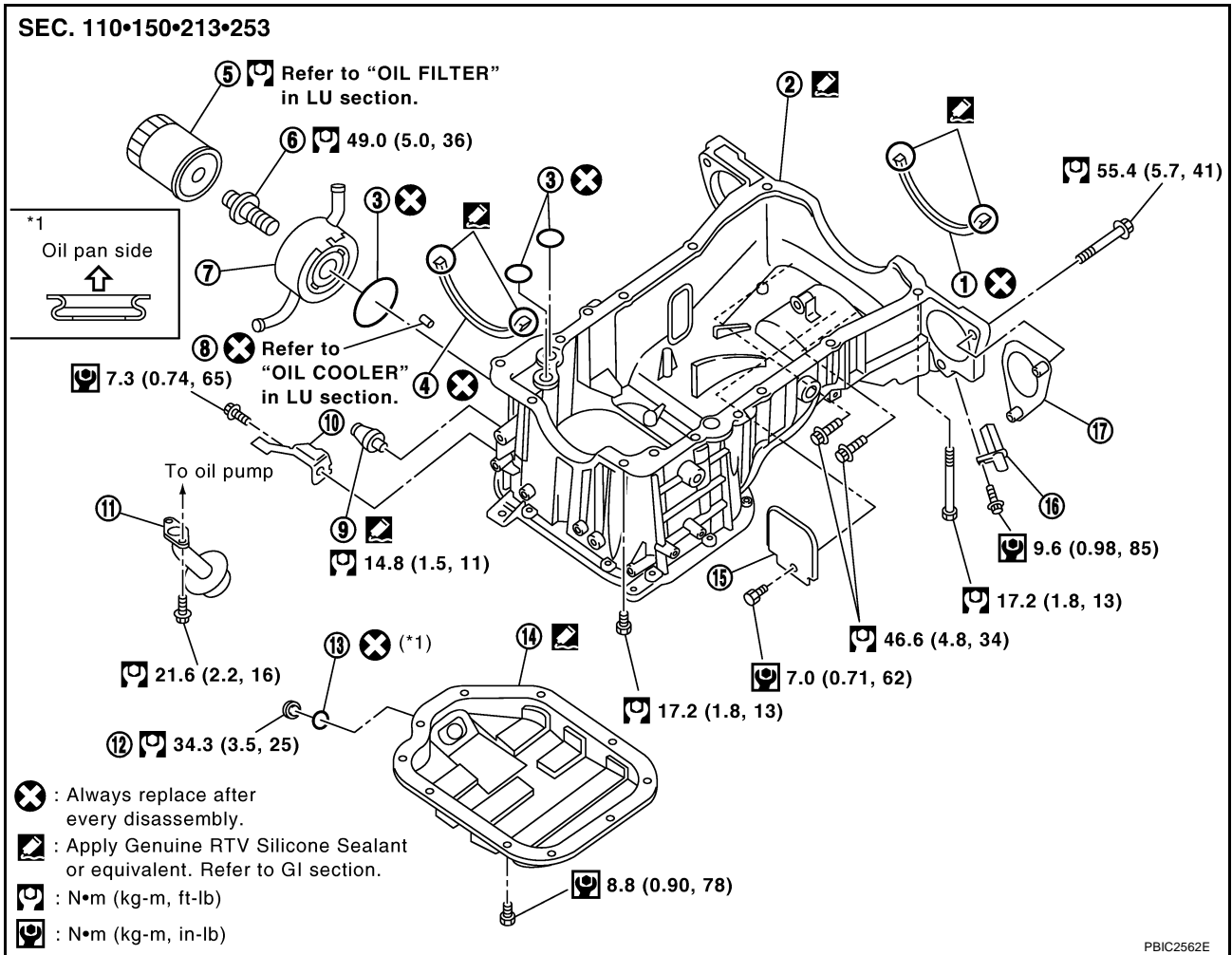
OIL PAN AND OIL STRAINER

PFP:11110

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OIL PAN AND OIL STRAINER

Removal and Installation



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

REMOVAL

WARNING:

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

NOTE:

To remove oil pan (lower) only, take step 4 and step 5, then step 18. Step 1 to 3 and 6 to 17 are unnecessary.

1. Remove hood assembly. Refer to [BL-12, "HOOD"](#).
2. Remove engine cover with power tool. Refer to [EM-17, "INTAKE MANIFOLD COLLECTOR"](#).
3. Remove air duct. Refer to [EM-15, "AIR CLEANER AND AIR DUCT"](#).
4. Remove undercover with power tool.
5. Drain engine oil. Refer to [LU-8, "Changing Engine Oil"](#).
6. Drain engine coolant. Refer to [CO-10, "Changing Engine Coolant"](#).

CAUTION:

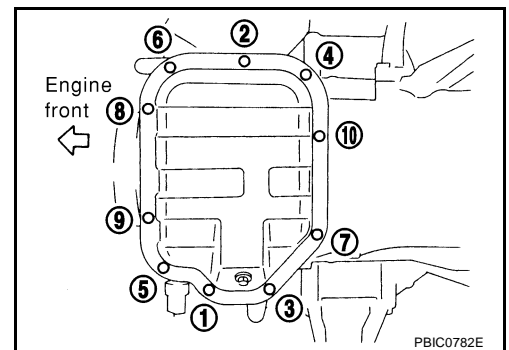
- Perform this step when engine is cold.
- Do not spill engine coolant on drive belts.

OIL PAN AND OIL STRAINER

7. Install engine slinger to sling engine assembly for positioning. Refer to [EM-104, "ENGINE ASSEMBLY"](#).
8. Remove front suspension member. Refer to [FSU-19, "FRONT SUSPENSION MEMBER"](#).
9. Remove drive belts. Refer to [EM-13, "DRIVE BELTS"](#).
10. Remove alternator. Refer to [SC-21, "CHARGING SYSTEM"](#).
11. Remove starter motor. Refer to [SC-10, "STARTING SYSTEM"](#).
12. Remove idler pulley and bracket assembly. Refer to [EM-55, "TIMING CHAIN"](#).
13. Disconnect oil cooler water hoses, and remove oil cooler water pipe mounting bolt. Refer to [LU-10, "OIL COOLER"](#).
14. Disconnect A/T fluid cooler hoses, and remove A/T fluid cooler tube (A/T models). Refer to [AT-274, "TRANSMISSION ASSEMBLY"](#).
15. Remove crankshaft position sensor (POS).

CAUTION:

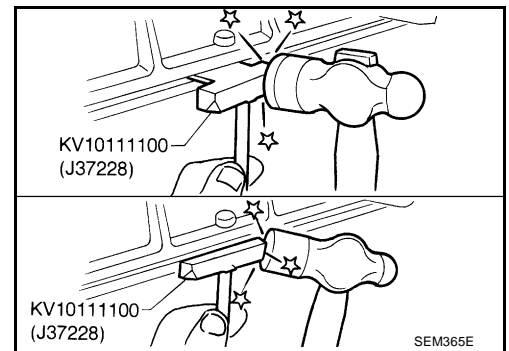
- Handle carefully to avoid dropping and shocks.
 - Do not disassemble.
 - Do not allow metal powder to adhere to magnetic part at sensor tip.
 - Do not place sensors in a location where they are exposed to magnetism.
16. Remove oil filter, as necessary. Refer to [LU-9, "OIL FILTER"](#).
 17. Remove oil cooler, as necessary. Refer to [LU-10, "OIL COOLER"](#).
 18. Remove oil pan (lower) as follows:
 - a. Loosen bolts in reverse order as shown in the figure to remove.



- b. Insert seal cutter (SST) between oil pan (upper) and oil pan (lower).

CAUTION:

- Be careful not to damage the mating surface.
 - Do not insert flat-bladed screwdriver, this will damage the mating surface.
- c. Slide seal cutter by tapping on the side of tool with hammer. Remove oil pan (lower).



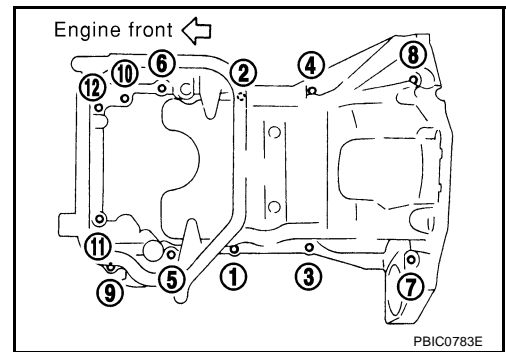
19. Remove oil strainer.
20. Remove transmission joint bolts which pierce oil pan (upper). Refer to [MT-19, "TRANSMISSION ASSEMBLY"](#) (M/T models) or [AT-274, "TRANSMISSION ASSEMBLY"](#) (A/T models).
21. Remove rear plate cover.

OIL PAN AND OIL STRAINER

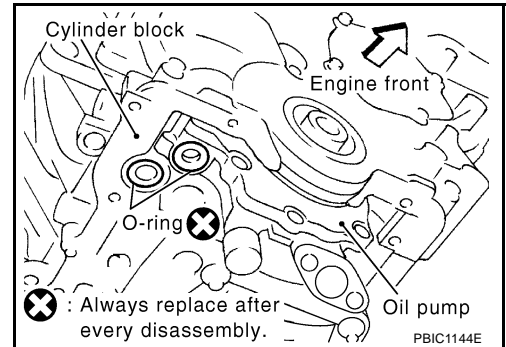
22. Loosen oil pan (upper) bolts with power tool in the reverse order as shown in the figure to remove.
- Insert seal cutter [SST: KV10111100 (J37228)] between oil pan (upper) and cylinder block. Slide seal cutter by tapping on the side of the tool with a hammer. Remove oil pan (upper).

CAUTION:

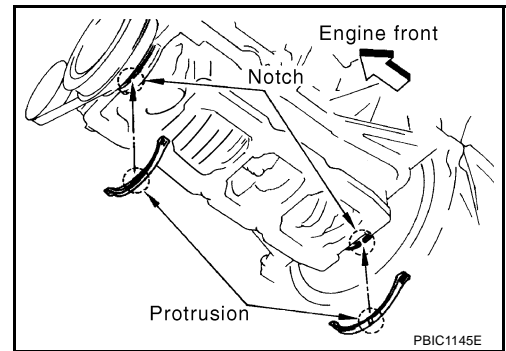
Be careful not to damage mating surface.



23. Remove O-rings from bottom of cylinder block and oil pump.



24. Remove oil pan gaskets.



INSPECTION AFTER REMOVAL

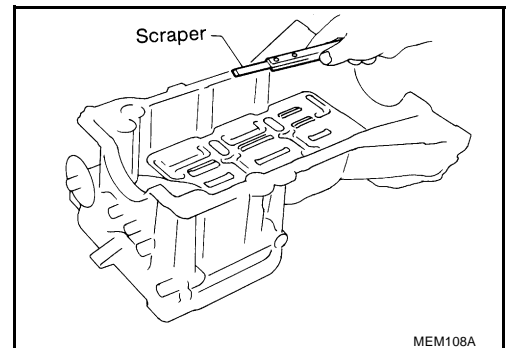
Clean oil strainer if any object attached.

INSTALLATION

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

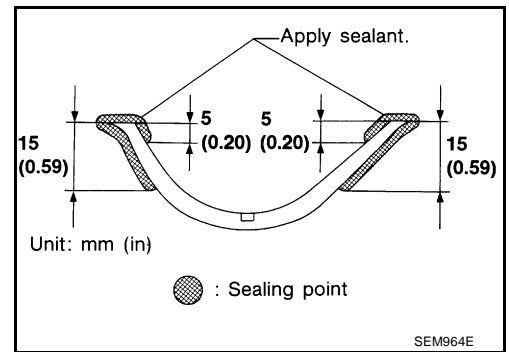
CAUTION:

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

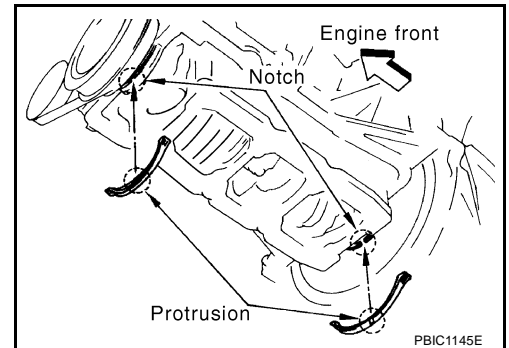


OIL PAN AND OIL STRAINER

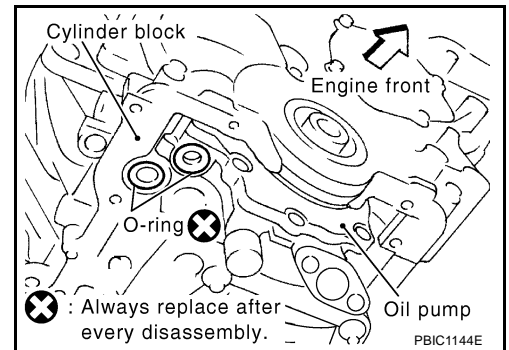
- b. Apply liquid gasket to oil pan gaskets as shown in the figure. **Use Genuine RTV Silicone Sealant or equivalent. Refer to [GI-46, "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS"](#).**



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



- c. Install new O-rings on the cylinder block and oil pump side.

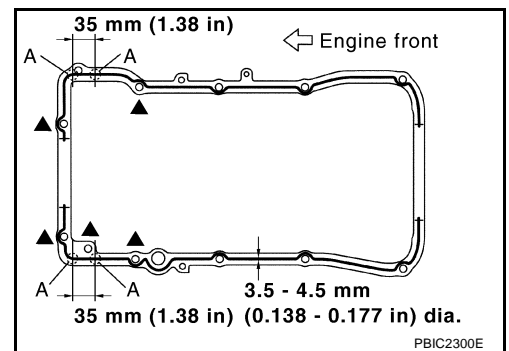


- d. Apply a continuous bead of liquid gasket with tube presser [SST: WS39930000 (—)] to the cylinder block mating surface of oil pan (upper) to a limited portion as shown in the figure.

Use Genuine RTV Silicone Sealant or equivalent. Refer to [GI-46, "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS"](#).

CAUTION:

- For bolt holes with ▲ marks (five locations), apply liquid gasket outside the holes.
- Apply a bead of 4.5 to 5.5 mm (0.177 to 0.217 in) in diameter to area "A".
- Attaching should be done within 5 minutes after coating.



- e. Install the oil pan (upper).

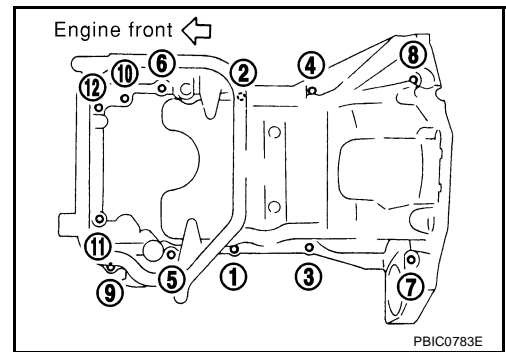
A
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OIL PAN AND OIL STRAINER

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

M8 × 100 mm (3.97 in) : 5, 7, 8, 11

M8 × 25 mm (0.98 in) : Except the above



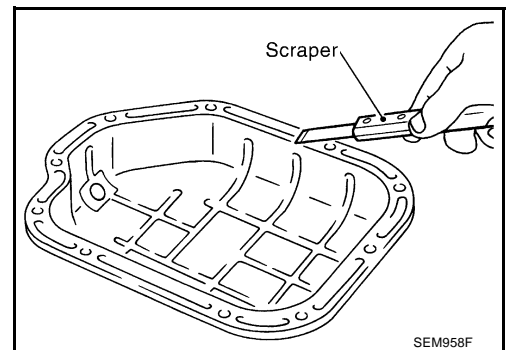
- f. Tighten transmission joint bolts. Refer to [MT-19, "TRANSMISSION ASSEMBLY"](#) (M/T models) or [AT-274, "TRANSMISSION ASSEMBLY"](#) (A/T models).

2. Install oil strainer to oil pump.

3. Install oil pan (lower) as follows:

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

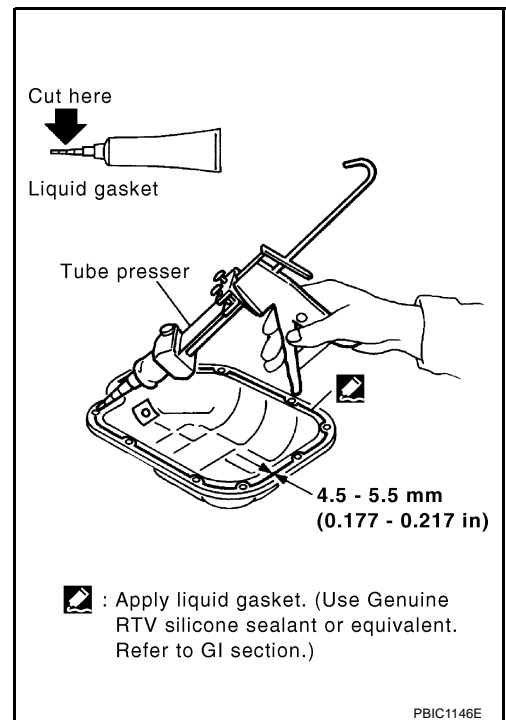
- **Also remove old liquid gasket from mating surface of oil pan (upper).**



b. Apply a continuous bead of liquid gasket with tube presser [SST: WS39930000 (—)] to oil pan (lower).

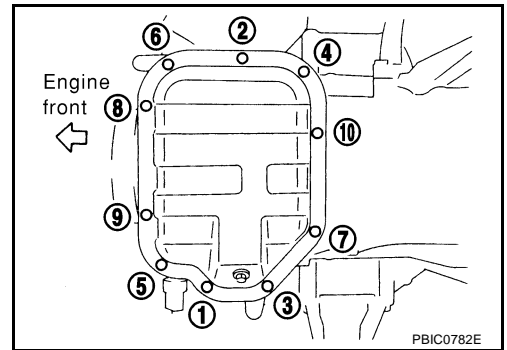
Use Genuine RTV Silicone Sealant or equivalent. Refer to [GI-46, "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS"](#).

- Be sure the sealant is 4.5 - 5.5 mm (0.177 - 0.217 in) wide.
- Attaching should be done within 5 minutes after coating.



OIL PAN AND OIL STRAINER

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



4. Install oil pan drain plug.
- Refer to the figure of components of former page for installation direction of drain plug washer. Refer to [EM-28. "Removal and Installation"](#) .
5. Install in the reverse order of removal after this step.
- **NOTE:**
At least 30 minutes after oil pan is installed, pour engine oil.

INSPECTION AFTER INSTALLATION

1. Check engine oil level and adjust engine oil. Refer to [LU-6. "ENGINE OIL"](#) .
2. Start engine, and check there is no leak of engine oil.
3. Stop engine and wait for 10 minutes.
4. Check engine oil level again. Refer to [LU-6. "ENGINE OIL"](#) .

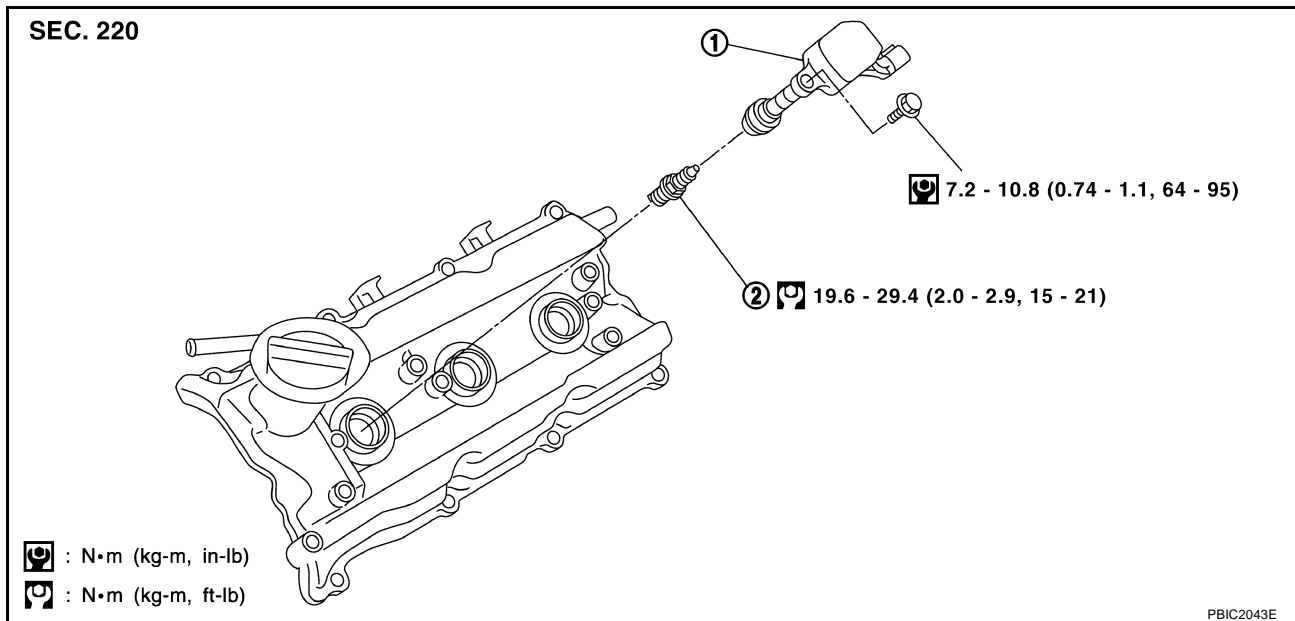
IGNITION COIL

IGNITION COIL

PFP:22448

Removal and Installation

ABS00A0P



1. Ignition coil

2. Spark plug

REMOVAL

1. Remove engine cover with power tool. Refer to [EM-17, "INTAKE MANIFOLD COLLECTOR"](#).
2. Remove air cleaner case and air duct (for ignition coil of left bank side). Refer to [EM-15, "AIR CLEANER AND AIR DUCT"](#).
3. Move aside harness, harness bracket, and hoses located above ignition coil.
4. Disconnect harness connector from ignition coil.
5. Remove ignition coil.

CAUTION:

Do not shock it.

INSTALLATION

Install in the reverse order of removal.

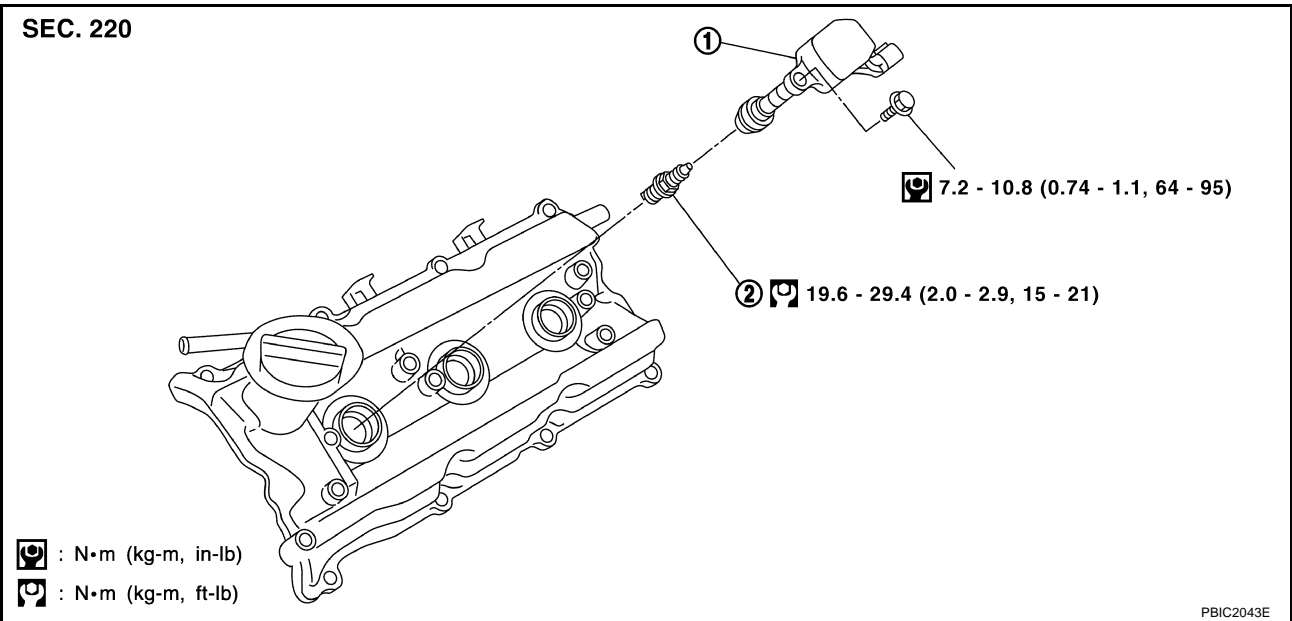
SPARK PLUG (PLATINUM-TIPPED TYPE)

SPARK PLUG (PLATINUM-TIPPED TYPE)

PFP:22401

Removal and Installation

ABS00A00

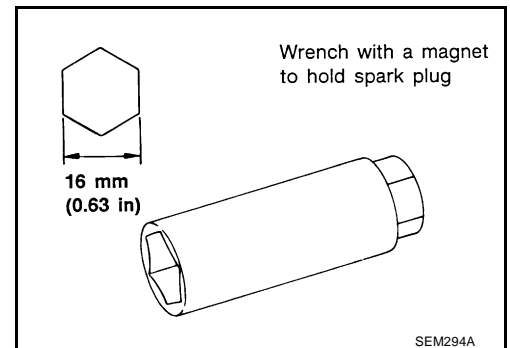


1. Ignition coil

2. Spark plug

REMOVAL

1. Remove engine cover with power tool. Refer to [EM-17, "INTAKE MANIFOLD COLLECTOR"](#) .
2. Remove ignition coil. Refer to [EM-34, "IGNITION COIL"](#) .
3. Remove spark plug using spark plug wrench (commercial service tool).



INSPECTION AFTER REMOVAL

Use standard type spark plug for normal condition.

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

- Frequent engine starts
- Low ambient temperatures

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

- Extended highway driving
- Frequent high engine revolution

Make	NGK
Standard type	PLFR5A-11
Hot type	PLFR4A-11
Cold type	PLFR6A-11

Gap (Nominal) : 1.1 mm (0.043 in)

SPARK PLUG (PLATINUM-TIPPED TYPE)

CAUTION:

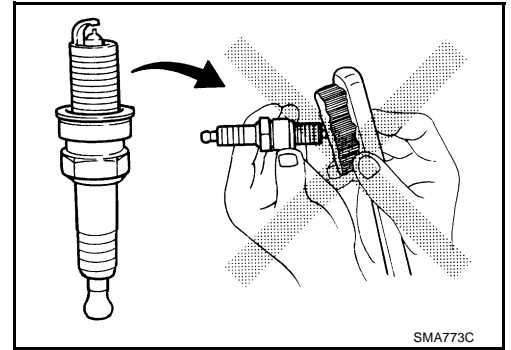
- Do not drop or shock spark plug.
- Do not use wire brush for cleaning.
- If plug tip is covered with carbon, spark plug cleaner may be used.

Cleaner air pressure:

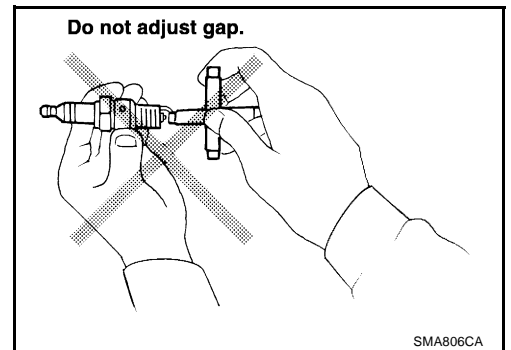
Less than 588 kPa (6 kg/cm² , 85 psi)

Cleaning time:

Less than 20 seconds



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



INSTALLATION

Install in the reverse order of removal.

FUEL INJECTOR AND FUEL TUBE

PFP:16600

A

FUEL INJECTOR AND FUEL TUBE

Removal and Installation

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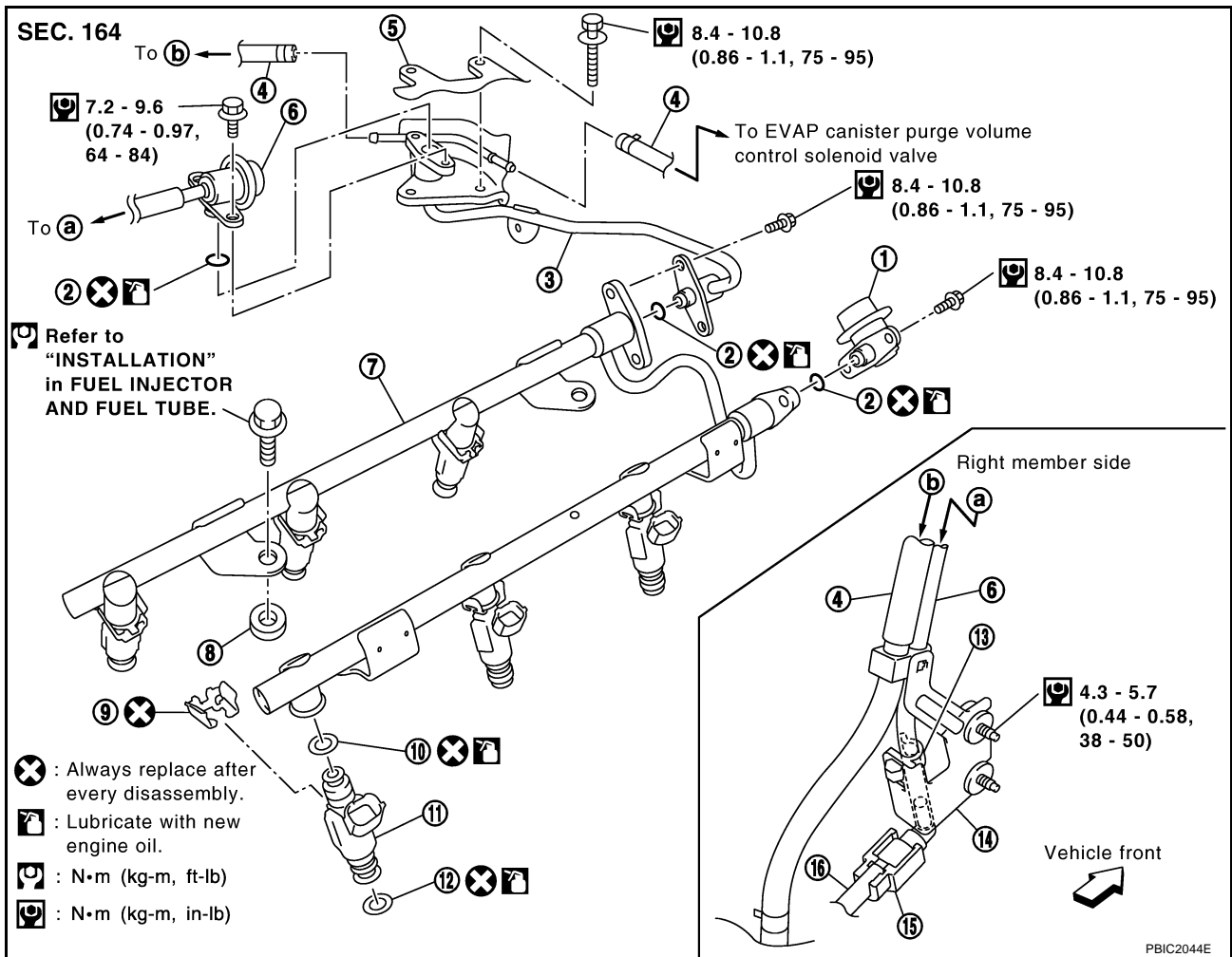
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- | | | |
|------------------------------------|--|---------------------------------|
| 1. Fuel damper | 2. O-ring | 3. Fuel sub-tube |
| 4. EVAP hose | 5. Intake manifold collector (lower) rear right side | 6. Fuel feed hose (with damper) |
| 7. Fuel tube | 8. Spacer | 9. Clip |
| 10. O-ring (blue) | 11. Fuel injector | 12. O-ring (brown) |
| 13. Hose clamp | 14. Bracket | 15. Quick connector cap |
| 16. Centralized under-floor piping | | |

CAUTION:

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

FUEL INJECTOR AND FUEL TUBE

REMOVAL

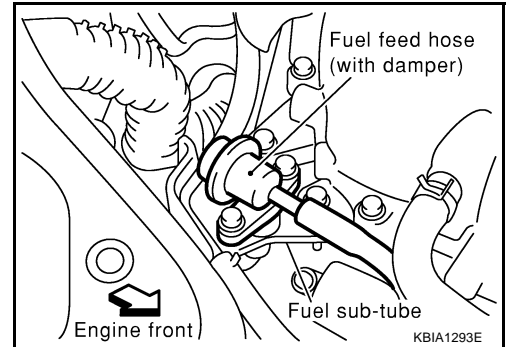
1. Remove engine cover with power tool. Refer to [EM-17, "INTAKE MANIFOLD COLLECTOR"](#) .
2. Release fuel pressure. Refer to [EC-91, "FUEL PRESSURE RELEASE"](#) .
3. Remove fuel feed hose (with damper) from fuel sub-tube.

NOTE:

There is no fuel return route.

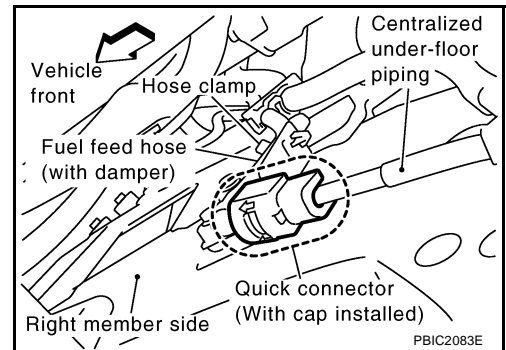
CAUTION:

- While hoses are disconnected, plug them to prevent fuel from draining.
- Do not separate fuel damper and fuel feed hose.



4. When separating fuel feed hose (with damper) and centralized under-floor piping connection, disconnect quick connector as follows:

- a. Remove quick connector cap from quick connector connection on right member side.
- b. Disconnect fuel feed hose (with damper) from bracket hose clamp.



- c. Disconnect quick connector from centralized under-floor piping as follows:

CAUTION:

Disconnect quick connector by using quick connector release [SST: — (J-45488)], not by picking out retainer tabs.

- i. With the sleeve side of quick connector release facing quick connector, install quick connector release onto fuel tube.
- ii. 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.

- iii. Draw and pull out quick connector straight from centralized under-floor piping.

CAUTION:

- Pull quick connector holding "A" position as shown in the figure.

- Do not pull with lateral force applied. O-ring inside quick connector may be damaged.

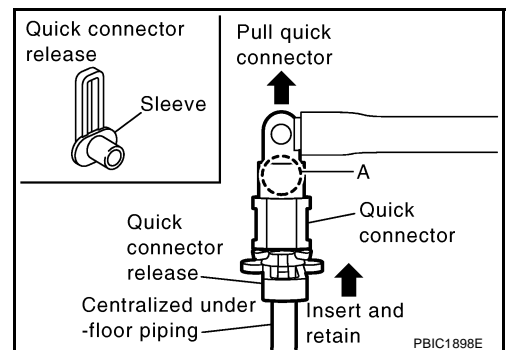
- Prepare container and cloth beforehand as fuel will leak out.

- Avoid fire and sparks.

- Keep parts away from heat source. Especially, be careful when welding is performed around them.

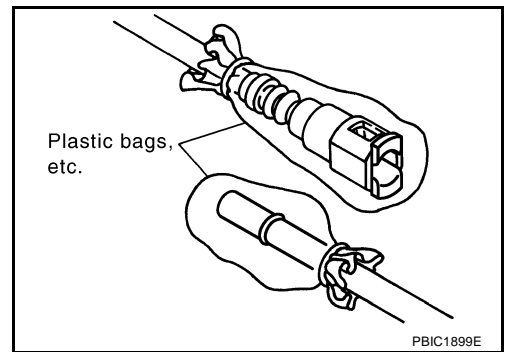
- Do not expose parts to battery electrolyte or other acids.

- Do not bend or twist connection between quick connector and fuel hose (with damper) during installation/removal.



FUEL INJECTOR AND FUEL TUBE

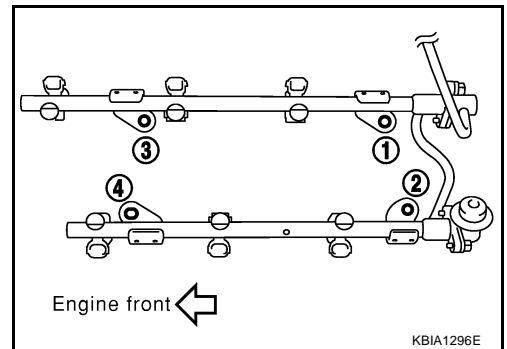
- To keep clean the connecting portion and to avoid damage and foreign materials, cover them completely with plastic bags or something similar.



5. Remove intake manifold collectors (upper and lower). Refer to [EM-17, "INTAKE MANIFOLD COLLECTOR"](#).
6. Disconnect harness connector from fuel injector.
7. Loosen mounting bolts in reverse order as shown in the figure, and remove fuel tube and fuel injector assembly.

CAUTION:

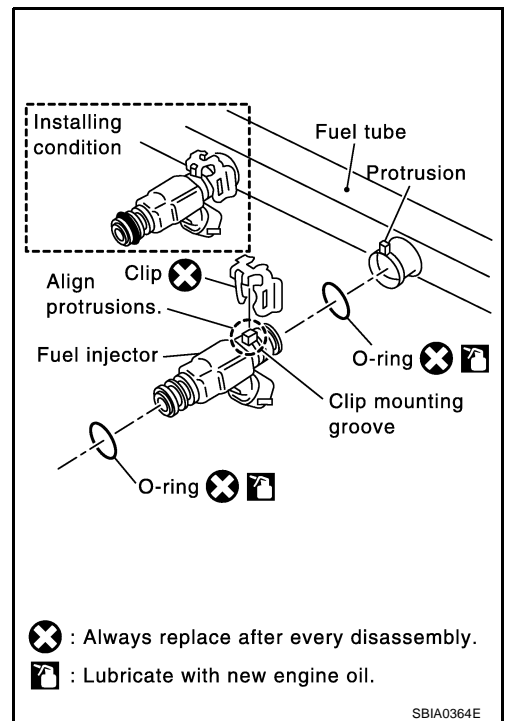
Do not tilt it, or remaining fuel in pipes may flow out from pipes.



8. Remove spacers on intake manifold.
9. Remove fuel injector from fuel tube as follows:
 - a. Open and remove clip.
 - b. Remove fuel injector from fuel tube by pulling straight.

CAUTION:

- Be careful with remaining fuel that may go out from fuel tube.
- Be careful not to damage injector nozzles during removal.
- Do not bump or drop fuel injectors.
- Do not disassemble fuel injectors.



10. Remove fuel sub-tube and fuel damper.

INSTALLATION

1. Install fuel damper and fuel sub-tube.
 - When handling O-rings, be careful of the following caution.

CAUTION:

 - Handle O-ring with bare hands. Do not wear gloves.

FUEL INJECTOR AND FUEL TUBE

- Lubricate O-ring with new engine oil.
 - Do not clean O-ring with solvent.
 - Make sure that O-ring and its mating part are free of foreign material.
 - When installing O-ring, be careful not to scratch it with tool or fingernails. Also be careful not to twist or stretch O-ring. If O-ring was stretched while it was being attached, do not insert it quickly into fuel tube.
 - Insert O-ring straight into fuel tube. Do not decenter or twist it.
2. Insert fuel damper and fuel sub-tube straight into fuel tube.
- Tighten mounting bolts evenly in turn.
- After tightening mounting bolts, make sure that there is no gap between flange and fuel tube.
2. Note the following, and install O-rings to fuel injector.

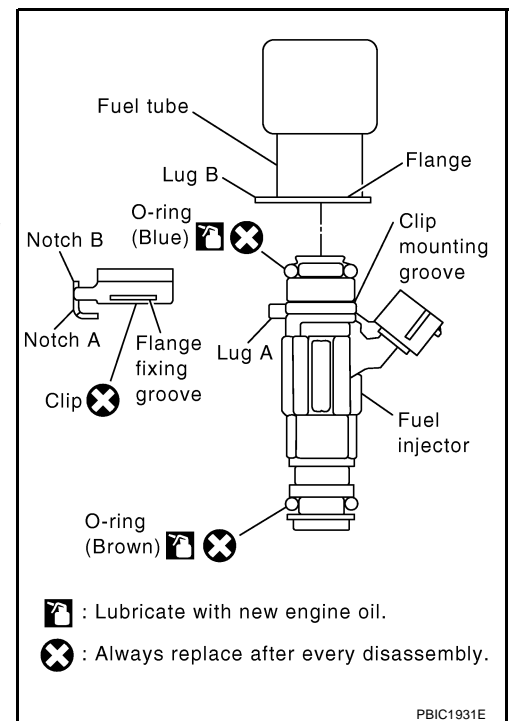
CAUTION:

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

Fuel tube side : Blue

Nozzle side : Brown

- Handle O-ring with bare hands. Do not wear gloves.
 - Lubricate O-ring with new engine oil.
 - Do not clean O-ring with solvent.
 - Make sure that O-ring and its mating part are free of foreign material.
 - When installing O-ring, be careful not to scratch it with tool or fingernails. Also be careful not to twist or stretch O-ring. If O-ring was stretched while it was being attached, do not insert it quickly into fuel tube.
 - Insert O-ring straight into fuel tube. Do not decenter or twist it.
3. Install fuel injector to fuel tube as follows:
- a. Insert clip into clip mounting groove on fuel injector.
- Insert clip so that lug "A" of fuel injector matches notch "A" of clip.
- CAUTION:**
- Do not 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 lug "B" of fuel tube matches notch "B" of the clip.
 - Make sure that fuel tube flange is securely fixed in flange fixing groove on clip.
- c. Make sure that installation is complete by checking that fuel injector does not rotate or come off.




4. Install spacers on intake manifold.
5. Install fuel tube and fuel injector assembly to intake manifold.


CAUTION:

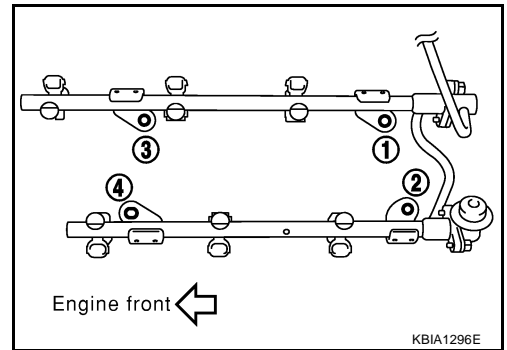
Be careful not to let tip of injector nozzle come in contact with other parts.

FUEL INJECTOR AND FUEL TUBE

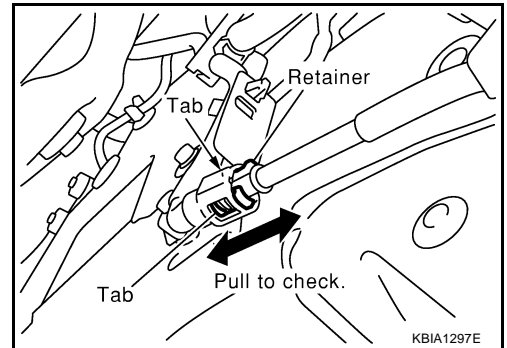
- Tighten mounting bolts in two steps in numerical order as shown in the figure.

 **1st step**
: 9.3 - 10.8 N·m (0.95 - 1.1 kg·m, 6.9 - 7.9 ft·lb)

 **2nd step**
: 20.6 - 26.5 N·m (2.1 - 2.7 kg·m, 16 - 19 ft·lb)



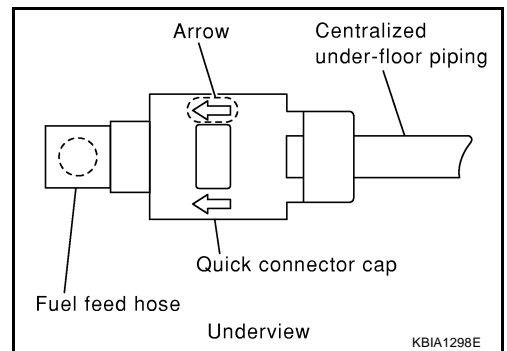
6. Connect fuel injector harness connector.
7. Install intake manifold collectors (upper and lower). Refer to [EM-17, "INTAKE MANIFOLD COLLECTOR"](#).
8. Install fuel sub-tube on rear end of intake manifold collector (lower).
9. Connect fuel feed hose (with damper).
 - Handling procedure of O-ring is the same as that of fuel damper and fuel sub-tube.
 - Insert fuel damper straight into fuel sub-tube.
 - Tighten mounting bolts evenly in turn.
 - After tightening mounting bolts, make sure that there is no gap between flange and fuel sub-tube.
10. Connect quick connector between fuel feed hose (with damper) and centralized under-floor piping connection as follows:
 - a. Check the connection for damage and foreign materials.
 - b. Align the connector with tube, then insert the connector straight into the tube until a click is heard.
 - c. After connecting quick connector, use the following method to make sure it is full connected.
 - Visually confirm that the two retainer tabs are connected to the connector.
 - Pull the tube and the connector to make sure they are securely connected.



- d. Install quick connector cap to quick connector connection.
 - Install quick connector cap with arrow on surface facing in direction of quick connector (fuel feed hose side).

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

- e. Secure fuel feed hose (with damper) to clamp.



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

INSPECTION AFTER INSTALLATION

Check on Fuel Leakage

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

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

FUEL INJECTOR AND FUEL TUBE

CAUTION:

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

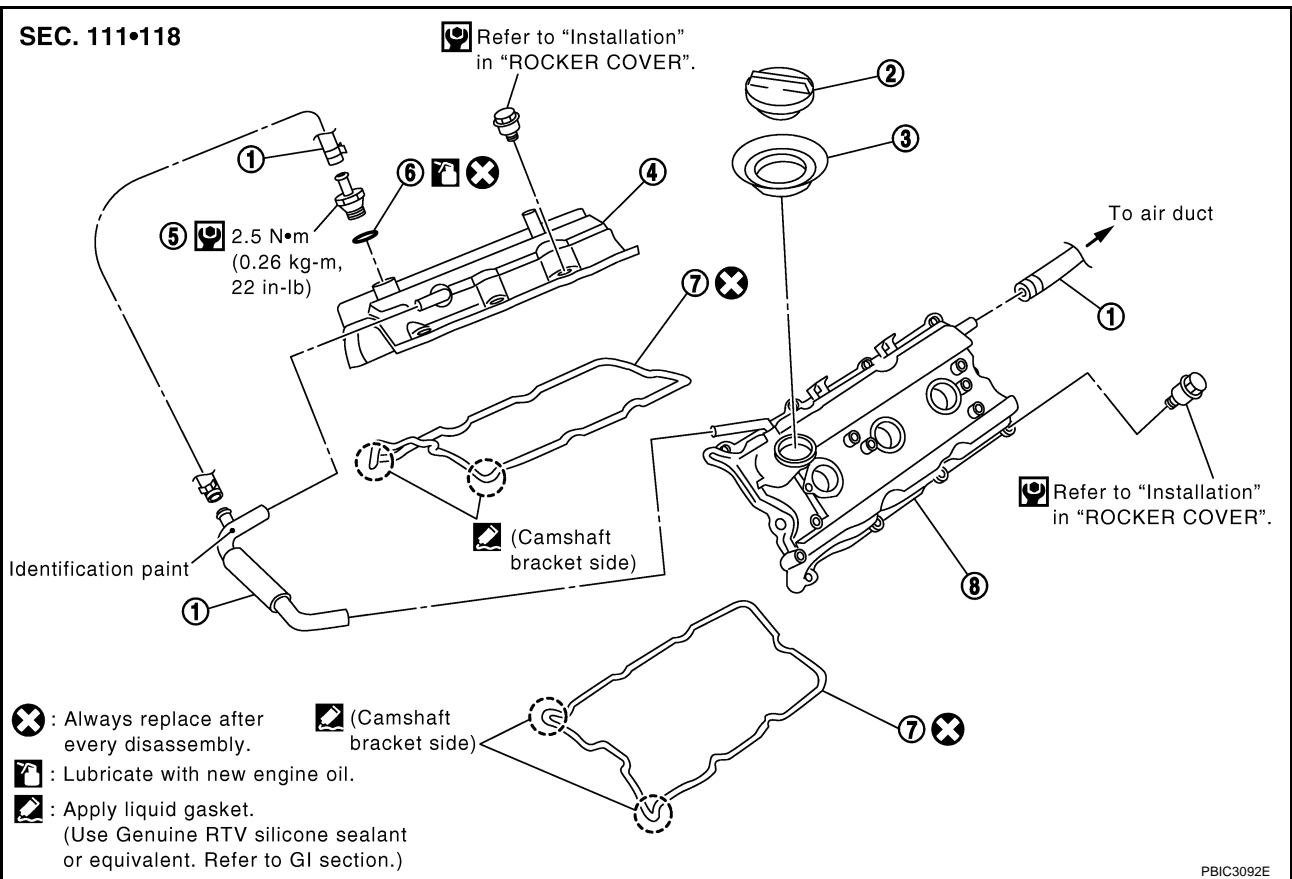
ROCKER COVER

PFP:13264

ROCKER COVER

Removal and Installation

ABS00A0S



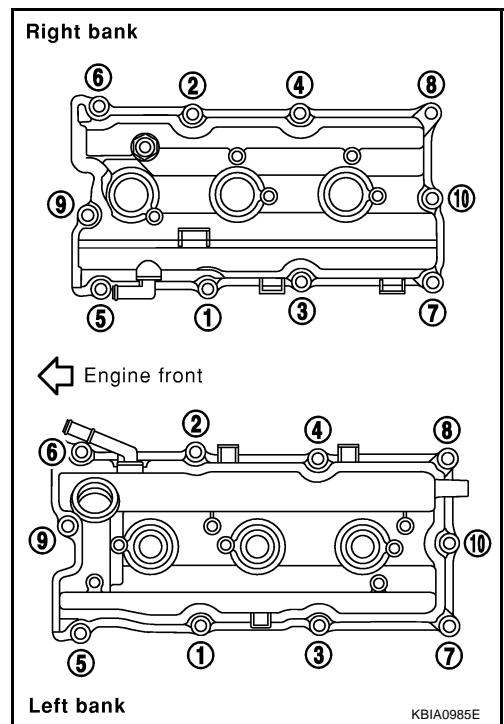
- | | | |
|------------------------------|-----------------------------|----------------|
| 1. PCV hose | 2. Oil filler cap | 3. Oil catcher |
| 4. Rocker cover (right bank) | 5. PCV valve | 6. O-ring |
| 7. Rocker cover gasket | 8. Rocker cover (left bank) | |

REMOVAL

1. Remove intake manifold collectors (upper and lower) with power tool. Refer to [EM-17, "INTAKE MANIFOLD COLLECTOR"](#).
2. Separate engine harness removing their brackets from rocker covers.
3. Remove ignition coil. Refer to [EM-34, "IGNITION COIL"](#).
4. Remove PCV hoses from rocker covers.

ROCKER COVER

- Loosen bolts in reverse order as shown in the figure (with power tool).



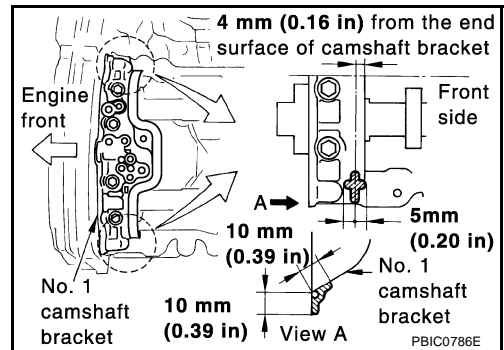
- Use scraper to remove all traces of liquid gasket from cylinder head and camshaft bracket (No. 1).

INSTALLATION

- Apply liquid gasket of 3.0 mm (0.12 in) diameter to position shown in the figure [both edges of camshaft bracket (No. 1)] (on both banks).

Use Genuine RTV Silicone Sealant or equivalent. Refer to [GI-46, "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS"](#).


- First, apply it to engine longitudinal direction [5.0 mm (0.197 in) + 5.0 mm (0.197 in) side in figure].




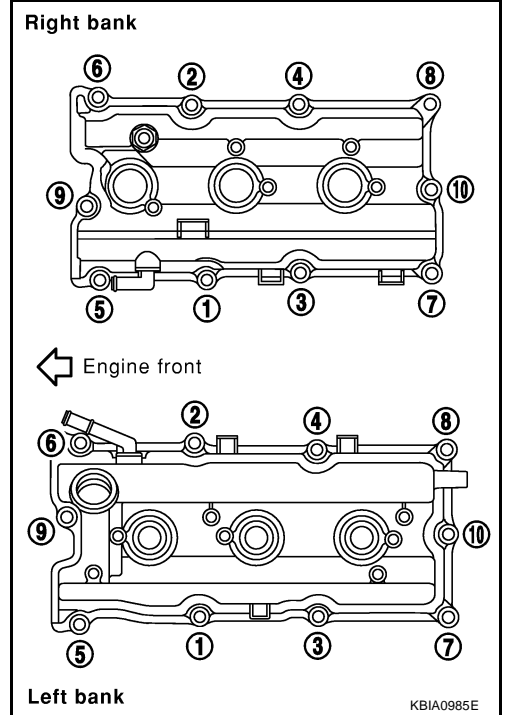
- Install rocker cover.
 - Check if rocker cover gasket is not dropped from installation groove of rocker cover.

ROCKER COVER

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

 **1st step**
: 0.96 - 2.96 N·m (0.10 - 0.30 kg·m, 9 - 26 in·lb)

 **2nd step**
: 7.33 - 9.33 N·m (0.75 - 0.95 kg·m, 65 - 82 in·lb)



4. Install PCV hose.
- Insert PCV hose by 25 to 30 mm (0.98 to 1.18 in) from connector end.
 - When installing, be careful not to twist or come in contact with other parts.
 - Install PCV hose between right and left rocker covers with its identification paint facing upward (right rocker cover side). Refer to component figure in [EM-43, "Removal and Installation"](#) .
5. Install in the reverse order of removal after this step.

FRONT TIMING CHAIN CASE

FRONT TIMING CHAIN CASE

PFP:13599

Removal and Installation

ABS00A0T

NOTE:

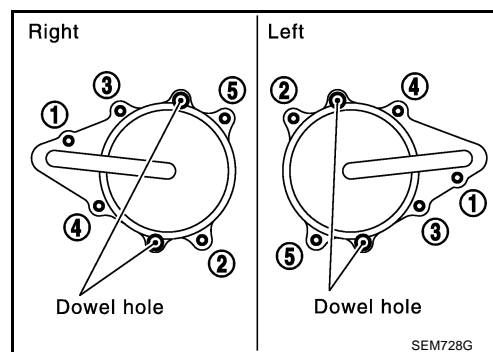
- This section describes removal/installation procedure of front timing chain case and timing chain (primary) related parts without removing oil pan (upper) on vehicle.
- When oil pan (upper) needs to be removed or installed, or when rear timing chain case is removed or installed, remove oil pans (upper and lower) first. Then remove front timing chain case, timing chain (primary) related parts, and rear timing chain case in this order, and install in the reverse order of removal. Refer to [EM-55, "TIMING CHAIN"](#).
- Refer to [EM-55, "TIMING CHAIN"](#) for component parts location.

REMOVAL

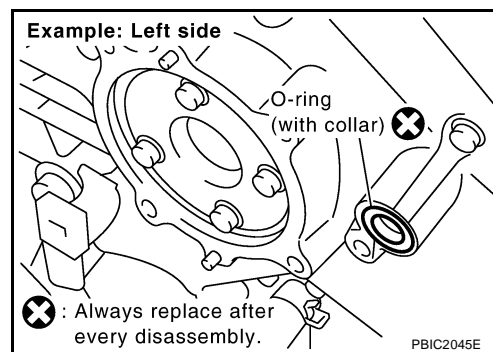
1. Remove engine cover with power tool. Refer to [EM-17, "INTAKE MANIFOLD COLLECTOR"](#).
2. Drain engine coolant from radiator. Refer to [CO-10, "Changing Engine Coolant"](#).
3. Separate engine harnesses removing their brackets from front timing chain case.
4. Remove radiator cooling fan assembly. Refer to [CO-21, "COOLING FAN"](#).
5. Remove drive belts. Refer to [EM-13, "DRIVE BELTS"](#).
6. Remove power steering oil pump from bracket with piping connected, and temporarily secure it aside. Refer to [PS-29, "POWER STEERING OIL PUMP"](#).
7. Remove power steering oil pump bracket. Refer to [PS-29, "POWER STEERING OIL PUMP"](#).
8. Remove alternator. Refer to [SC-21, "CHARGING SYSTEM"](#).
9. Remove water bypass hose, water hose clamp and idler pulley bracket from front timing chain case.
10. Remove right and left intake valve timing control covers.
 - Loosen bolts in reverse order as shown in the figure.
 - Use seal cutter [SST: KV10111100 (J37228)] or an equivalent tool to cut liquid gasket for removal.

CAUTION:

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



11. Remove collared O-ring from front timing chain case (left and right side).



12. Remove right and left rocker covers with power tool. Refer to [EM-43, "ROCKER COVER"](#).

NOTE:

When only timing chain (primary) is removed, rocker cover does not need to be removed.

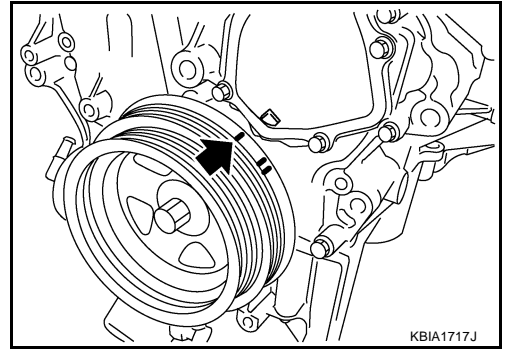
13. Obtain compression TDC of No. 1 cylinder as follows:

NOTE:

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

FRONT TIMING CHAIN CASE

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

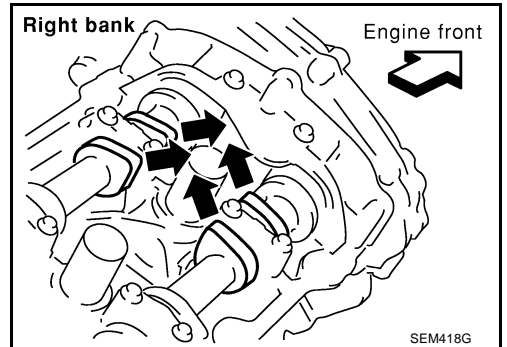


- b. Make sure that intake and exhaust cam noses on No. 1 cylinder (engine front side of right bank) are located as shown.

- If not, turn the crankshaft one revolution (360 degrees) and align as shown.

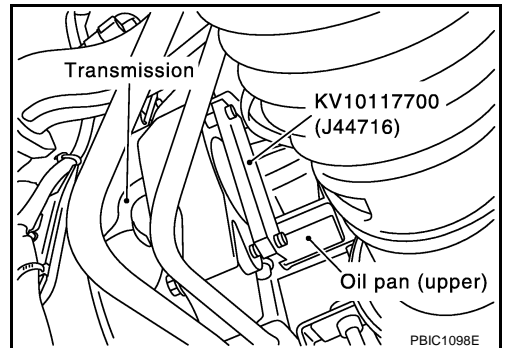
NOTE:

When only timing chain (primary) is removed, rocker cover does not need to be removed. To make sure that No. 1 cylinder is at its compression TDC, remove front timing chain case first. Then check mating marks on camshaft sprockets. Refer to [EM-64, "INSTALLATION"](#).



14. Remove crankshaft pulley as follows:

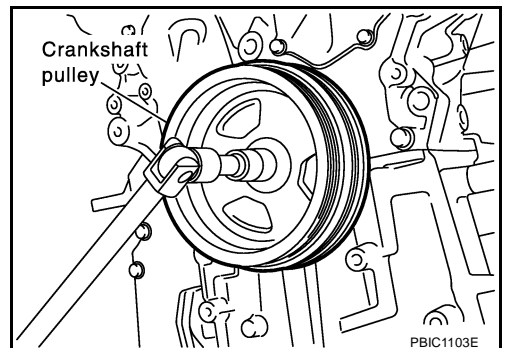
- a. Remove starter motor and set ring gear stopper (SST) as shown in the figure. Refer to [SC-10, "STARTING SYSTEM"](#).



- b. Loosen crankshaft pulley bolt and locate bolt seating surface as 10 mm (0.39 in) from its original position.

CAUTION:

Do not remove crankshaft pulley bolt as it will be used as a supporting point for suitable puller.



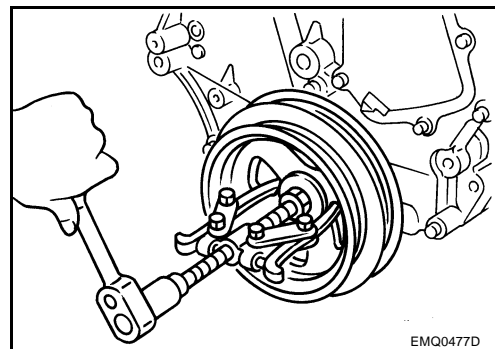
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FRONT TIMING CHAIN CASE

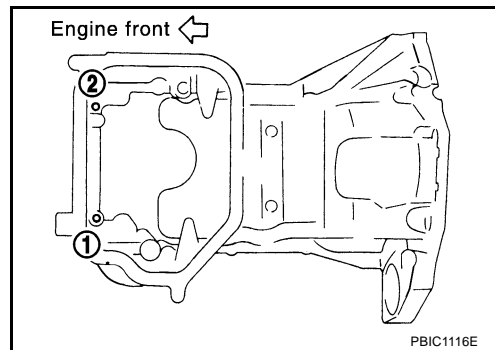
- c. Place suitable puller tab on holes of crankshaft pulley, and pull crankshaft pulley through.

CAUTION:

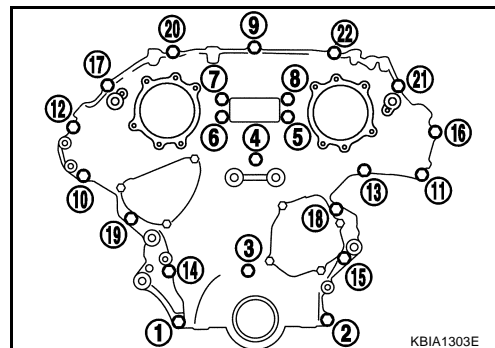
Do not put suitable puller tab on crankshaft pulley periphery, as this will damage internal damper.



15. Remove oil pan (lower). Refer to [EM-28, "OIL PAN AND OIL STRAINER"](#) .
16. Loosen two mounting bolts in front of oil pan (upper) in reverse order as shown in the figure.



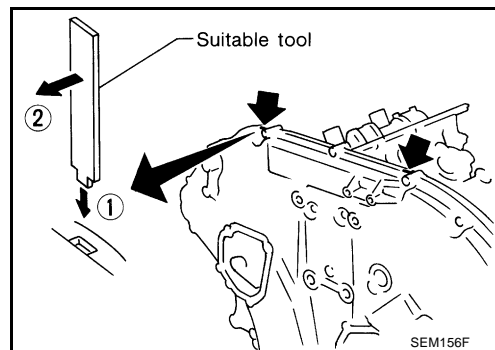
17. Remove front timing chain case as follows:
- a. Loosen mounting bolts in reverse order as shown in the figure.



- b. Insert suitable tool into the notch at the top of the front timing chain case as shown (1).
- c. Pry off case by moving tool as shown (2).
- Use seal cutter [SST: KV10111100 (J37228)] or equivalent tool to cut liquid gasket for removal.

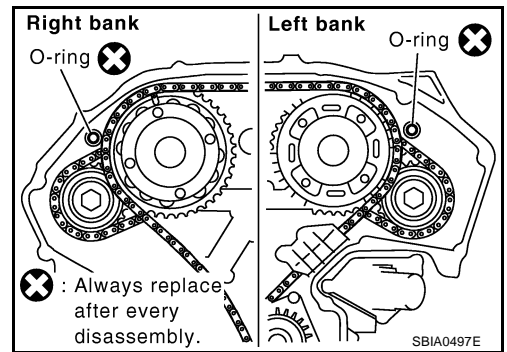
CAUTION:

- **Do not use flat-bladed screwdriver or something similar.**
- **After removal, handle front timing chain case carefully so it does not tilt, cant, or warp under a load.**



FRONT TIMING CHAIN CASE

18. Remove O-rings from rear timing chain case.



19. Remove oil pan gasket. Refer to [EM-28, "OIL PAN AND OIL STRAINER"](#) .

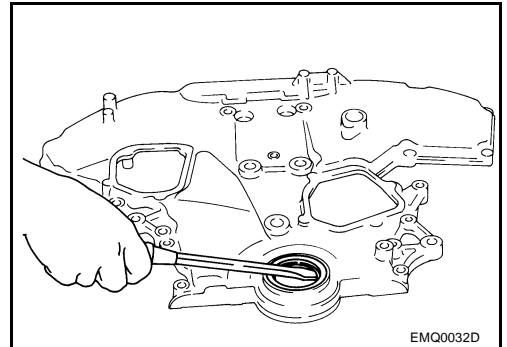
20. Remove water pump cover and chain tensioner cover from front timing chain case.

- Use seal cutter [SST: KV10111100 (J37228)] or equivalent tool to cut liquid gasket for removal.

21. Remove front oil seal from front timing chain case using suitable tool.

- Use flat-bladed screwdriver for removal.

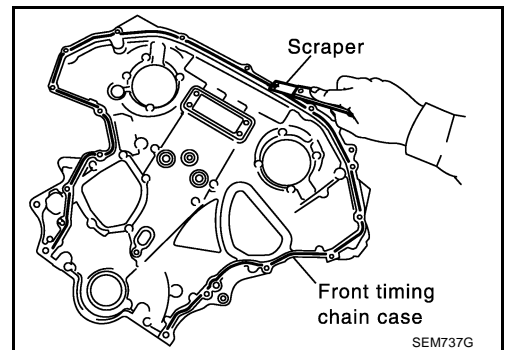
CAUTION:
Be careful not to damage front timing chain case.



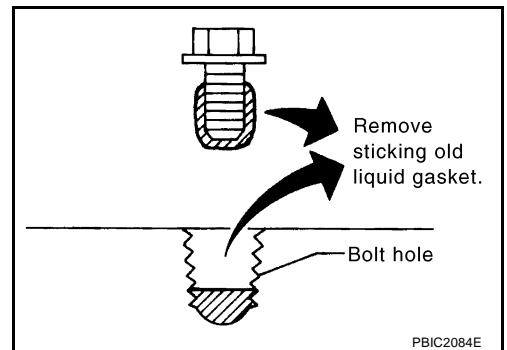
22. Remove timing chain (primary) and related parts. Refer to [EM-55, "TIMING CHAIN"](#) .

23. Use scraper to remove all traces of old liquid gasket from front and rear timing chain cases and oil pan (upper), and liquid gasket mating surfaces.

CAUTION:
Be careful not to allow gasket fragments to enter oil pan.



- Remove old liquid gasket from bolt hole and thread.

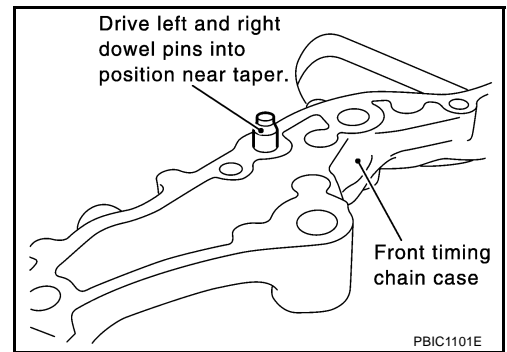


INSTALLATION

1. Install timing chain (primary) and related parts. Refer to [EM-55, "TIMING CHAIN"](#) .

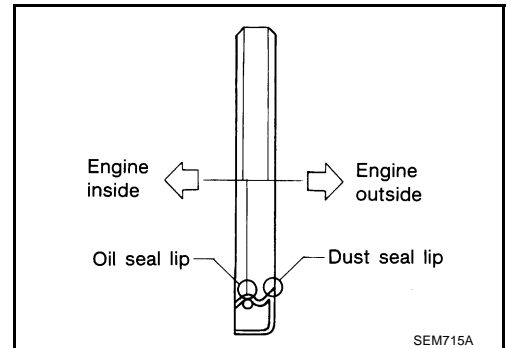
FRONT TIMING CHAIN CASE

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

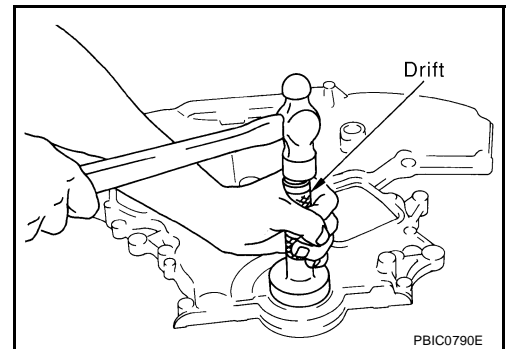


3. Install front oil seal on the front timing chain case. Apply new engine oil to the oil seal lip, dust seal lip and outer round of oil seal.

- Install it so that each seal lip is oriented as shown in the figure.



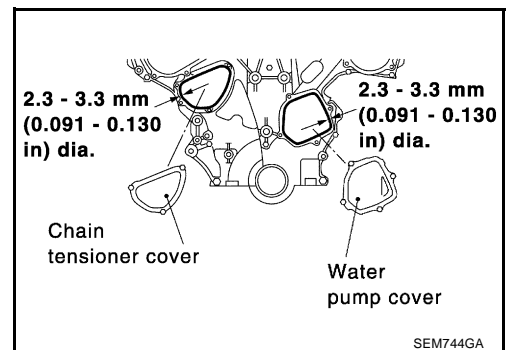
- Using suitable drift, press-fit oil seal until it becomes flush with front timing chain case end face.
- Make sure the garter spring is in position and seal lip is not inverted.



4. Install water pump cover and chain tensioner cover to front timing chain case.

- Apply a continuous bead of liquid gasket to front timing chain case as shown in the figure.

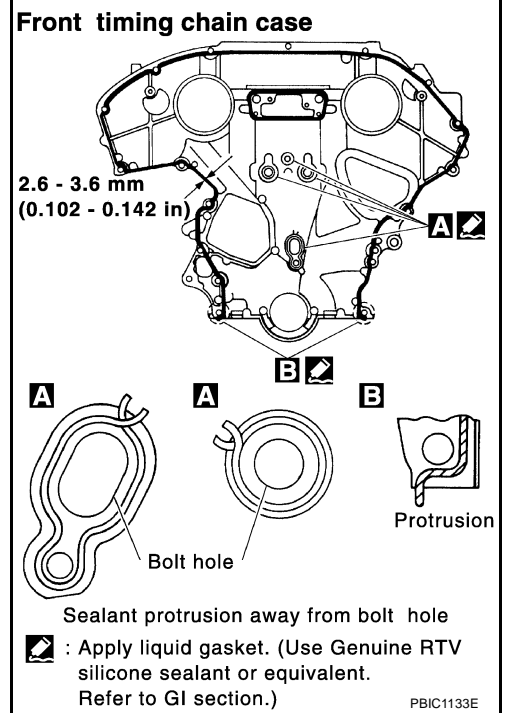
Use Genuine RTV Silicone Sealant or equivalent. Refer to [GI-46, "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS"](#) .



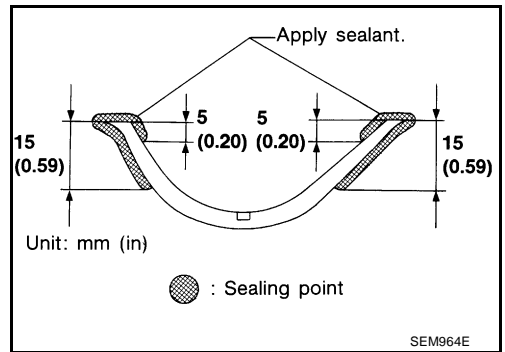
5. Install front timing chain case as follows:

FRONT TIMING CHAIN CASE

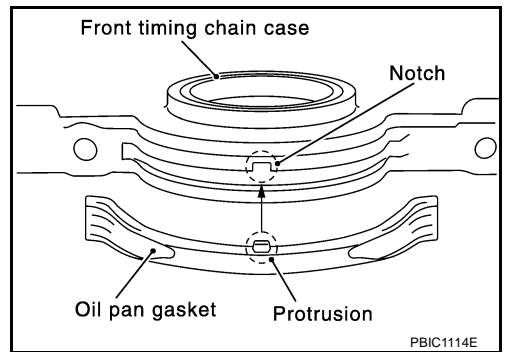
- a. Apply liquid gasket to front timing chain case back side as shown in the figure.
Use Genuine RTV Silicone Sealant or equivalent. Refer to [GI-46, "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS"](#).



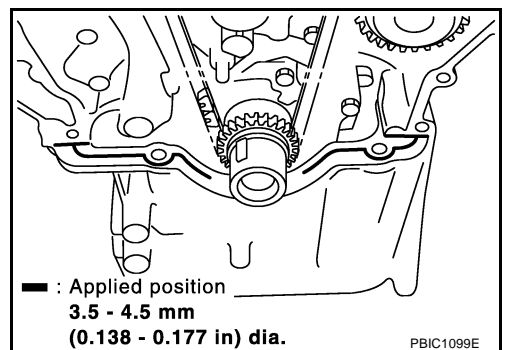
- b. Install oil pan gasket.
- Apply liquid gasket to oil pan gasket as shown in the figure.
Use Genuine RTV Silicone Sealant or equivalent. Refer to [GI-46, "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS"](#).



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



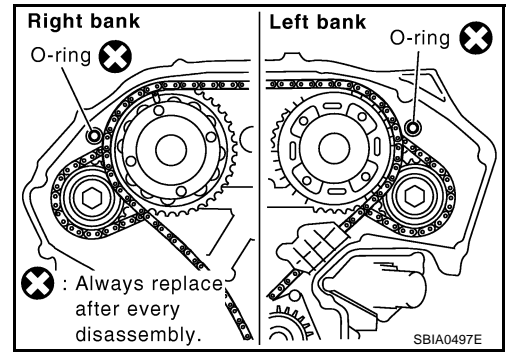
- Apply liquid gasket to top surface of oil pan (upper) as shown in the figure.
Use Genuine RTV Silicone Sealant or equivalent. Refer to [GI-46, "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS"](#).



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FRONT TIMING CHAIN CASE

c. Install new O-rings on rear timing chain case.

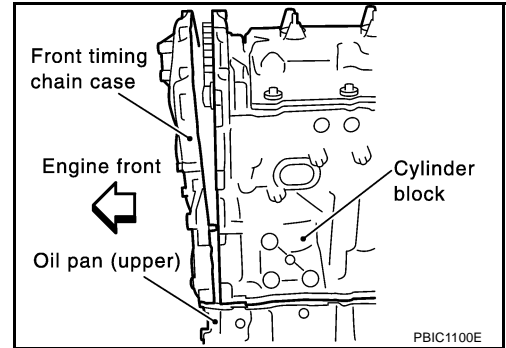


d. Assemble front timing chain case as follows:

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

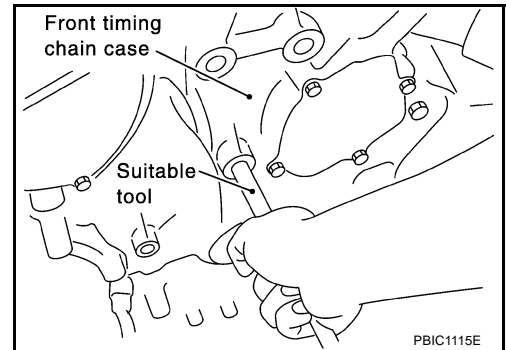
CAUTION:

Be careful that oil pan gasket is in place.



ii. Since front timing chain case is offset for difference of bolt holes, tight bolts temporarily with holding front timing chain case from front and top as shown in the figure.

iii. Same as the step ii, insert dowel pin with holding front timing chain case from front and top completely.



e. Tighten bolts to the specified torque in numerical order as shown in the figure.

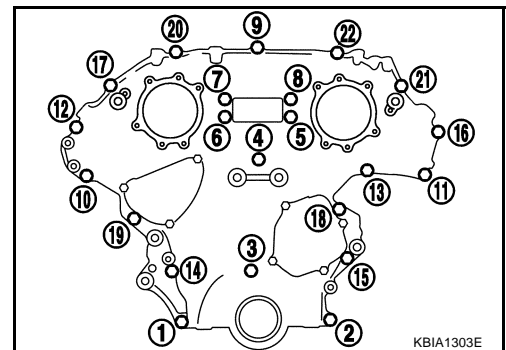
● There are two types of mounting bolts. Refer to the following for locating bolts.

M8 bolts : 1, 2

: 25.5 - 31.3 N·m (2.6 - 3.2 kg-m, 19 - 23 ft-lb)

M6 bolts : Except the above


: 11.7 - 13.7 N·m (1.2 - 1.4 kg-m, 9 - 10 ft-lb)

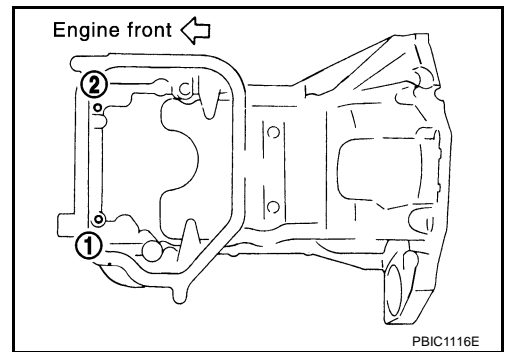


f. After all bolts tightened, retighten them to the specified torque in numerical order as shown in the figure.

FRONT TIMING CHAIN CASE

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

: 15.7 - 18.6 N·m (1.6 - 1.9 kg-m, 12 - 13 ft-lb)

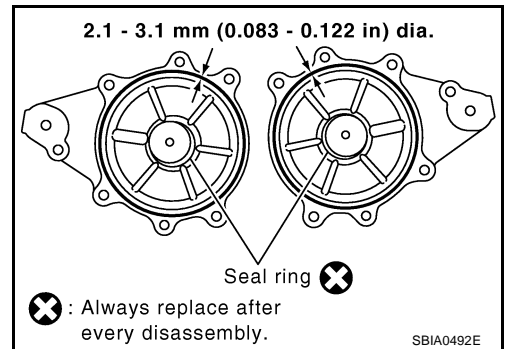


7. Install oil pan (lower). Refer to [EM-28, "OIL PAN AND OIL STRAINER"](#).

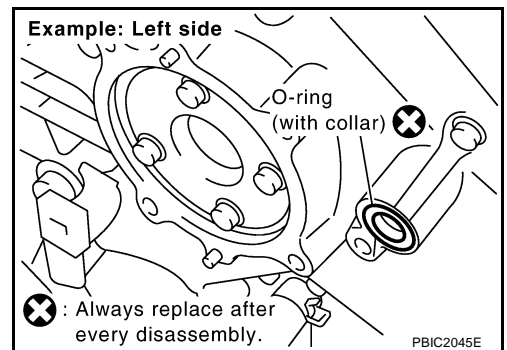
8. Install right and left intake valve timing control covers as follows:

a. Install seal rings in shaft grooves.

- b. Apply liquid gasket to the intake valve timing control covers.
Use Genuine RTV Silicone Sealant or equivalent. Refer to [GI-46, "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS"](#).

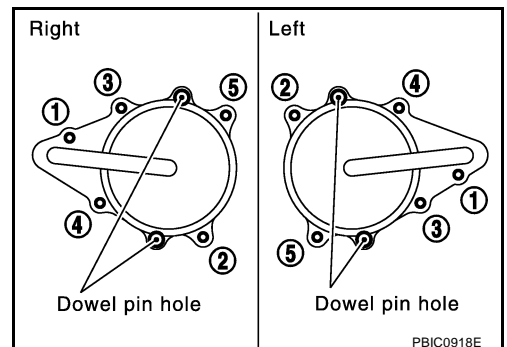


- c. Install collared O-ring in front timing chain case oil hole (left and right sides).



- d. Being careful not to move seal ring from the installation groove, align dowel pins on front timing chain case with the holes to install intake valve timing control covers.

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



9. Install crankshaft pulley as follows:


a. Fix crankshaft using ring gear stopper [SST: KV10117700 (J44716)].

b. Install crankshaft pulley, taking care not to damage front oil seal.

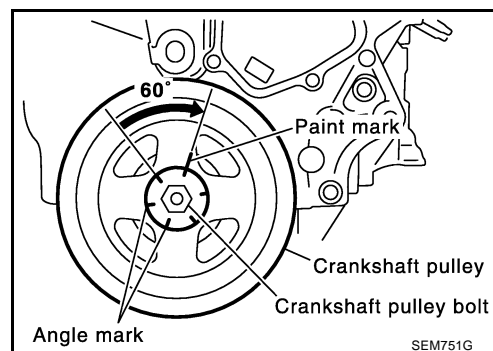
- When press-fitting crankshaft pulley with plastic hammer, tap on its center portion (not circumference).

FRONT TIMING CHAIN CASE

c. Tighten crankshaft pulley bolt.

: **39.2 - 49.0 N-m (4.0 - 5.0 kg-m, 29 - 36 ft-lb)**

d. Put a paint mark on crankshaft pulley aligning with angle mark on crankshaft pulley bolt. Then, further retighten bolt by 60 to 65 degrees [Target: 60 degrees (equivalent to one graduation)].



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

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

NOTE:

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

INSPECTION AFTER INSTALLATION

Inspection for Leaks

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

- Before starting engine, check oil/fluid levels including engine coolant and engine oil. If less than required quantity, fill to the specified level. Refer to [MA-9, "RECOMMENDED FLUIDS AND LUBRICANTS"](#).
- Use procedure below to check for fuel leakage.
 - Turn ignition switch "ON" (with engine stopped). With fuel pressure applied to fuel piping, check for fuel leakage at connection points.
 - Start engine. With engine speed increased, check again for fuel leakage at connection points.
- Run engine to check for unusual noise and vibration.

NOTE:

If hydraulic pressure inside 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 an unusualness. Noise will stop after hydraulic pressure rises.

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

Summary of the inspection items:

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

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

TIMING CHAIN

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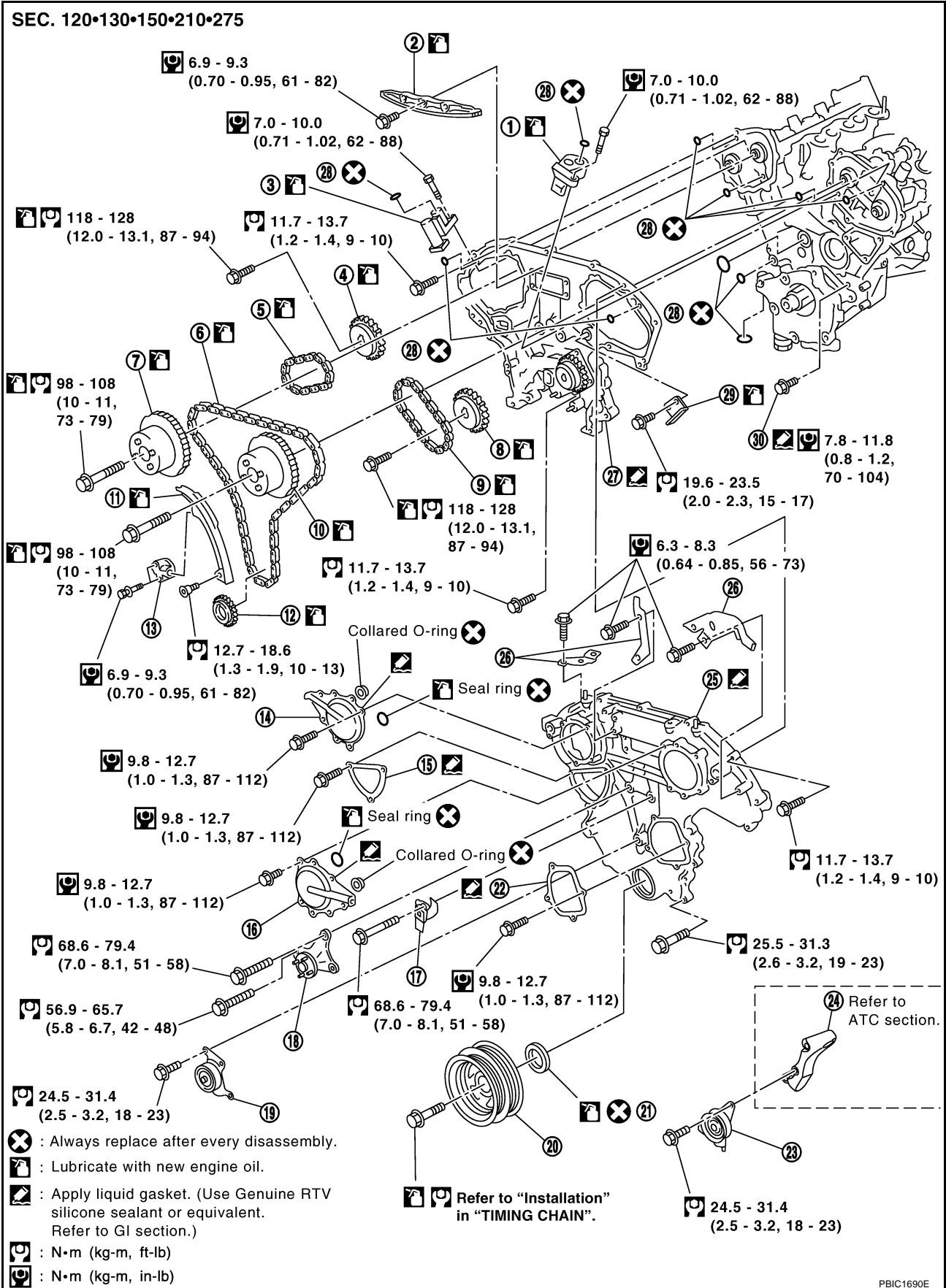
TIMING CHAIN

Removal and Installation

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TIMING CHAIN

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|---------------------------------------|---------------------------------------|---------------------------------------|
| 1. Timing chain tensioner (secondary) | 2. Internal chain guide | 3. Timing chain tensioner (secondary) |
| 4. Camshaft sprocket (EXH) | 5. Timing chain (secondary) | 6. Timing chain (primary) |
| 7. Camshaft sprocket (INT) | 8. Camshaft sprocket (EXH) | 9. Timing chain (secondary) |
| 10. Camshaft sprocket (INT) | 11. Slack guide | 12. Crankshaft sprocket |
| 13. Timing chain tensioner (primary) | 14. Intake valve timing control cover | 15. Chain tensioner cover |
| 16. Intake valve timing control cover | 17. Water hose clamp | 18. Idler pulley bracket |
| 19. Idler pulley | 20. Crankshaft pulley | 21. Front oil seal |
| 22. Water pump cover | 23. Idler pulley | 24. A/C compressor bracket |
| 25. Front timing chain case | 26. Bracket | 27. Rear timing chain case |
| 28. O-ring | 29. Tension guide | 30. Water drain plug |

NOTE:

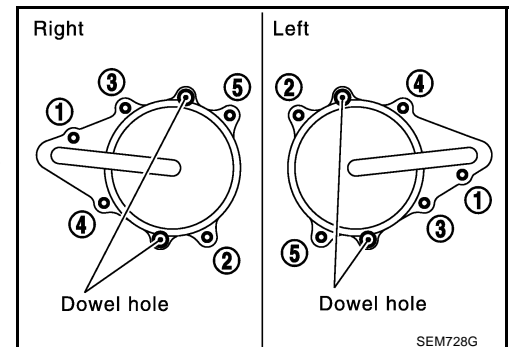
- This section describes procedures for removing/installing front timing chain case and timing chain related parts, and rear timing chain case, when oil pan (upper) needs to be removed/installed for engine overhaul, etc.
- To remove/install front timing chain case, timing chain, and its related parts without removing oil pan (upper), refer to [EM-46, "FRONT TIMING CHAIN CASE"](#).

REMOVAL

1. Remove engine cover with power tool. Refer to [EM-17, "INTAKE MANIFOLD COLLECTOR"](#).
2. Remove air cleaner case assembly. Refer to [EM-15, "AIR CLEANER AND AIR DUCT"](#).
3. Remove undercover with power tool.
4. Drain engine coolant from radiator. Refer to [CO-10, "Changing Engine Coolant"](#).
5. Drain engine oil. Refer to [LU-8, "Changing Engine Oil"](#).
6. Separate engine harnesses removing their brackets from front timing chain case.
7. Remove intake manifold collectors (upper and lower) with power tool. Refer to [EM-17, "INTAKE MANIFOLD COLLECTOR"](#).
8. Remove radiator cooling fan assembly. Refer to [CO-21, "COOLING FAN"](#).
9. Remove drive belts. Refer to [EM-13, "DRIVE BELTS"](#).
10. Remove A/C compressor from bracket with piping connected, and temporarily secure it aside. Refer to [ATC-140, "Components"](#).
11. Remove power steering oil pump from bracket with piping connected, and temporarily secure it aside. Refer to [PS-29, "POWER STEERING OIL PUMP"](#).
12. Remove power steering oil pump bracket. Refer to [PS-29, "POWER STEERING OIL PUMP"](#).
13. Remove alternator. Refer to [SC-21, "CHARGING SYSTEM"](#).
14. Remove water bypass hose, water hose clamp and idler pulley bracket from front timing chain case.
15. Remove right and left intake valve timing control covers.
 - Loosen bolts in reverse order as shown in the figure.
 - Use seal cutter [SST: KV10111100 (J37228)] or equivalent tool to cut liquid gasket for removal.

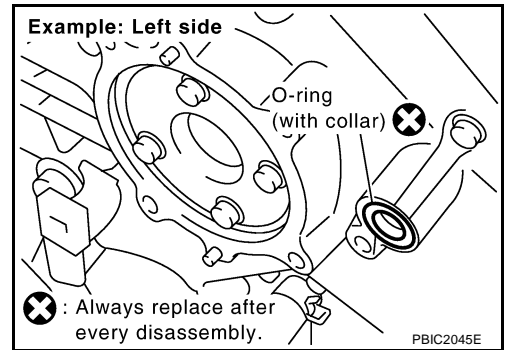
CAUTION:

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



TIMING CHAIN

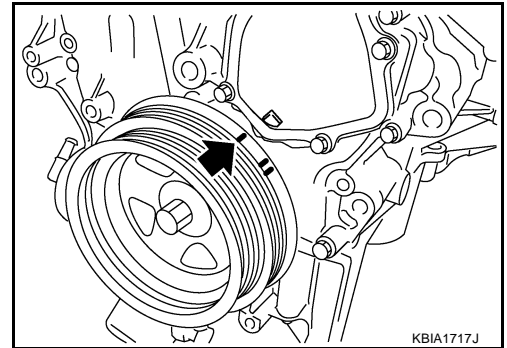
16. Remove collared O-ring from front timing chain case (left and right side).



17. Remove rocker covers (right and left banks) with power tool. Refer to [EM-43. "ROCKER COVER"](#) .

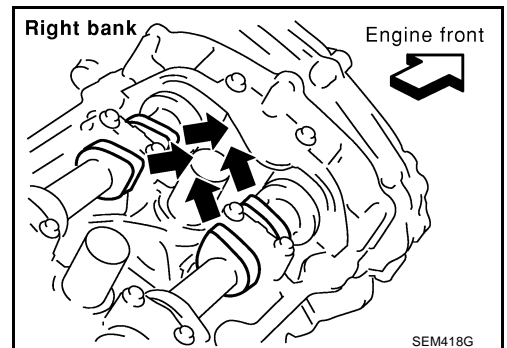
18. Obtain compression TDC of No. 1 cylinder as follows:

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



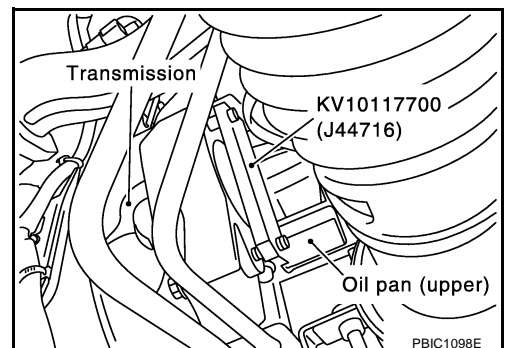
- b. Make sure that intake and exhaust cam noses on No. 1 cylinder (engine front side of right bank) are located as shown in the figure.

- If not, turn crankshaft one revolution (360 degrees) and align as shown in the figure.



19. Remove crankshaft pulley as follows:

- a. Remove starter motor and set ring gear stopper (SST) as shown in the figure. Refer to [SC-10. "STARTING SYSTEM"](#) .



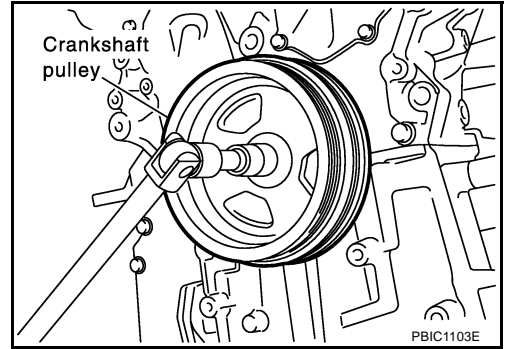
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TIMING CHAIN

- b. Loosen crankshaft pulley bolt and locate bolt seating surface at 10 mm (0.39 in) from its original position.

CAUTION:

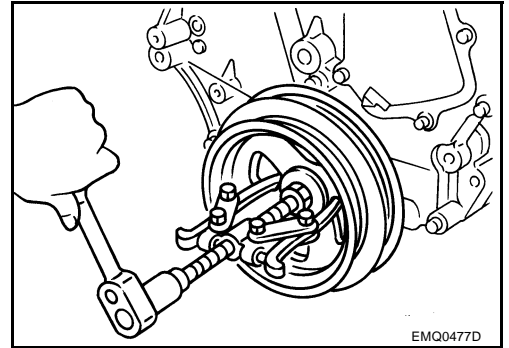
Do not remove crankshaft pulley bolt as it will be used as a supporting point for suitable puller.



- c. Place suitable puller tab on holes of crankshaft pulley, and pull crankshaft pulley through.

CAUTION:

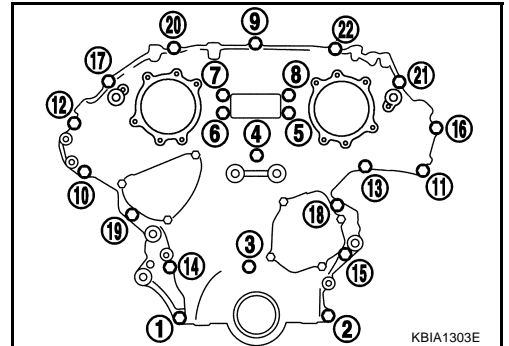
Do not put suitable puller tab on crankshaft pulley periphery, as this will damage internal damper.



20. Remove oil pans (upper and lower). Refer to [EM-28, "OIL PAN AND OIL STRAINER"](#).

21. Remove front timing chain case as follows:

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



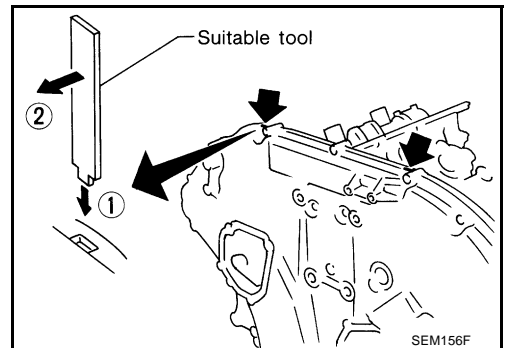
- b. Insert suitable tool into the notch at the top of the front timing chain case as shown (1).

- c. Pry off case by moving the tool as shown (2).

- Use seal cutter [SST: KV10111100 (J37228)] or equivalent tool to cut liquid gasket for removal.

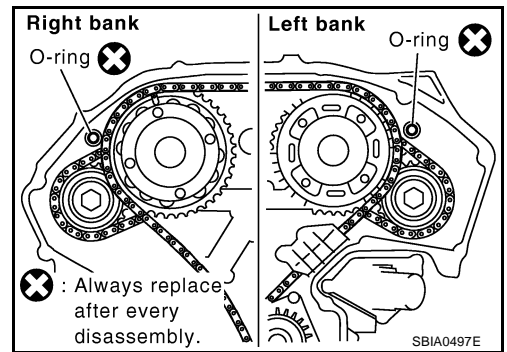
CAUTION:

- **Do not use flat-bladed screwdriver or something similar.**
- **After removal, handle front timing chain case carefully so it does not tilt, cant, or warp under a load.**



TIMING CHAIN

22. Remove O-rings from rear timing chain case.



23. Remove water pump cover and chain tensioner cover from front timing chain case.

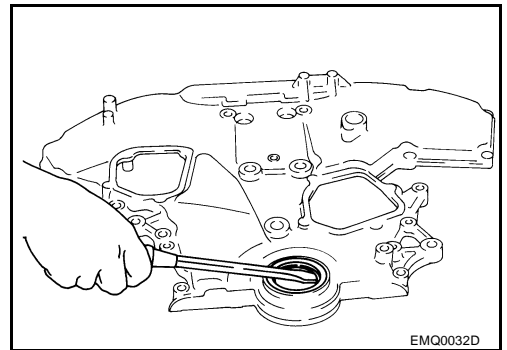
- Use seal cutter [SST: KV10111100 (J37228)] or equivalent tool to cut liquid gasket for removal.

24. Remove front oil seal from front timing chain case using suitable tool.

- Use flat-bladed screwdriver for removal.

CAUTION:

Be careful not to damage front timing chain case.



25. Remove timing chain tensioner (primary) as follows:

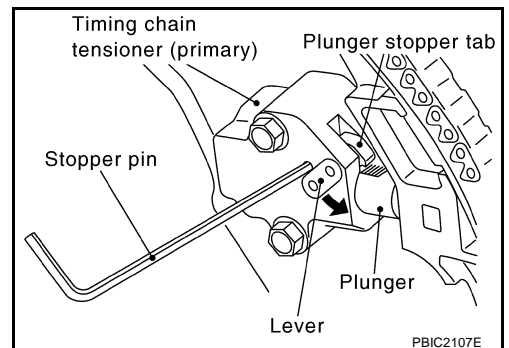
a. Pull lever down and release plunger stopper tab.

- Plunger stopper tab can be pushed up to release (coaxial structure with lever).

b. Insert stopper pin into tensioner body hole to hold lever, and keep tab released.

NOTE:

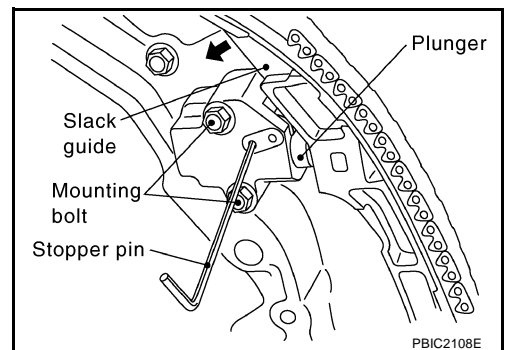
Allen wrench [2.5 mm (0.098 in)] is used for a stopper pin as an example.



c. Insert plunger into tensioner body by pressing slack guide.

d. Keep slack guide pressed and hold it by pushing stopper pin through the lever hole and body hole.

e. Remove mounting bolts and remove timing chain tensioner (primary).

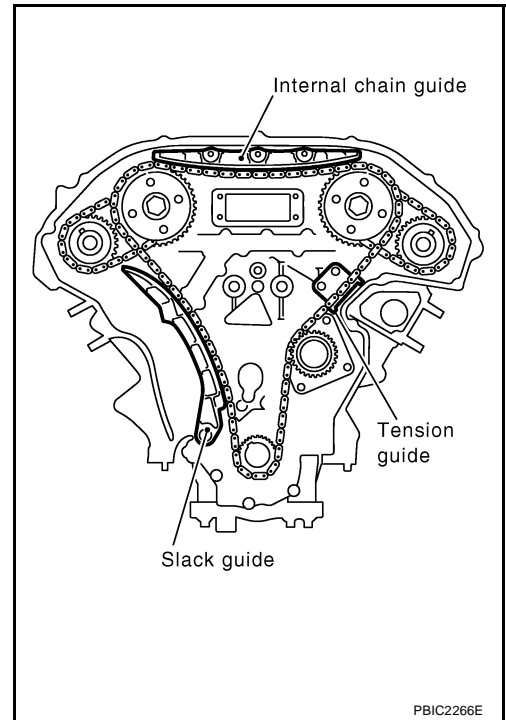


TIMING CHAIN

26. Remove internal chain guide, tension guide and slack guide.

NOTE:

Tension guide can be removed after removing timing chain (primary).



27. Remove timing chain (primary) and crankshaft sprocket.

CAUTION:

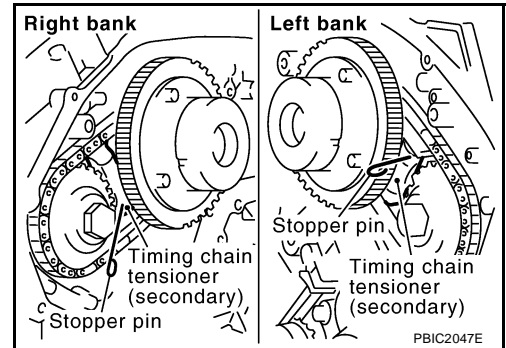
After removing timing chain (primary), do not turn crankshaft and camshaft separately, or valves will strike the piston heads.

28. Remove timing chain (secondary) and camshaft sprockets as follows:

- a. Attach suitable stopper pin to the right and left timing chain tensioners (secondary).

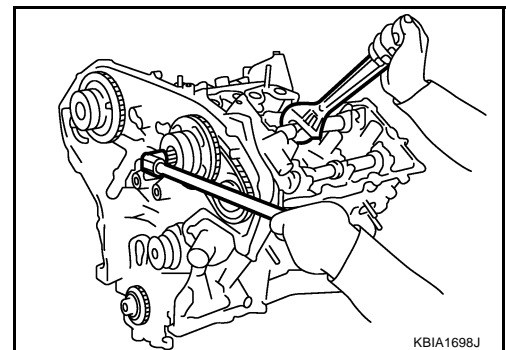
NOTE:

For removal of timing chain tensioner (secondary), refer to [EM-75. "CAMSHAFT"](#) . [Removing camshaft bracket (No. 1) is required.]



- b. Remove intake and exhaust camshaft sprocket bolts.

- Secure the hexagonal portion of camshaft using wrench to loosen mounting bolts.



- c. Remove timing chain (secondary) together with camshaft sprockets.

- Turn camshaft slightly to secure slackness of timing chain (secondary) on timing chain tensioner (secondary) side.

TIMING CHAIN

- Insert 0.5 mm (0.020 in)-thick metal or resin plate between timing chain and timing chain tensioner plunger (guide). Remove timing chain (secondary) together with camshaft sprockets with timing chain loose from guide groove.

CAUTION:

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

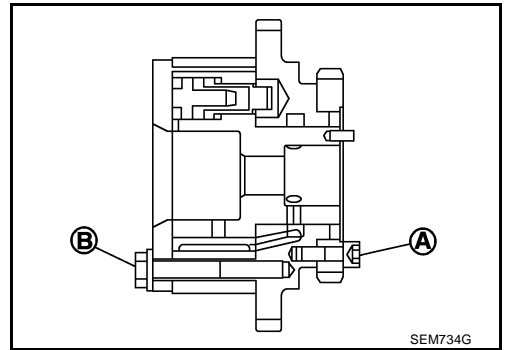
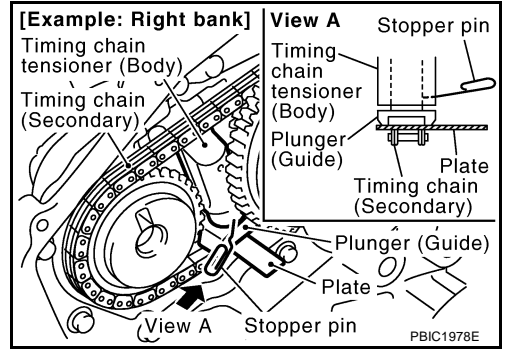
NOTE:

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

- When handling camshaft sprocket (INT), be careful of the following:

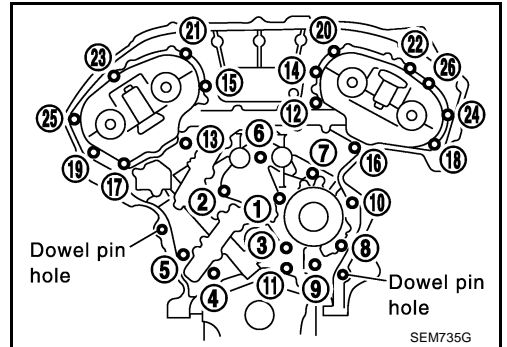
CAUTION:

- Handle carefully to avoid any shock to camshaft sprocket.
- Do not disassemble. (Do not loosen bolts "A" and "B" as shown in the figure).



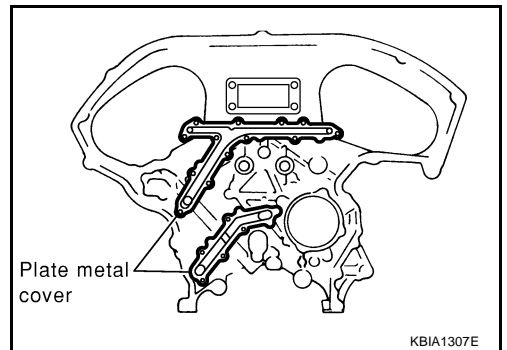
29. Remove rear timing chain case as follows:

- Loosen and remove mounting bolts in reverse order as shown in the figure.
- Cut sealant using seal cutter [SST: KV10111100 (J37228)] or equivalent tool and remove rear timing chain case.



CAUTION:

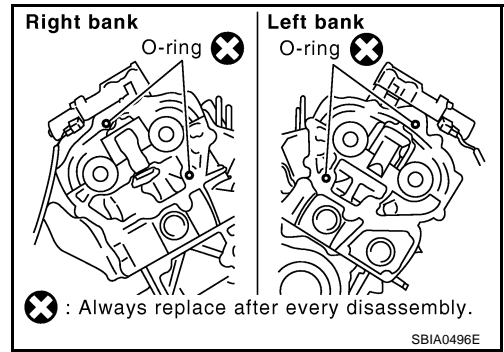
- Do not remove plate metal cover of oil passage.
- After removal, handle rear timing chain case carefully so it does not tilt, cant, or warp under a load.



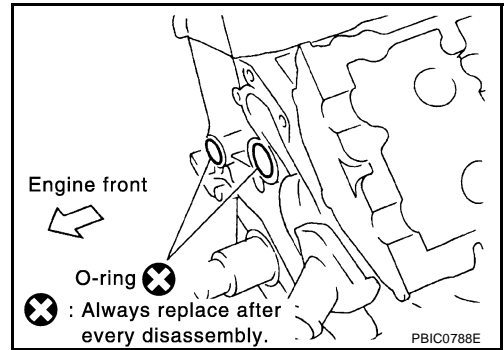
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TIMING CHAIN

30. Remove O-rings from cylinder head.



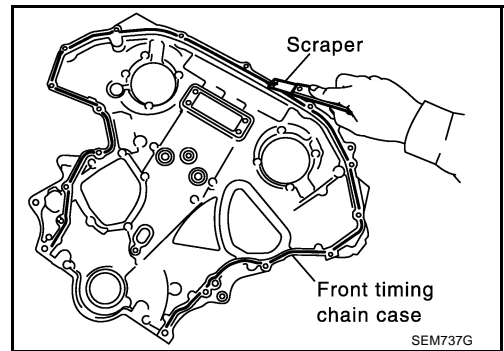
31. Remove O-rings from cylinder block.



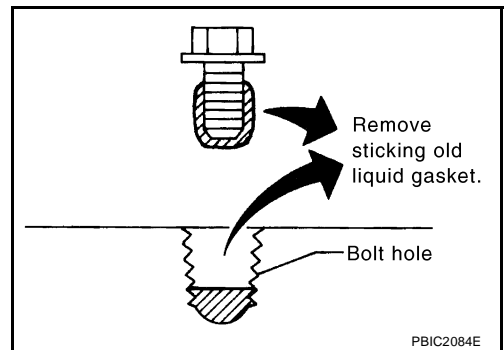
32. Remove timing chain tensioners (secondary) from cylinder head as follows, if necessary.

- a. Remove camshaft brackets (No. 1). Refer to [EM-76, "REMOVAL"](#).
- b. Remove timing chain tensioners (secondary) with stopper pin attached.

33. Use scraper to remove all traces of liquid gasket from front and rear timing chain cases, and opposite mating surfaces.

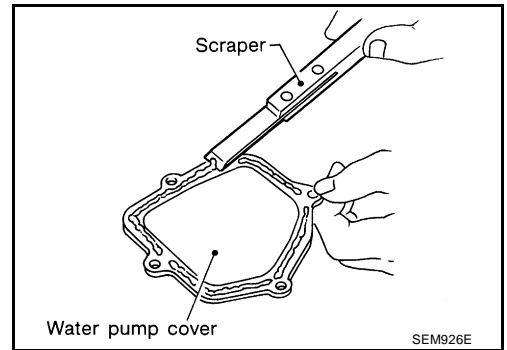


- Remove old liquid gasket from bolt hole and thread.



TIMING CHAIN

34. Use scraper to remove all traces of liquid gasket from water pump cover, chain tensioner cover and intake valve timing control covers.



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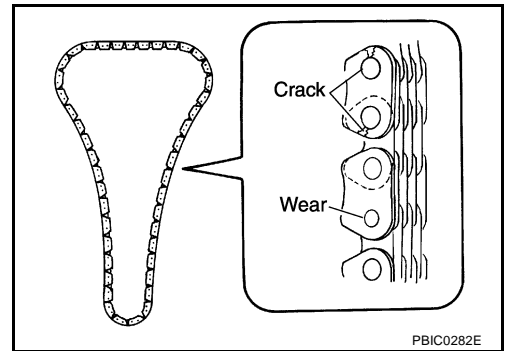
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INSPECTION AFTER REMOVAL

Timing Chain

Check for cracks and any excessive wear at the roller links of timing chain. Replace timing chain as necessary.



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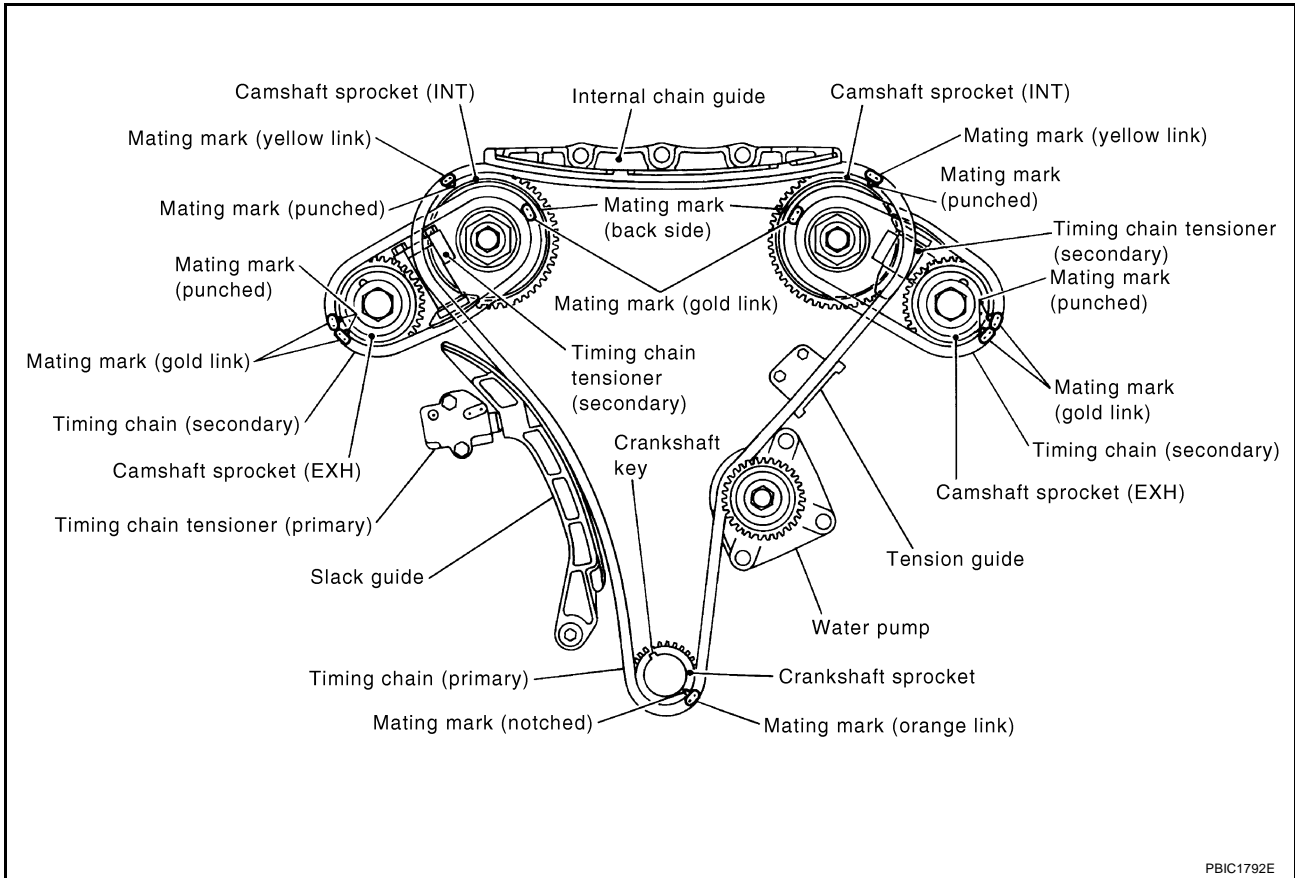
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TIMING CHAIN

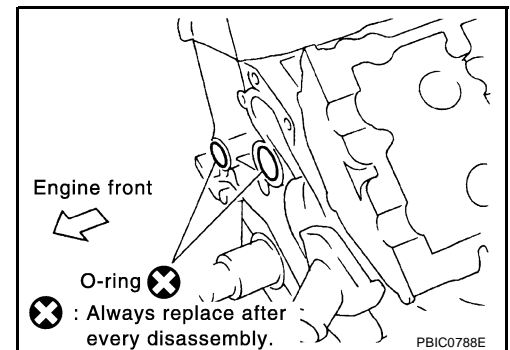
INSTALLATION

NOTE:

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

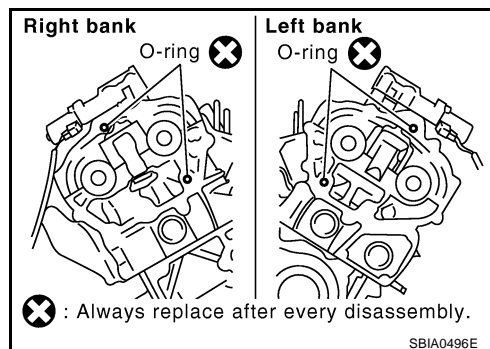


1. Install timing chain tensioners (secondary) to cylinder head as follows if removed. Refer to [EM-80, "INSTALLATION"](#).
 - a. Install timing chain tensioners (secondary) with stopper pin attached and new O-ring.
 - b. Install camshaft brackets (No. 1). Refer to [EM-80, "INSTALLATION"](#).
2. Install rear timing chain case as follows:-
 - a. Install O-rings onto cylinder block.



TIMING CHAIN

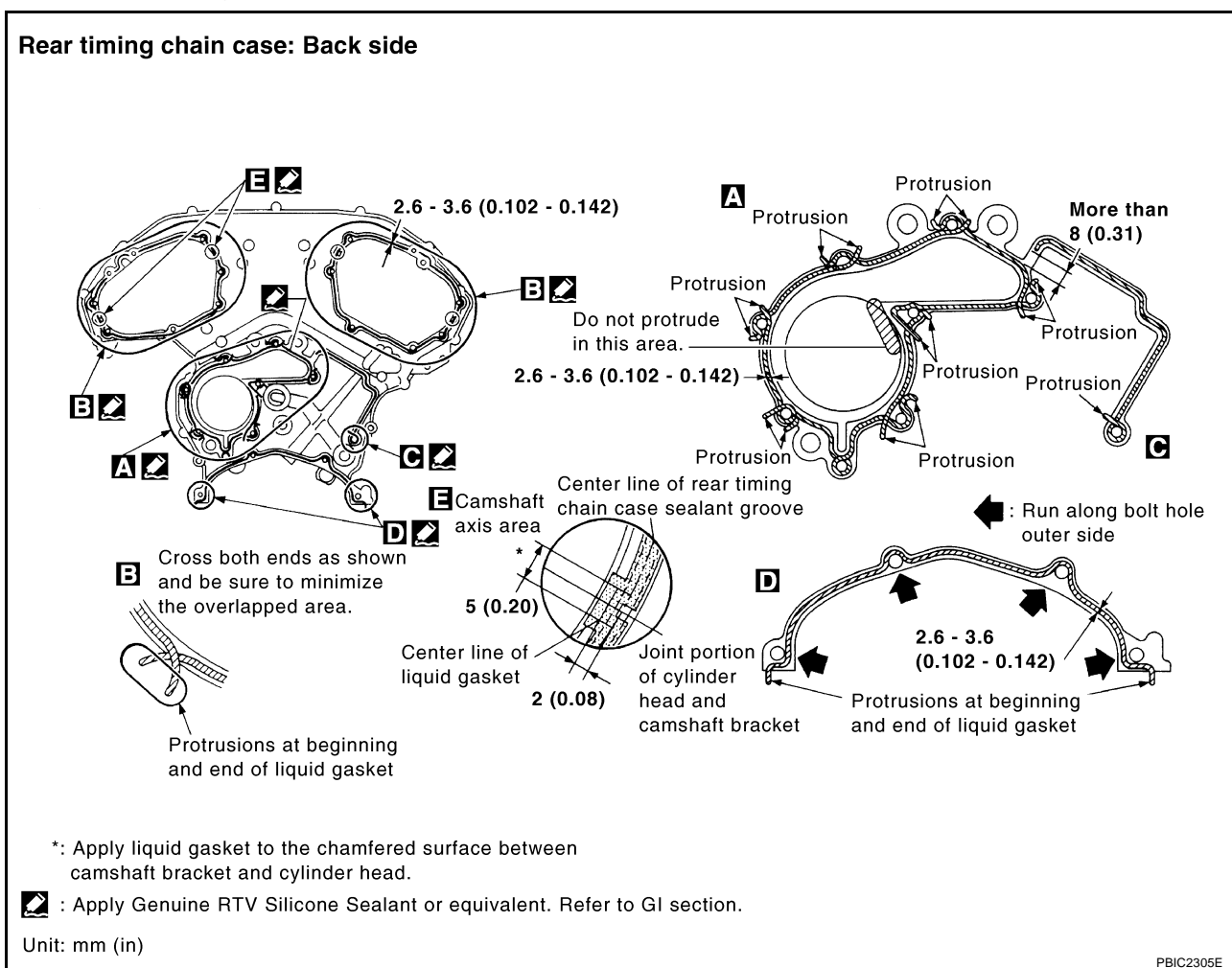
b. Install O-rings to cylinder head.



c. Apply liquid gasket to rear timing chain case back side as shown in the figure.
Use Genuine RTV Silicone Sealant or equivalent. Refer to [GI-46, "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS"](#) .

CAUTION:

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



d. Align rear timing chain case and water pump assembly with dowel pins (right and left) on cylinder block and install rear timing chain case.


- Make sure O-rings stay in place during installation to cylinder block and cylinder head.

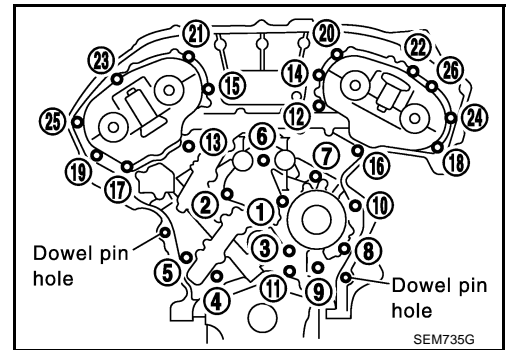
TIMING CHAIN

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

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

Bolt length:	Bolt position
20 mm (0.79 in)	: 1, 2, 3, 6, 7, 8, 9, 10
16 mm (0.63 in)	: Except the above

: 11.7 - 13.7 N·m (1.2 - 1.4 kg·m, 9 - 10 ft·lb)



- f. After all bolts are tightened, retighten them to the specified in numerical order shown in the figure.

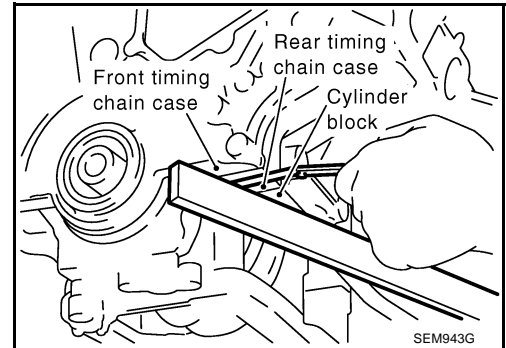
- If the RTV Silicone Sealant protrudes, wipe it off immediately.

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

Standard

Rear timing chain case to cylinder block:
-0.24 to 0.14 mm (-0.0094 to 0.0055 in)

- If out of the standard, repeat the installation procedure.



3. Install tension guide.

4. Position crankshaft so No. 1 piston is set at TDC on the compression stroke.

- Make sure that dowel pin hole, dowel pin and crankshaft key are located as shown in the figure.

NOTE:

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

Camshaft dowel pin hole (intake side)

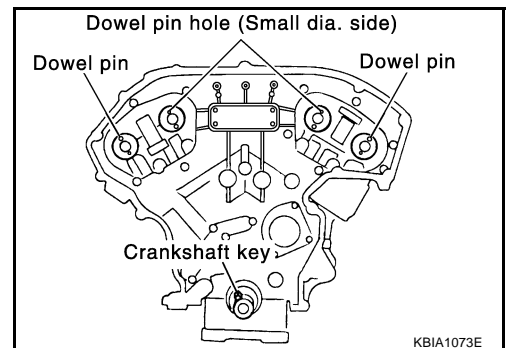
: At cylinder head upper face side in each bank.

Camshaft dowel pin (exhaust side)

: At cylinder head upper face side in each bank.

Crankshaft key

: At cylinder head side of right bank.



CAUTION:

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

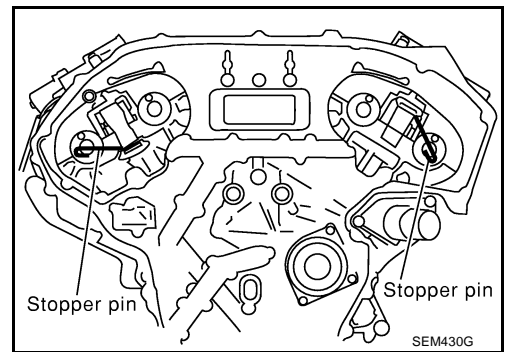
5. Install timing chains (secondary) and camshaft sprockets as follows:

CAUTION:

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

TIMING CHAIN

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



- b. Install timing chains (secondary) and camshaft sprockets.

- Align the mating marks on timing chain (secondary) (gold link) with the ones on intake and exhaust camshaft sprockets (punched), and install them.

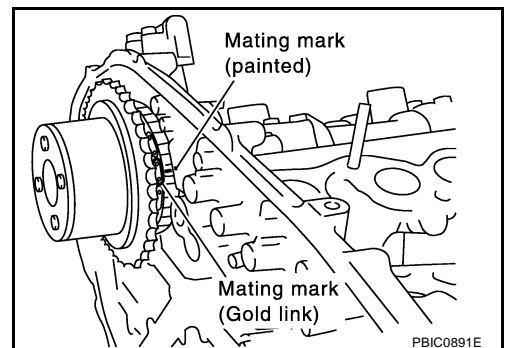
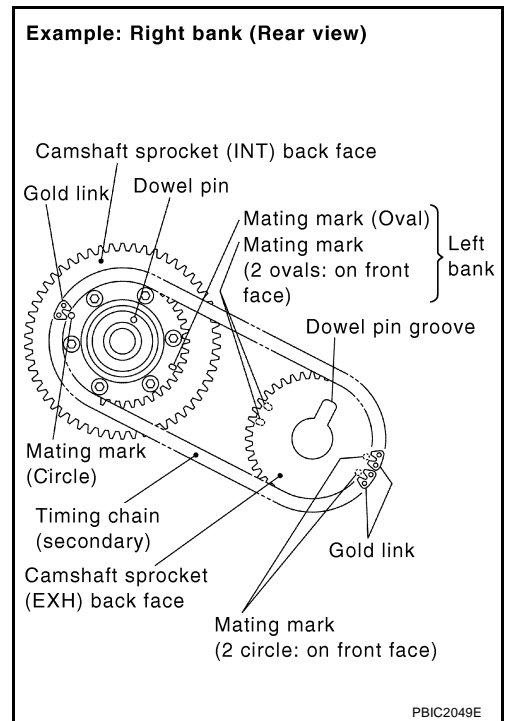
NOTE:

- Mating marks for intake camshaft sprocket are on the back side of camshaft sprocket (secondary).
- There are two types of mating marks, circle and oval types. They should be used for the right and left banks, respectively.

right bank : Use circle type.

left bank : Use oval type.

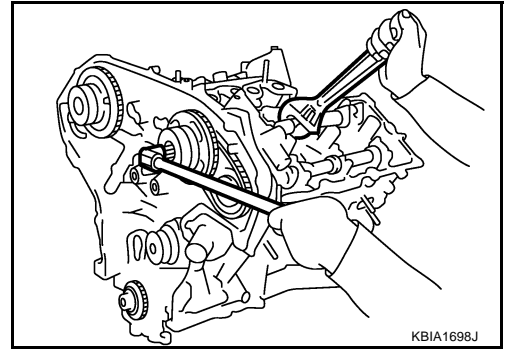
- Align dowel pin and pin hole on camshafts with the groove and dowel pin on sprockets, and install them.
- On the intake side, align pin hole on the small diameter side of the camshaft front end with dowel pin on the back side of camshaft sprocket, and install them.
- On the exhaust side, align dowel pin on camshaft front end with pin groove on camshaft sprocket, and install them.
- In a case that positions of each mating mark and each dowel pin are not fit on mating parts, make fine adjustment to the position holding the hexagonal portion on camshaft with wrench or equivalent.
- Mounting bolts for camshaft sprockets must be tightened in the next step. Tightening them by hand is enough to prevent the dislocation of dowel pins.
- It may be difficult to visually check the dislocation of mating marks during and after installation. To make the matching easier, make a mating mark on the top of sprocket teeth and its extended line in advance with paint.



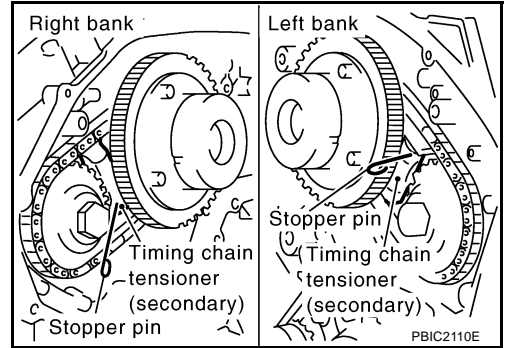
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TIMING CHAIN

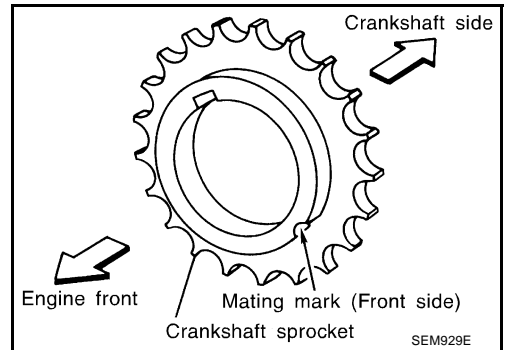
- c. After confirming the mating marks are aligned, tighten camshaft sprocket mounting bolts.
- Secure camshaft using wrench at the hexagonal portion to tighten mounting bolts.



- d. Pull stopper pins out from timing chain tensioners (secondary).



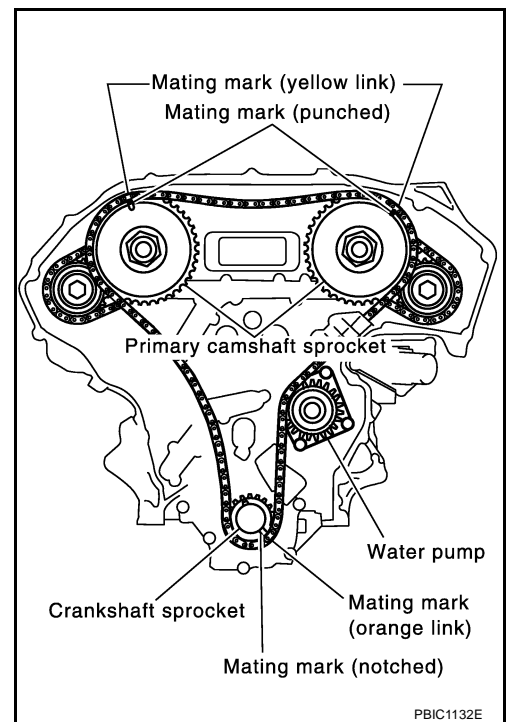
6. Install timing chain (primary) as follows:
- a. Install crankshaft sprocket.
- Make sure the mating marks on crankshaft sprocket face the front of engine.



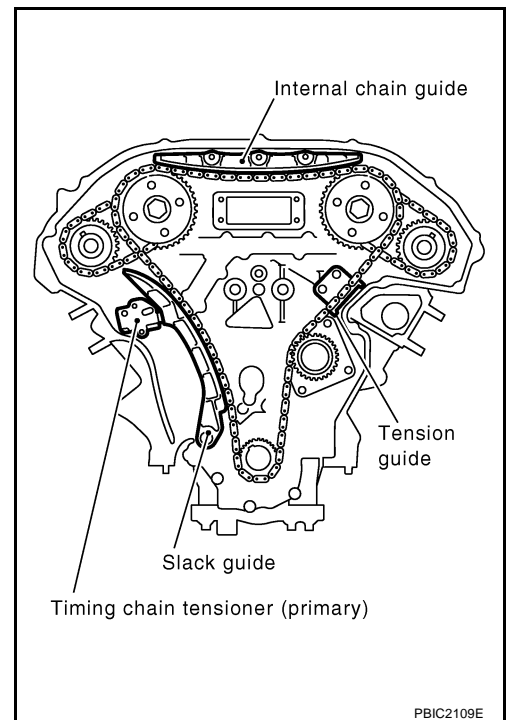
- b. Install timing chain (primary).

TIMING CHAIN

- Install timing chain (primary) so the mating mark (punched) on camshaft sprocket is aligned with the yellow link on timing chain, while the mating mark (notched) on crankshaft sprocket is aligned with the orange one on timing chain, as shown in the figure.
- When it is difficult to align mating marks of timing chain (primary) with each sprocket, gradually turn camshaft using wrench on the hexagonal portion to align it with the mating marks.
- During alignment, be careful to prevent dislocation of mating mark alignments of timing chains (secondary).



7. Install internal chain guide and slack guide.



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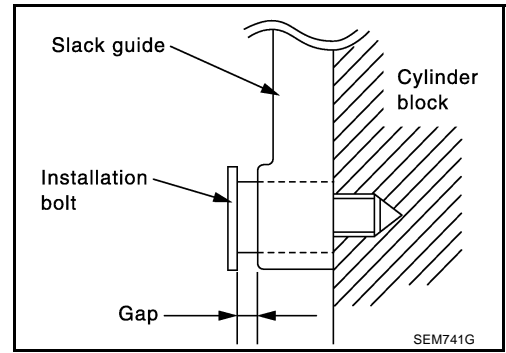
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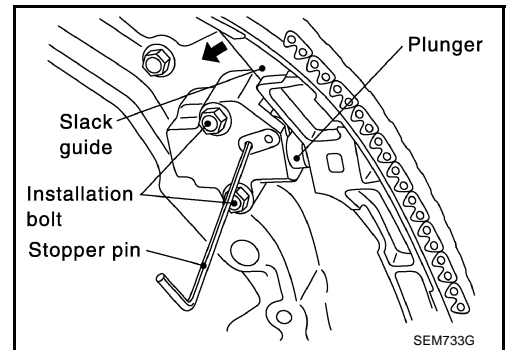
TIMING CHAIN

CAUTION:

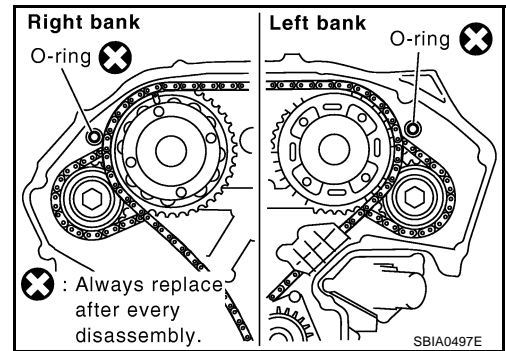
Do not overtighten slack guide mounting bolts. It is normal for a gap to exist under the bolt seats when mounting bolts are tightened to specification.



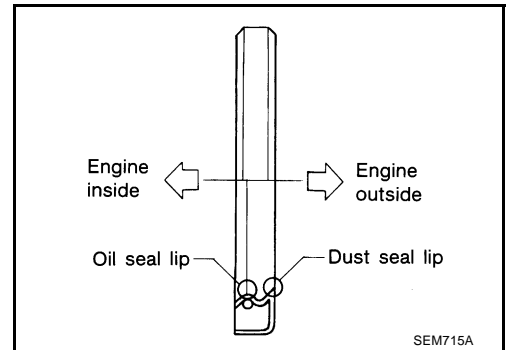
- When installing timing chain tensioner (primary), push in plunger and keep it pressed in with stopper pin.
- Remove any dirt and foreign materials completely from the back and the mounting surfaces of chain tensioner.
- After installation, pull out stopper pin by pressing slack guide.



8. Make sure again that the mating marks on sprockets and timing chain have not slipped out of alignment.
9. Install new O-rings on rear timing chain case.

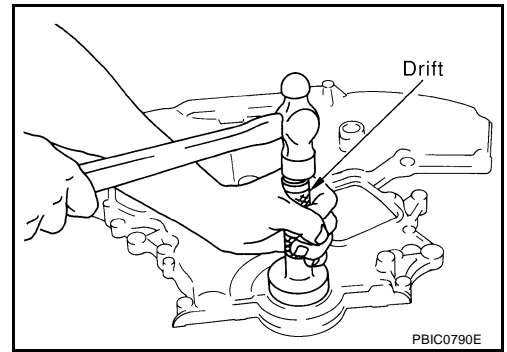


10. Install front oil seal on front timing chain case. Apply new engine oil to the oil seal lip, dust seal lip and outer round of oil seal.
 - Install it so that each seal lip is oriented as shown in the figure.



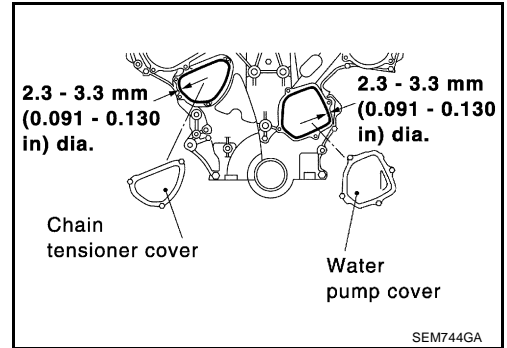
TIMING CHAIN

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



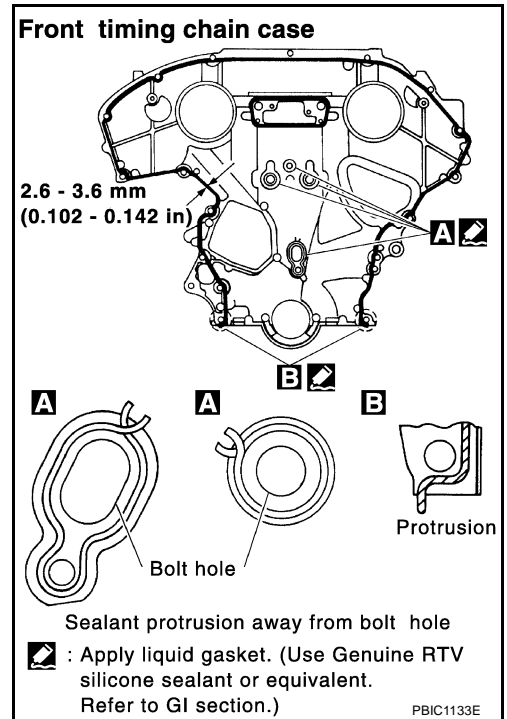
11. Install water pump cover and chain tensioner cover to front timing chain case.

- Apply a continuous bead of liquid gasket with tube presser [SST: WS39930000 (—)] to front timing chain case as shown in the figure.
Use Genuine RTV Silicone Sealant or equivalent. Refer to [GI-46, "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS"](#) .



12. Install front timing chain case as follows:

- Apply liquid gasket to front timing chain case back side as shown in the figure.
Use Genuine RTV Silicone Sealant or equivalent. Refer to [GI-46, "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS"](#) .
- Install dowel pin on rear timing chain case into dowel pin hole on front timing chain case.




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TIMING CHAIN


- c. Tighten bolts to the specified torque in numerical order as shown in the figure.

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

M8 bolts : 1, 2

: 25.5 - 31.3 N·m (2.6 - 3.2 kg-m, 19 - 23 ft-lb)

M6 bolts : Except the above

: 11.7 - 13.7 N·m (1.2 - 1.4 kg-m, 9 - 10 ft-lb)

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

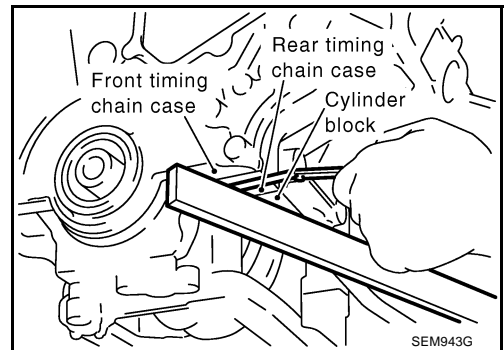
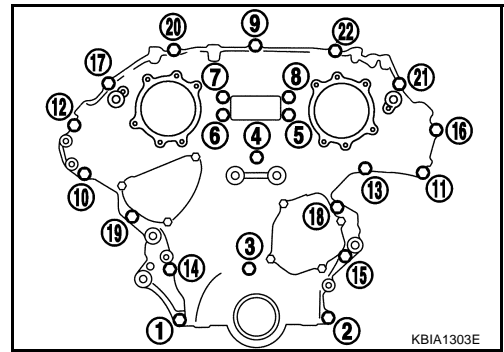
- e. After installing front timing chain case, check surface height difference between the following parts on the oil pan (upper) mounting surface.

Standard

Front timing chain case to rear timing chain case:

-0.14 to 0.14 mm (-0.005 to 0.0055 in)

- If out of the standard, repeat the installation procedure.

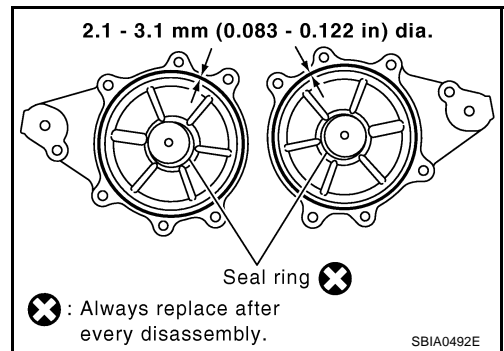


13. Install right and left intake valve timing control covers as follows:

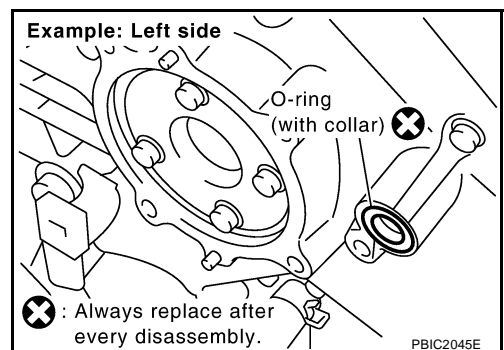
- a. Install seal rings in shaft grooves.

- b. Apply liquid gasket to intake valve timing control covers as shown in the figure.

Use Genuine RTV Silicone Sealant or equivalent. Refer to [GI-46, "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS"](#).



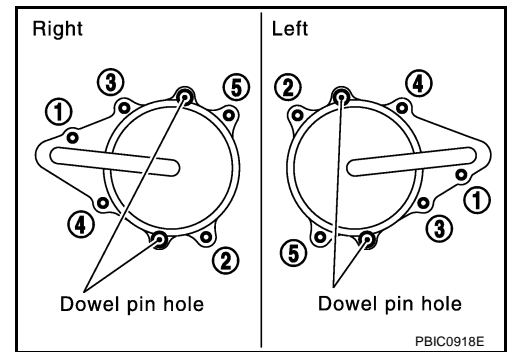
- c. Install collared O-ring in front timing chain case oil hole (left and right sides).



- d. Being careful not to move seal ring from the installation groove, align dowel pins on front timing chain case with holes to install intake valve timing control covers.

TIMING CHAIN

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



14. Install oil pans (upper and lower). Refer to [EM-28, "OIL PAN AND OIL STRAINER"](#) .

15. Install rocker covers (right and left banks). Refer to [EM-43, "ROCKER COVER"](#) .


16. Install crankshaft pulley as follows:

a. Fix crankshaft using ring gear stopper [SST: KV10117700 (J44716)].

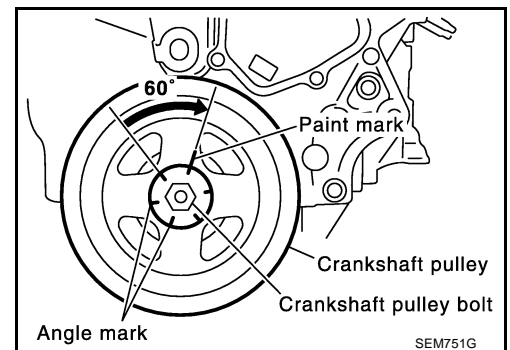
b. Install crankshaft pulley, taking care not to damage front oil seal.

- When press-fitting crankshaft pulley with plastic hammer, tap on its center portion (not circumference).

c. Tighten crankshaft pulley bolt.

: **39.2 - 49.0 N·m (4.0 - 5.0 kg·m, 29 - 36 ft·lb)**

d. Put a paint mark on crankshaft pulley aligning with angle mark on crankshaft pulley bolt. Then, further retighten bolt by 60 to 65 degrees [Target: 60 degrees (equivalent to one graduation)].



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

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

NOTE:

If hydraulic pressure inside timing chain tensioner drops after removal/installation, slack in guide may generate a pounding noise during and just after engine start. However, this does not indicate an unusualness. Noise will stop after hydraulic pressure rises.

TIMING CHAIN

INSPECTION AFTER INSTALLATION

Inspection for Leaks

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

- Before starting engine, check oil/fluid levels including engine coolant and engine oil. If less than required quantity, fill to the specified level. Refer to [MA-9, "RECOMMENDED FLUIDS AND LUBRICANTS"](#) .
- Use procedure below to check for fuel leakage.
 - Turn ignition switch "ON" (with engine stopped). With fuel pressure applied to fuel piping, check for fuel leakage at connection points.
 - Start engine. With engine speed increased, check again for fuel leakage at connection points.
- Run engine to check for unusual noise and vibration.

NOTE:

If hydraulic pressure inside 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 an unusualness. Noise will stop after hydraulic pressure rises.

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

Summary of the inspection items:

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

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

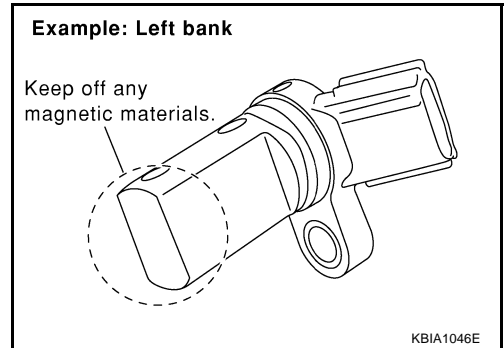
CAMSHAFT

REMOVAL

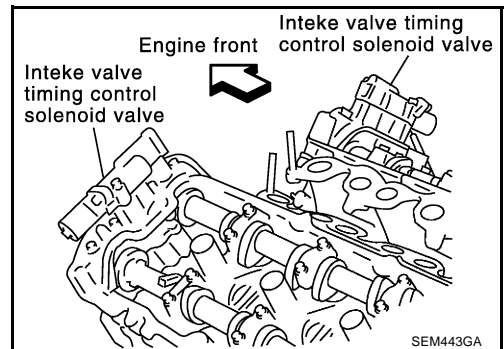
1. Remove front timing chain case, camshaft sprocket, timing chain and rear timing chain case. Refer to [EM-55. "TIMING CHAIN"](#).
2. Remove camshaft position sensor (PHASE) (right and left banks) from cylinder head back side.

CAUTION:

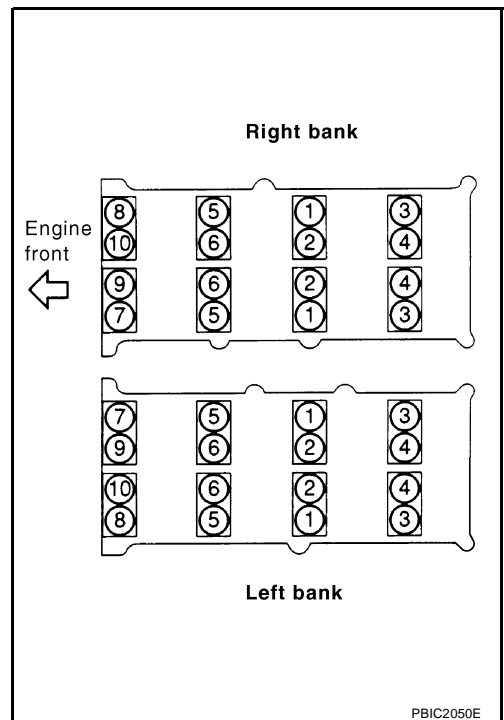
- Handle carefully to avoid dropping and shocks.
- Do not disassemble.
- Do not allow metal powder to adhere to magnetic part at sensor tip.
- Do not place sensors in a location where they are exposed to magnetism.



3. Remove intake valve timing control solenoid valves.
 - Discard intake valve timing control solenoid valve gaskets and use new gaskets for installation.



4. Remove intake and exhaust camshaft brackets.
 - Mark camshafts, camshaft brackets, and bolts so they are placed in the same position and direction for installation.
 - Equally loosen camshaft bracket bolts in several steps in reverse order shown in the figure.



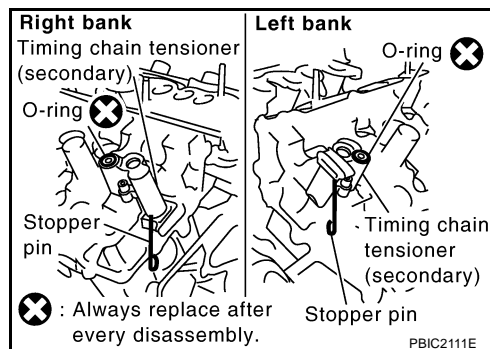
5. Remove camshaft.
6. Remove valve lifter.
 - Identify installation positions, and store them without mixing them up.

CAMSHAFT

- Remove timing chain tensioner (secondary) from cylinder head.
 - Remove timing chain tensioner (secondary) with its stopper pin attached.

NOTE:

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



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INSPECTION AFTER REMOVAL

Camshaft Runout

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

CAUTION:

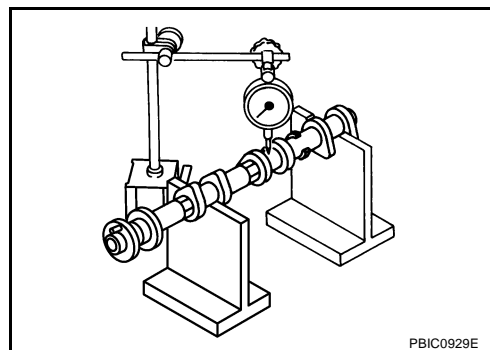
Do not support journal No. 1 (on the side of camshaft sprocket) because it has a different diameter from the other three locations.

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

Standard : Less than 0.02 mm (0.001 in)

Limit : 0.05 mm (0.002 in)

- If it exceeds the limit, replace camshaft.



Camshaft Cam Height

- Measure the camshaft cam height with micrometer.

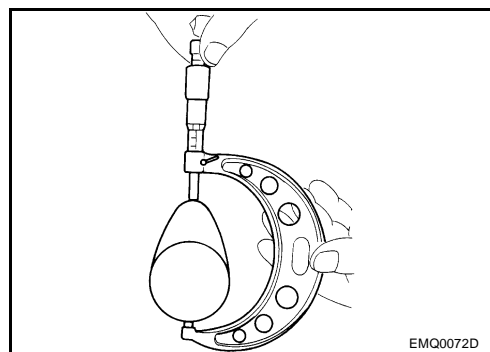
Standard cam height (intake and exhaust)

: 44.865 - 45.055 mm (1.7663 - 1.7738 in)

Cam wear limit

: 0.2 mm (0.008 in)

- If wear is beyond the limit, replace camshaft.



Camshaft Journal Oil Clearance

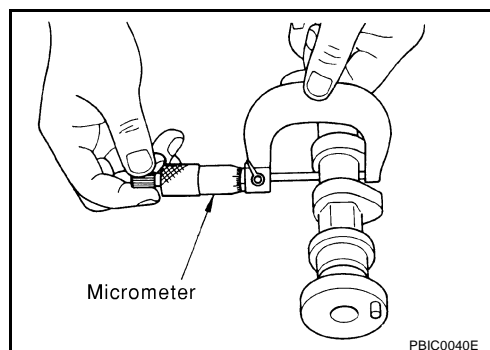
CAMSHAFT JOURNAL DIAMETER

- Measure the outer diameter of camshaft journal with micrometer.

Standard:

No. 1 : 25.935 - 25.955 mm (1.0211 - 1.0218 in)

No. 2, 3, 4 : 23.445 - 23.465 mm (0.9230 - 0.9238 in)



CAMSHAFT BRACKET INNER DIAMETER

- Tighten camshaft bracket bolt with specified torque. Refer to [EM-80, "INSTALLATION"](#) for the tightening procedure.

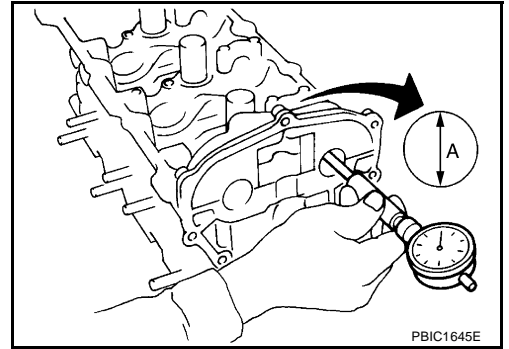
CAMSHAFT

- Measure the inner diameter "A" of camshaft bracket with bore gauge.

Standard:

No. 1 : 26.000 - 26.021 mm (1.0236 - 1.0244 in)

No. 2, 3, 4 : 23.500 - 23.521 mm (0.9252 - 0.9260 in)



CAMSHAFT JOURNAL OIL CLEARANCE

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

Standard:

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

No. 2, 3, 4 : 0.035 - 0.076 mm (0.0014 - 0.0030 in)

Limit : 0.15 mm (0.0059 in)

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

NOTE:

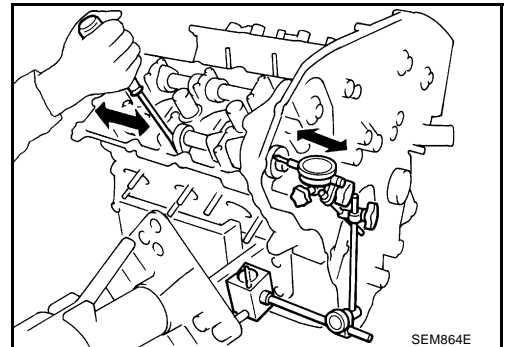
Camshaft brackets cannot be replaced as a single part, because it is machined together with cylinder head. Replace whole cylinder head assembly.

Camshaft End Play

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

Standard : 0.115 - 0.188 mm (0.0045 - 0.0074 in)

Limit : 0.24 mm (0.0094 in)



- Measure the following parts if out of the limit.

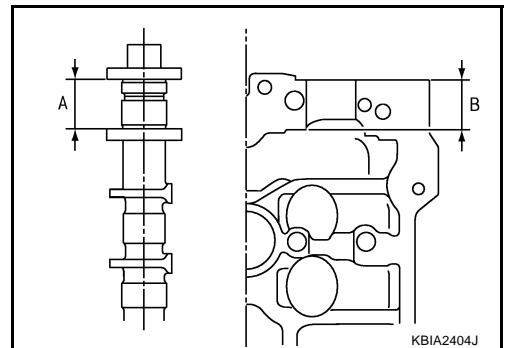
- Dimension "A" for camshaft No. 1 journal

Standard : 27.500 - 27.548 mm (1.0827 - 1.0846 in)

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

Standard : 27.360 - 27.385 mm (1.0772 - 1.0781 in)

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



Camshaft Sprocket Runout

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

CAUTION:

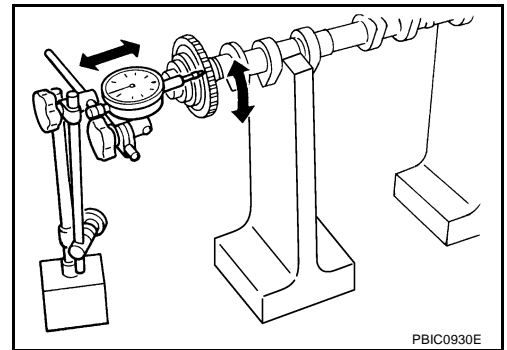
Do not support journal No. 1 (on the side of camshaft sprocket) because it has a different diameter from the other three locations.

CAMSHAFT

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

Limit : 0.15 mm (0.0059 in)

- If it exceeds the limit, replace camshaft sprocket.



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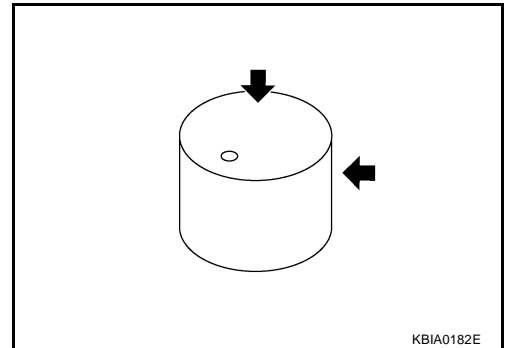
C

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Valve Lifter

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

- If anything above is found, replace valve lifter.



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F

G

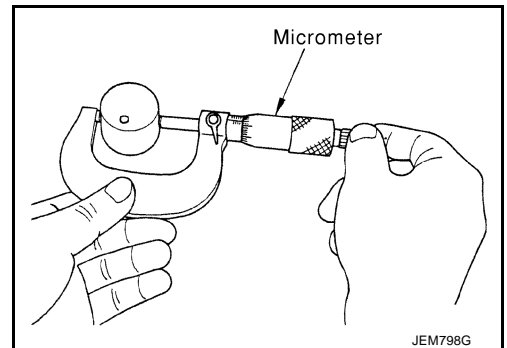
Valve Lifter Clearance

VALVE LIFTER OUTER DIAMETER

- Measure the outer diameter of valve lifter with micrometer.

Standard (Intake and exhaust)

: 33.977 - 33.987 mm (1.3377 - 1.3381 in)



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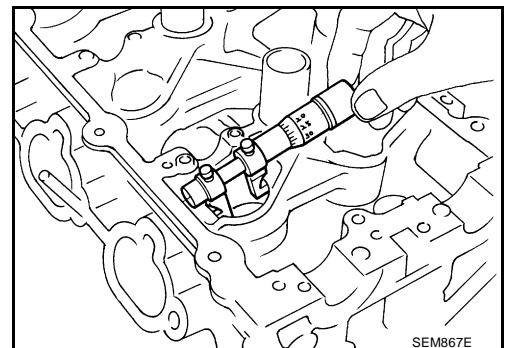
L

VALVE LIFTER HOLE DIAMETER

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

Standard (Intake and exhaust)

: 34.000 - 34.016 mm (1.3386 - 1.3392 in)



M

VALVE LIFTER CLEARANCE

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

Standard (Intake and exhaust)

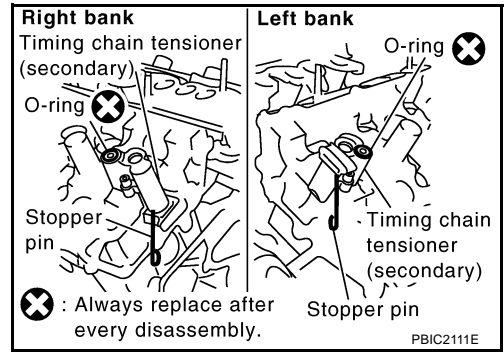
: 0.013 - 0.039 mm (0.0005 - 0.0015 in)

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

CAMSHAFT

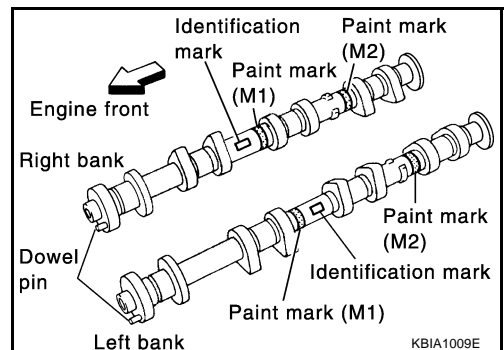
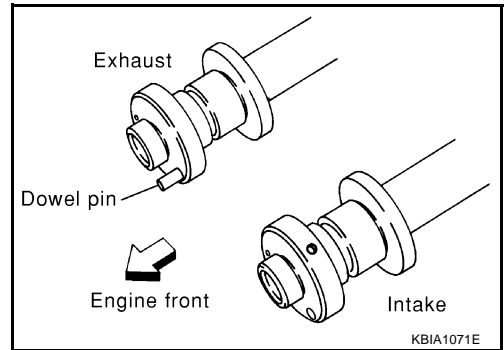
INSTALLATION

1. Install timing chain tensioners (secondary) on both sides of cylinder head.
 - Install timing chain tensioner with its stopper pin attached.
 - Install timing chain tensioner with sliding part facing downward on right-side cylinder head, and with sliding part facing upward on left-side cylinder head.
 - Install new O-ring as shown in the figure.
2. Install valve lifter.
 - Install it in the original position.
3. Install camshafts.
 - Install camshaft with dowel pin attached to its front end face on the exhaust side.



- Follow your identification marks made during removal, or follow the identification marks that are present on new camshafts for proper placement and direction.

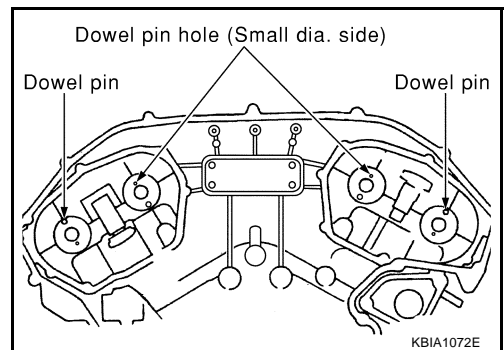
Bank	INT/EXH	Dowel pin	Paint marks		ID mark
			M1	M2	
RH	INT	No	Pink	No	RE
	EXH	Yes	No	Orange	RE
LH	INT	No	Pink	No	LH
	EXH	Yes	No	Orange	LH



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

NOTE:

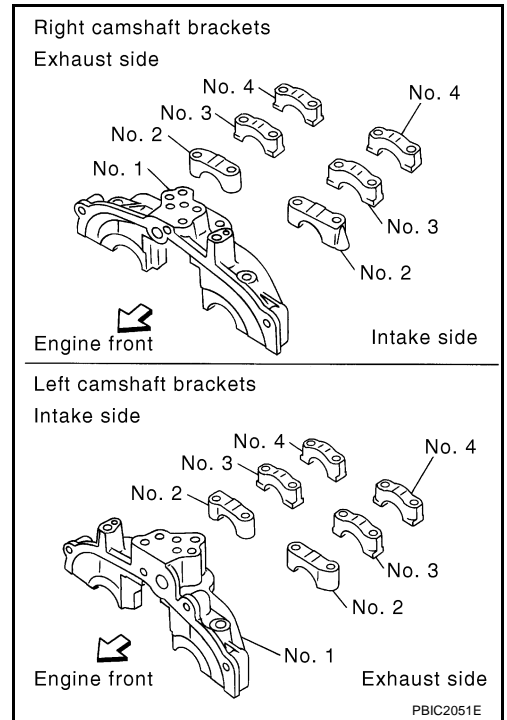
Large- and small-pin holes are located on front end face of camshaft (INT), at intervals of 180 degrees. Face small dia. side pin hole upward (in cylinder head upper face direction).



CAMSHAFT

4. Install camshaft brackets.

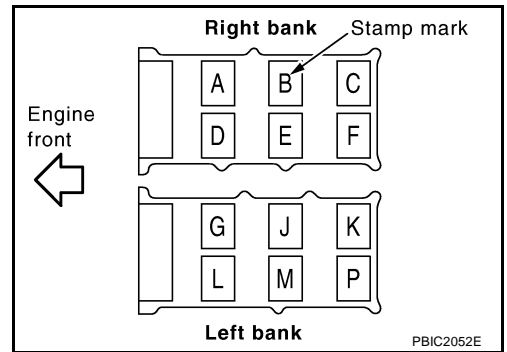
- Remove foreign material completely from camshaft bracket backside and from cylinder head installation face.
- Install camshaft bracket in original position and direction as shown in the figure.



- Install camshaft brackets (No. 2 to No. 4) aligning the stamp marks as shown in the figure.

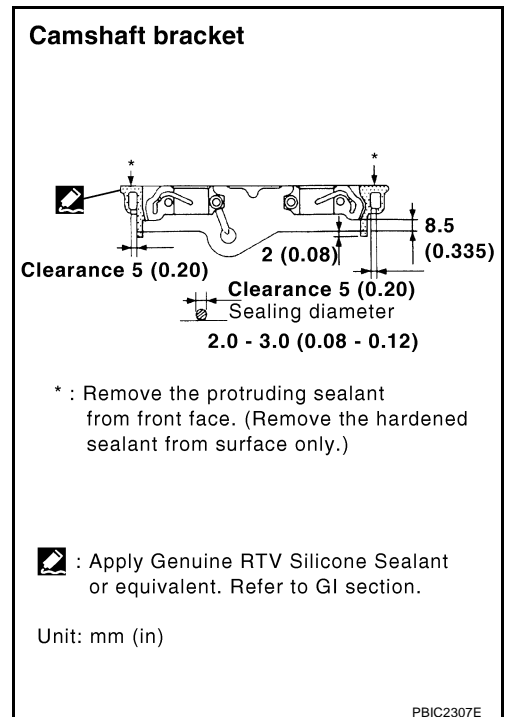
NOTE:

There are no identification marks indicating left and right for camshaft brackets (No. 1).



- Apply sealant to mating surface of camshaft brackets (No. 1) as shown on right and left banks.

Use Genuine RTV Silicone Sealant or equivalent. Refer to [GI-46, "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS"](#) .



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CAMSHAFT


5. Tighten camshaft bracket bolts in the following steps, in numerical order as shown in the figure.
 - a. Tighten No. 7 to 10, then tighten No. 1 to 6 in order as shown.

: **1.96 N·m (0.20 kg-m, 1 ft-lb)**

- b. Tighten all bolts in numerical order as shown.

: **5.88 N·m (0.60 kg-m, 4 ft-lb)**

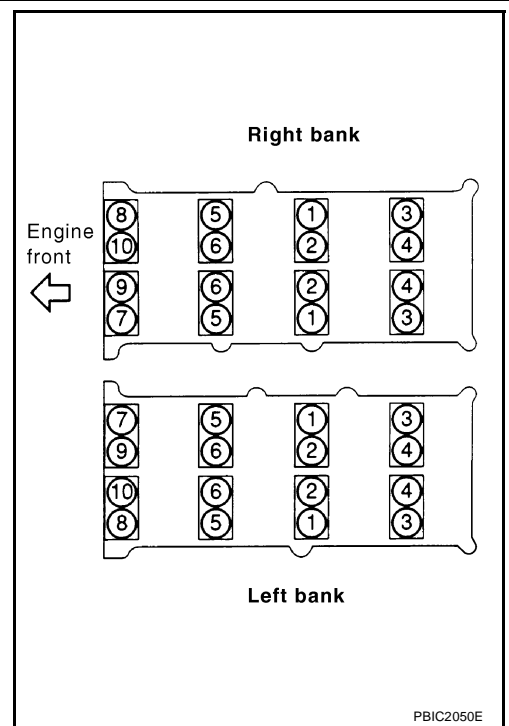
- c. Tighten all bolts in numerical order as shown.

: **10.4 N·m (1.1 kg-m, 8 ft-lb)**

CAUTION:

After tightening mounting bolts of camshaft brackets (No. 1), be sure to wipe off excessive liquid gasket from the parts list below.

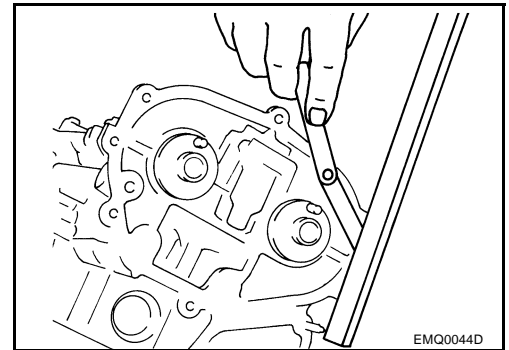
- Mating surface of rocker cover
- Mating surface of rear timing chain case



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

Standard : -0.14 to 0.14 mm (-0.0055 to 0.0055 in)

- If measured value is out of the standard, re-install camshaft bracket (No. 1).



7. Check and adjust valve clearance. Refer to [EM-84, "Valve Clearance"](#).
8. Install in the reverse order of removal after this step.

CAMSHAFT

INSPECTION AFTER INSTALLATION

Inspection of Camshaft Sprocket (INT) Oil Groove

CAUTION:

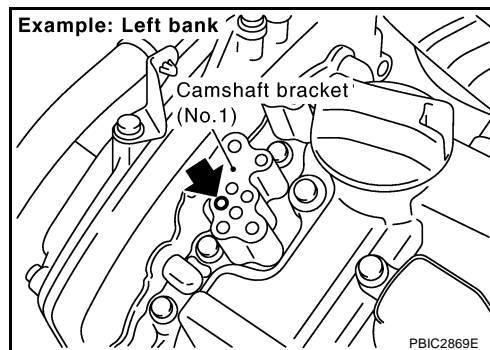
- Perform this inspection only when DTC P0011 or P0021 are detected in self-diagnostic results of CONSULT-II and it is directed according to inspection procedure of EC section. Refer to [EC-93, "TROUBLE DIAGNOSIS"](#) .
 - Check when engine is cold so as to prevent burns from any splashing engine oil.
1. Check the engine oil level. Refer to [LU-6, "ENGINE OIL"](#) .
 2. Perform the following procedure so as to prevent the engine from being unintentionally started while checking.
 - a. Release fuel pressure. Refer to [EC-91, "FUEL PRESSURE RELEASE"](#) .
 - b. Disconnect ignition coil and injector harness connectors.
 3. Remove intake valve timing control solenoid valve. Refer to [EM-75, "Removal and Installation"](#) .
 4. Crank the engine, and then make sure that engine oil comes out from camshaft bracket (No. 1) oil hole. End crank after checking.

WARNING:

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

CAUTION:

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



- Clean oil groove between oil strainer and intake valve timing control solenoid valve if engine oil does not come out from camshaft bracket (No. 1) oil hole. Refer to [LU-4, "LUBRICATION SYSTEM"](#) .
5. Remove components between intake valve timing control solenoid valve and camshaft sprocket (INT), and then check each oil groove for clogging.
 - Clean oil groove if necessary. Refer to [LU-4, "LUBRICATION SYSTEM"](#) .
 6. After inspection, install removed parts.

Inspection for Leaks

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

- Before starting engine, check oil/fluid levels including engine coolant and engine oil. If less than required quantity, fill to the specified level. Refer to [MA-9, "RECOMMENDED FLUIDS AND LUBRICANTS"](#) .
- Use procedure below to check for fuel leakage.
 - Turn ignition switch "ON" (with engine stopped). With fuel pressure applied to fuel piping, check for fuel leakage at connection points.
 - Start engine. With engine speed increased, check again for fuel leakage at connection points.
- Run engine to check for unusual noise and vibration.

NOTE:

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

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

CAMSHAFT

Summary of the inspection items:

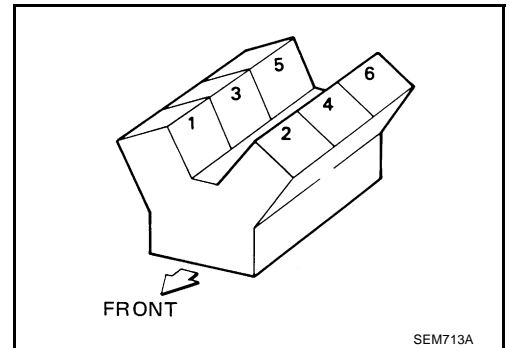
Item	Before starting engine	Engine running	After engine stopped
Engine coolant	Level	Leakage	Level
Engine oil	Level	Leakage	Level
Other oils and fluid*	Level	Leakage	Level
Fuel	Leakage	Leakage	Leakage

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

Valve Clearance INSPECTION

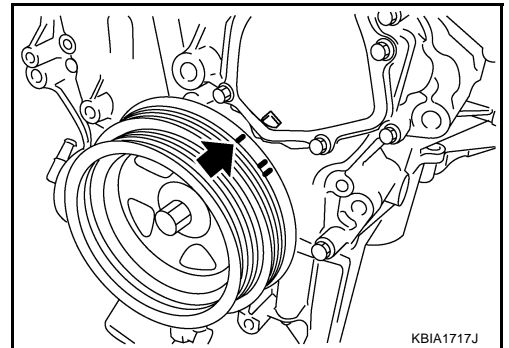
ABS00A0W

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



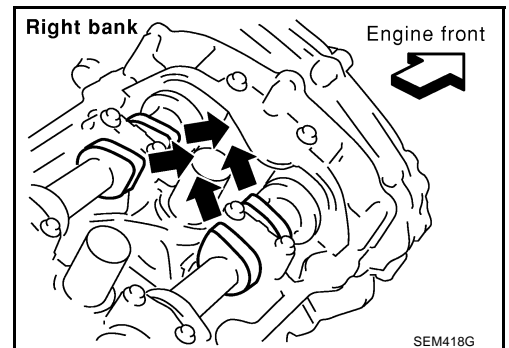
SEM173A

1. Remove rocker covers (right and left banks) with power tool. Refer to [EM-43. "ROCKER COVER"](#).
2. Measure the valve clearance as follows:
 - a. Set No.1 cylinder at TDC of its compression stroke.
 - Rotate crankshaft pulley clockwise to align timing mark (grooved line without color) with timing indicator.



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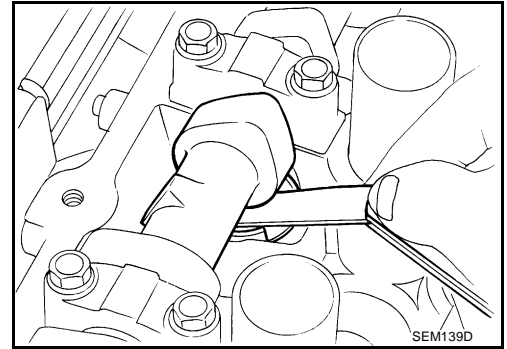
- Make sure that intake and exhaust cam nose on No. 1 cylinder (engine front side of right bank) are located as shown in the figure.
- If not, turn crankshaft one revolution (360 degrees) and align as shown in the figure.



SEM418G

CAMSHAFT

b. Measure the valve clearance with feeler gauge.



Valve clearance:

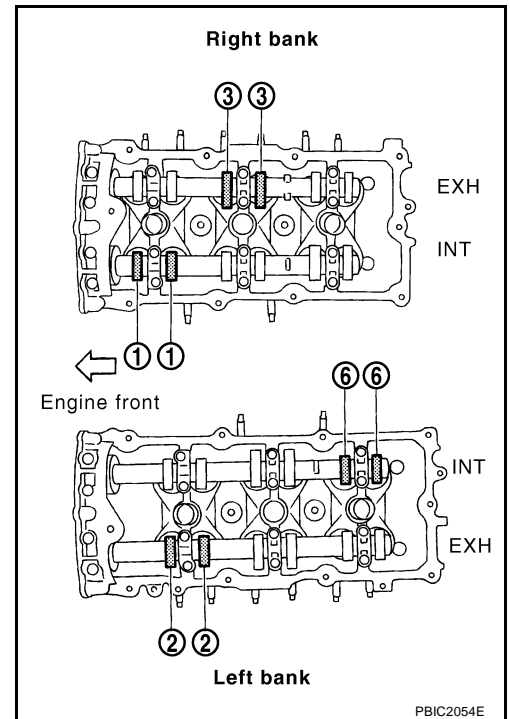
Unit: mm (in)

	Cold	Hot * (reference data)
Intake	0.26 - 0.34 (0.010 - 0.013)	0.304 - 0.416 (0.012 - 0.016)
Exhaust	0.29 - 0.37 (0.011 - 0.015)	0.308 - 0.432 (0.012 - 0.017)

*: Approximately 80°C (176°F)

● No.1 cylinder at compression TDC

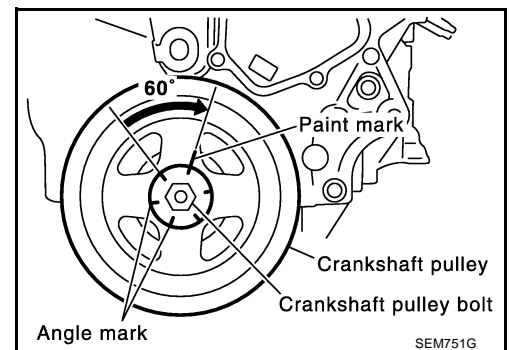
Measuring position (right bank)		No. 1 CYL.	No. 3 CYL.	No. 5 CYL.
No. 1 cylinder at TDC	EXH		×	
	INT	×		
Measuring position (left bank)		No. 2 CYL.	No. 4 CYL.	No. 6 CYL.
No. 1 cylinder at TDC	INT			×
	EXH	×		



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

NOTE:

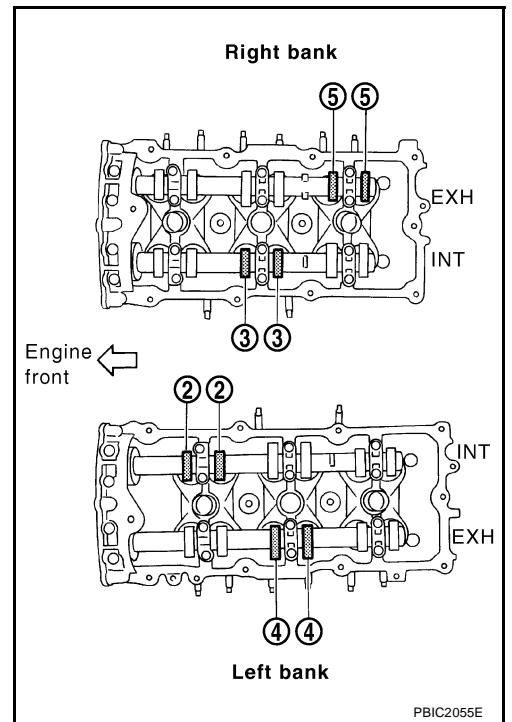
Crankshaft pulley mounting bolt flange has a stamped line every 60 degrees. They can be used as a guide to rotation angle.



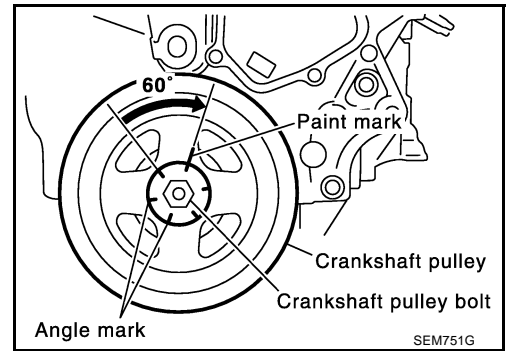
CAMSHAFT

● No. 3 cylinder at compression TDC

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

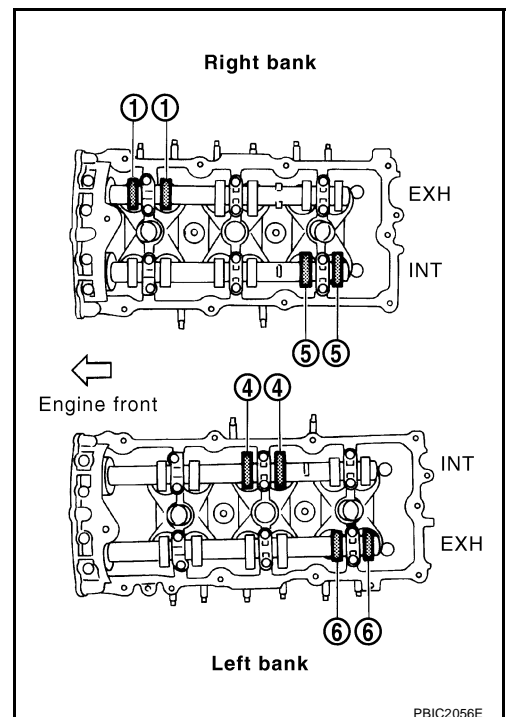


- d. Rotate crankshaft by 240 degrees clockwise (when viewed from engine front) to align No. 5 cylinder at TDC of compression stroke.



● No. 5 cylinder at compression TDC

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

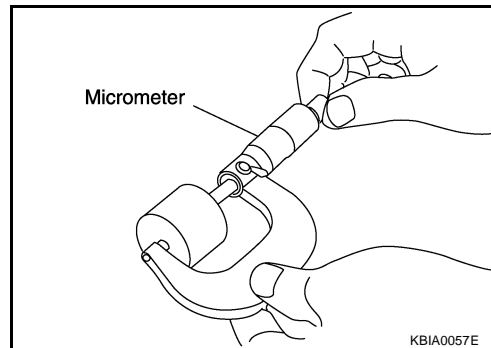


CAMSHAFT

3. For measured value are out of the standard, perform adjustment. Refer to [EM-87, "ADJUSTMENT"](#) .

ADJUSTMENT

- Perform adjustment depending on selected head thickness of valve lifter.
1. Measure the valve clearance. Refer to [EM-84, "INSPECTION"](#) .
 2. Remove camshaft. Refer to [EM-76, "REMOVAL"](#) .
 3. Remove valve lifters at the locations that are out of the standard.
 4. Measure the center thickness of removed valve lifters with micrometer.



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

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

t = Valve lifter thickness to be replaced

t₁ = Removed valve lifter thickness

C₁ = Measured valve clearance

C₂ = Standard valve clearance:

Intake : 0.30 mm (0.012 in)*

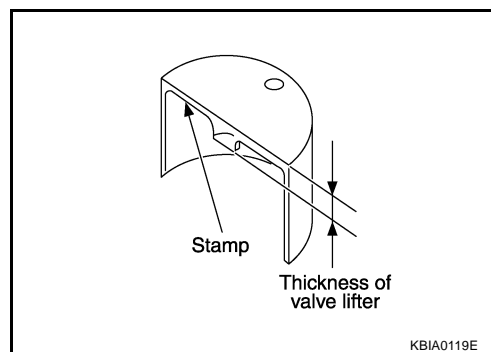
Exhaust : 0.33 mm (0.013 in)*

*: Approximately 20°C (68°F)

- Thickness of new valve lifter can be identified by stamp marks on the reverse side (inside the cylinder). Stamp mark 788U or 788R indicates 7.88 mm (0.3102 in) in thickness.

NOTE:

2 types of stamp marks are used for parallel setting and for manufacturer identification.



Available thickness of valve lifter: 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 [EM-142, "Available Valve Lifter"](#) .

6. Install selected valve lifter.
7. Install camshaft. Refer to [EM-80, "INSTALLATION"](#) .
8. Manually turn crankshaft pulley a few turns.
9. Make sure that the valve clearances for cold engine are within the specifications by referring to the specified values. Refer to [EM-84, "INSPECTION"](#) .
10. Install all removal parts in the reverse order of removal. Refer to [EM-80, "INSTALLATION"](#) .
11. Warm up the engine, and check for unusual noise and vibration.

OIL SEAL

PFP:00100

Removal and Installation of Valve Oil Seal REMOVAL

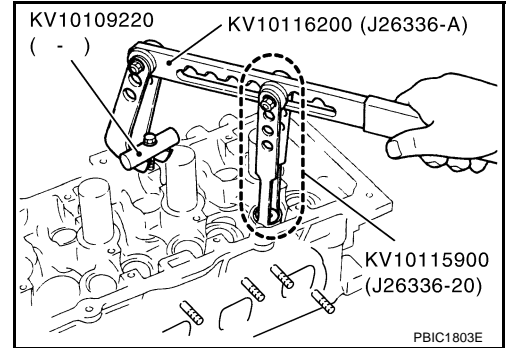
ABS00A0X

1. Remove camshaft relating to valve oil seal to be removed. Refer to [EM-75, "CAMSHAFT"](#) .
2. Remove valve lifters. Refer to [EM-75, "CAMSHAFT"](#) .
3. Turn crankshaft until the cylinder requiring new oil seals is at TDC. This will prevent valve from dropping into cylinder.
4. Remove valve collet.

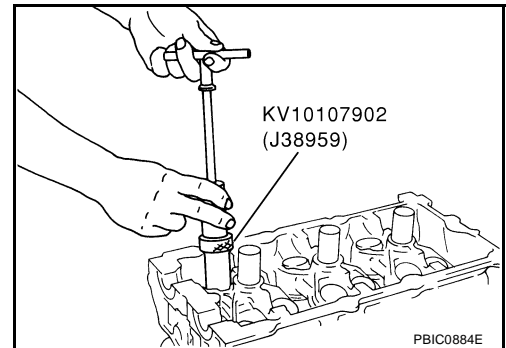
- Compress valve spring with valve spring compressor, attachment and adapter (SST). Remove valve collet with magnet hand.

CAUTION:

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



5. Remove valve spring retainer and valve spring.
6. Remove valve oil seal using valve oil seal puller (SST).



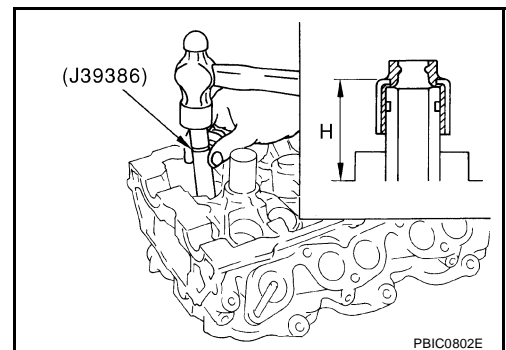
INSTALLATION

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

NOTE:

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

Intake and exhaust : 14.3 - 14.9 mm (0.563 - 0.587 in)



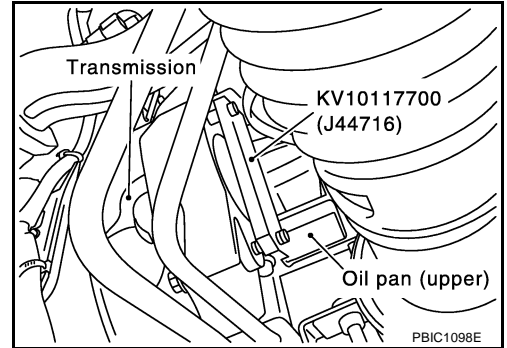
3. Install in the reverse order of removal after this step.

OIL SEAL

ABS00A0Y

Removal and Installation of Front Oil Seal REMOVAL

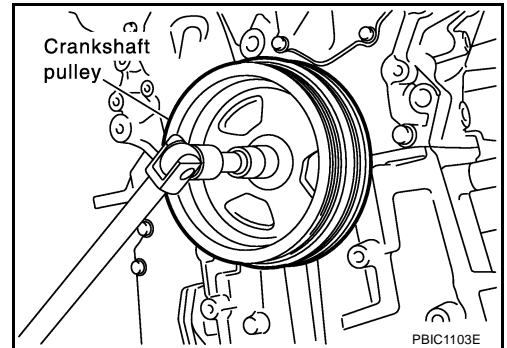
1. Remove the following parts:
 - Undercover
 - Drive belts; Refer to [EM-13, "DRIVE BELTS"](#) .
 - Radiator cooling fan assembly; Refer to [CO-21, "COOLING FAN"](#) .
 - Starter motor; Refer to [SC-10, "STARTING SYSTEM"](#) .
2. Remove crankshaft pulley as follows:
 - a. Set ring gear stopper (SST) as shown in the figure.



- b. Loosen crankshaft pulley mounting bolt and locate bolt seating surface at 10 mm (0.39 in) from its original position.

CAUTION:

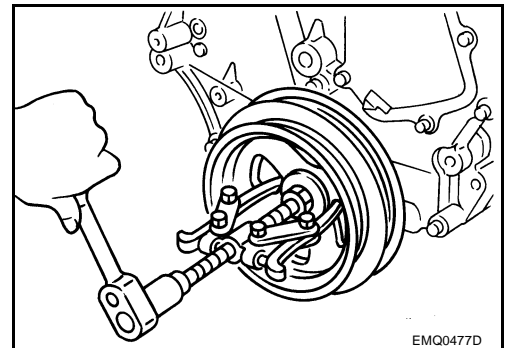
Do not remove crankshaft pulley bolt as it will be used as a supporting point for suitable puller.



- c. Place suitable puller tab on holes of crankshaft pulley, and pull crankshaft pulley through.

CAUTION:

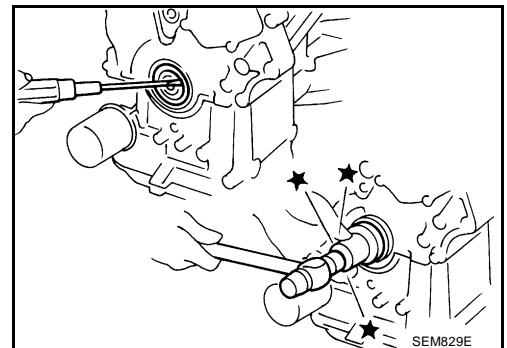
Do not put suitable puller tab on crankshaft pulley periphery, as this will damage internal damper.



3. Remove front oil seal using suitable tool.

CAUTION:

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

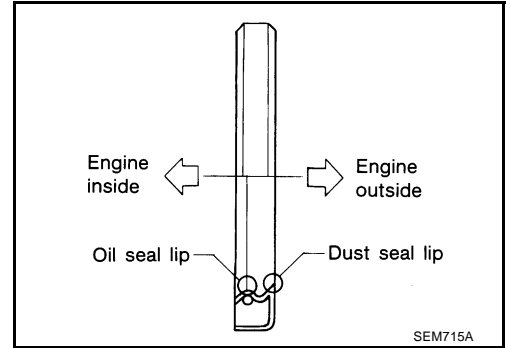


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OIL SEAL

INSTALLATION

1. Install front oil seal on the front timing chain case. Apply new engine oil to the oil seal lip, dust seal lip and outer round of oil seal.
 - Install it so that each seal lip is oriented as shown in the figure.



- Using suitable drift, press-fit oil seal until it becomes flush with front timing chain case end face.

Suitable drift

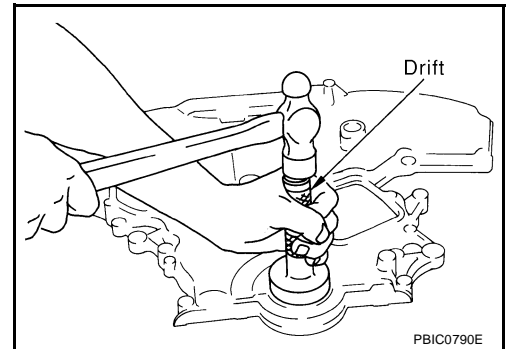
outer diameter: 59 mm (2.32 in)

inner diameter: 49 mm (1.93 in)

CAUTION:

Press fit straight and avoid causing burrs or tilting oil seal.

- Make sure the garter spring is in position and seal lip is not inverted.



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

Removal and Installation of Rear Oil Seal

ABS00A0Z

REMOVAL

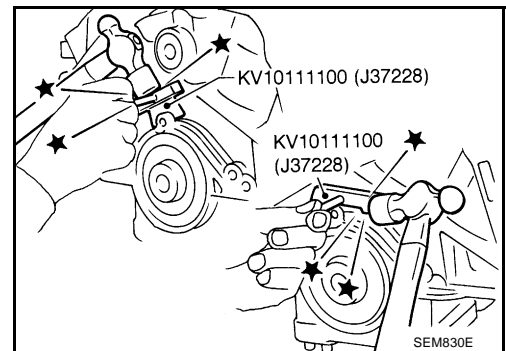
1. Remove oil pan (upper). Refer to [EM-28, "OIL PAN AND OIL STRAINER"](#).
2. Remove transmission assembly. Refer to [MT-19, "TRANSMISSION ASSEMBLY"](#) (M/T models) or [AT-274, "TRANSMISSION ASSEMBLY"](#) (A/T models).
3. Use seal cutter (SST) to cut away liquid gasket and remove rear oil seal retainer.

CAUTION:

Be careful not to damage mounting surface.

NOTE:

Rear oil seal and retainer from a single part are handled as an assembly.



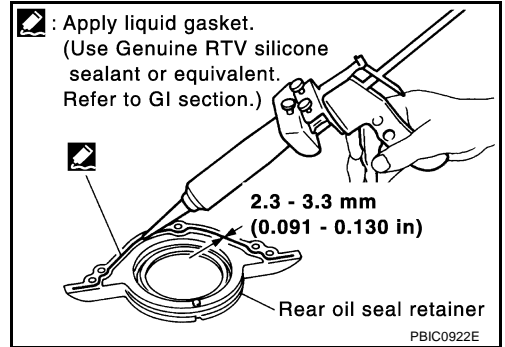
INSTALLATION

1. Remove old liquid gasket on mating surface of cylinder block and oil pan using scraper.
2. Apply new engine oil to the oil and dust seal lips.

OIL SEAL

3. Apply liquid gasket to rear oil seal retainer using tube presser [SST: WS39930000 (—)] as shown in the figure.
Use Genuine RTV Silicone Sealant or equivalent. Refer to [GI-46, "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS"](#).

- Assembly should be done within 5 minutes after coating.



4. Install rear oil seal retainer to cylinder block.
5. Install in the reverse order of removal after this step.

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CYLINDER HEAD

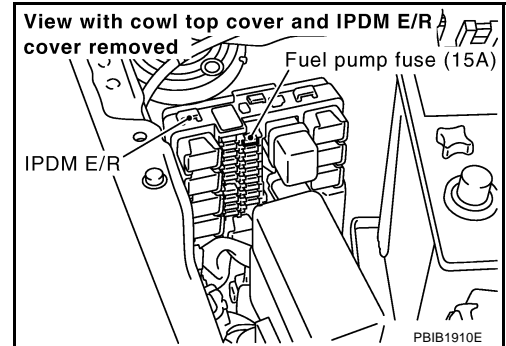
CYLINDER HEAD

PF1:11041

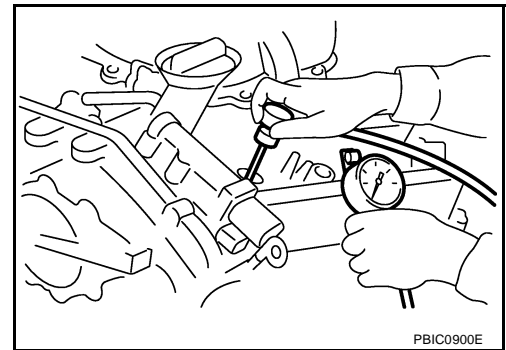
On-Vehicle Service CHECKING COMPRESSION PRESSURE

ABS00A10

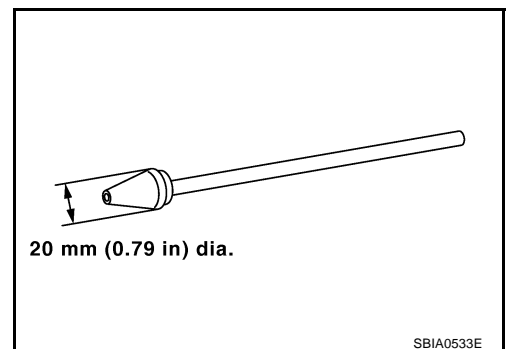
1. Warm up engine thoroughly. Then, stop it.
2. Release fuel pressure. Refer to [EC-91, "FUEL PRESSURE RELEASE"](#) .
3. Disconnect fuel pump fuse to avoid fuel injection during measurement.



4. Remove engine cover with power tool. Refer to [EM-17, "INTAKE MANIFOLD COLLECTOR"](#) .
5. Remove ignition coil and spark plug from each cylinder. Refer to [EM-34, "IGNITION COIL"](#) and [EM-35, "SPARK PLUG \(PLATINUM-TIPPED TYPE\)"](#) .
6. Connect engine tachometer (not required in use of CONSULT-II).
7. Install compression tester with adapter onto spark plug hole.



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



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

Compression pressure:

Unit: kPa (kg/cm², psi) /rpm

Standard	Minimum	Differential limit between cylinders
1,270 (13.0, 184) / 300	980 (10.0, 142) / 300	100 (1.0, 15) / 300

CAUTION:

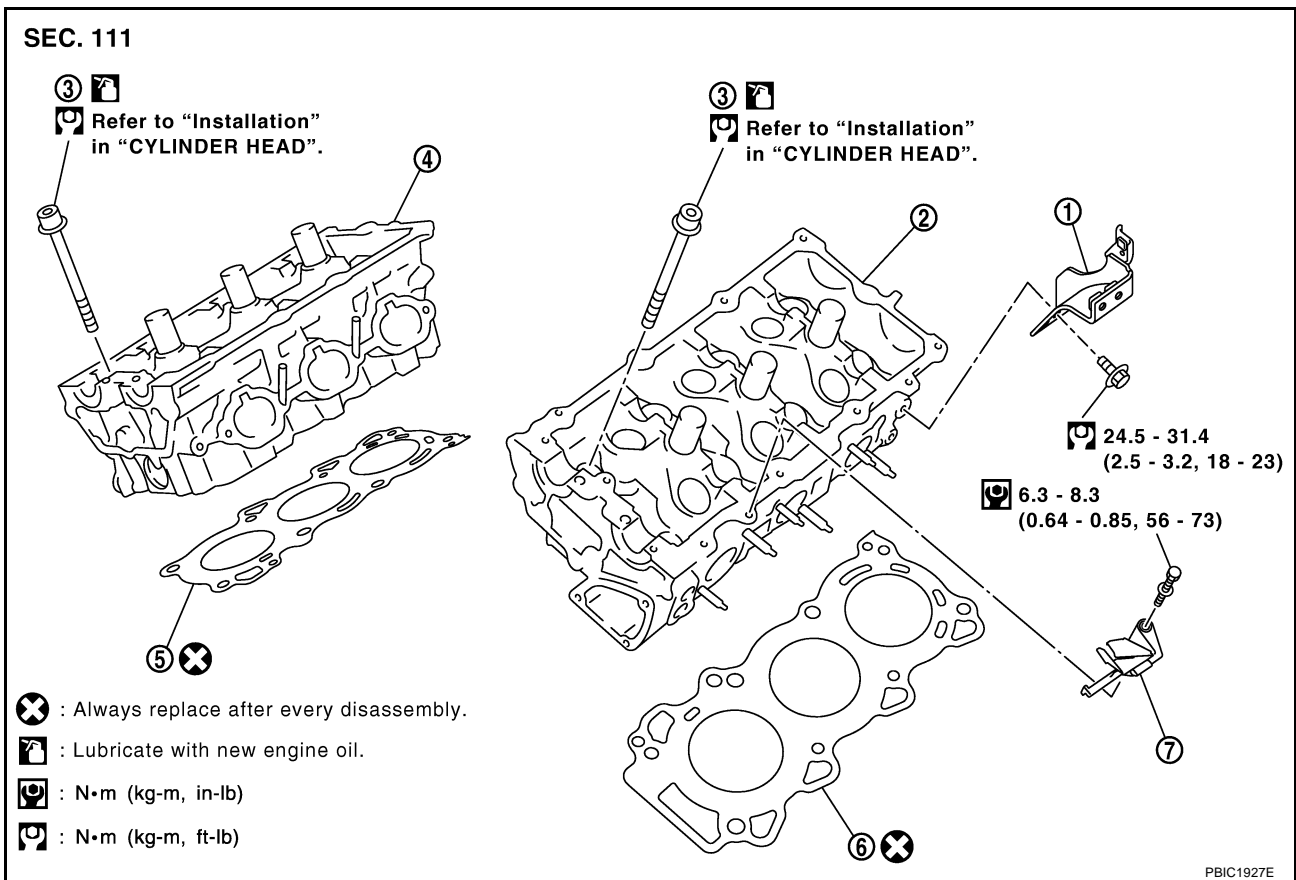
Always use a fully charged battery to obtain specified engine speed.

CYLINDER HEAD

- If the engine speed is out of specified range, check battery liquid for proper gravity. Check engine speed again with normal battery gravity.
 - If compression pressure is below minimum value, check valve clearances and parts associated with combustion chamber (valve, valve seat, piston, piston ring, cylinder bore, cylinder head, cylinder head gasket). After the checking, measure the compression pressure again.
 - If some cylinders have low compression pressure, pour small amount of engine oil into the spark plug hole of the cylinder to re-check it for compression.
 - If the added engine oil improves the compression, piston rings may be worn out or damaged. Check piston rings and replace if necessary.
 - If the compression pressure remains at low level despite the addition of engine oil, valves may be malfunctioning. Check valves for damage. Replace valve or valve seat accordingly.
 - If two adjacent cylinders have respectively low compression pressure and their compression remains low even after the addition of engine oil, gaskets are leaking. In such a case, replace cylinder head gaskets.
9. After inspection is completed, install removed parts.
10. Start engine, and make sure that engine runs smoothly.
11. Perform trouble diagnosis. If DTC appears, erase it. Refer to [EC-93, "TROUBLE DIAGNOSIS"](#).

Removal and Installation

ABS00A11



- | | | |
|-------------------------------|--------------------------------------|-------------------------------------|
| 1. Engine rear lower slinger | 2. Cylinder head (left bank) | 3. Cylinder head bolt |
| 4. Cylinder head (right bank) | 5. Cylinder head gasket (right bank) | 6. Cylinder head gasket (left bank) |
| 7. Oil level gauge guide | | |

REMOVAL

1. Remove camshaft. Refer to [EM-75, "CAMSHAFT"](#).

NOTE:

It is also possible to perform the following steps 2 and 3 just before removing the camshaft.

2. Temporarily fit front suspension member to support engine. Refer to [FSU-19, "FRONT SUSPENSION MEMBER"](#).

CYLINDER HEAD

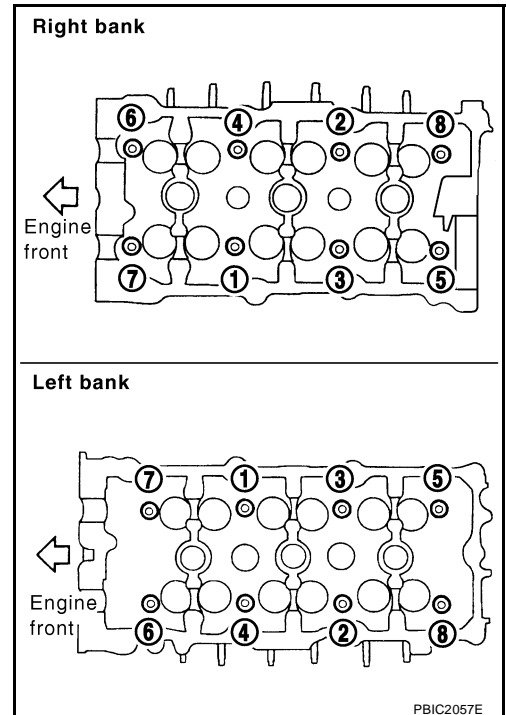
CAUTION:

Temporary fitting means the status that engine is adequately stable though the hoist is released from hanging.

NOTE:

At the time of the start of this procedure front suspension member is removed, and cylinder head is hanged by the hoist with engine slinger installed.

3. Release the hoist from hanging, then remove the engine slinger.
4. Remove the following components and related parts:
 - Fuel tube and fuel injector assembly. Refer to [EM-37, "FUEL INJECTOR AND FUEL TUBE"](#) .
 - Intake manifold. Refer to [EM-22, "INTAKE MANIFOLD"](#) .
 - Exhaust manifold. Refer to [EM-24, "EXHAUST MANIFOLD AND THREE WAY CATALYST"](#) .
 - Water inlet and thermostat assembly. Refer to [CO-28, "WATER INLET AND THERMOSTAT ASSEMBLY"](#) .
 - Water outlet and water pipe. Refer to [CO-30, "WATER OUTLET AND WATER PIPING"](#) .
5. Remove cylinder head bolts in reverse order as shown in the figure with cylinder head bolt wrench (commercial service tool: J24239-01) and power tool.



6. Remove cylinder head gaskets.

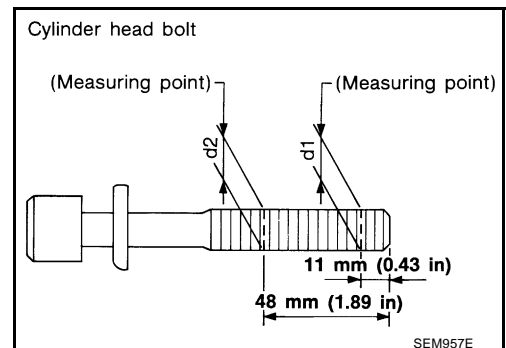
INSPECTION AFTER REMOVAL

Cylinder Head Bolts Outer Diameter

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

Limit ("d1" - "d2") : 0.11 mm (0.0043 in)

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



Cylinder Head Distortion

NOTE:

When performing this inspection, cylinder block distortion should be also checking. Refer to [EM-131, "CYLINDER BLOCK DISTORTION"](#) .

CYLINDER HEAD

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

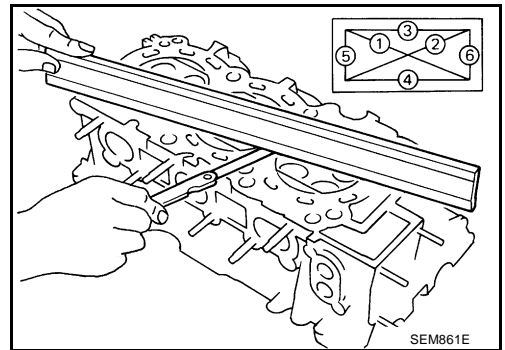
CAUTION:

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

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

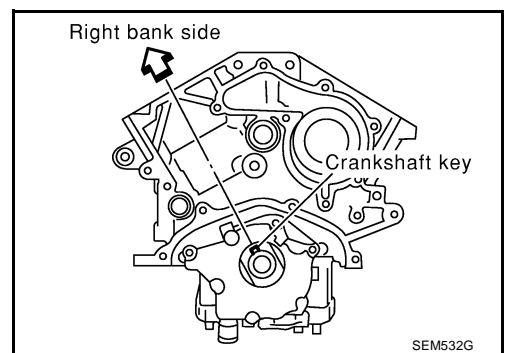
Limit : 0.1 mm (0.004 in)

- If it exceeds the limit, replace cylinder head.



INSTALLATION

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



- Install cylinder head follow the steps below to tighten cylinder head bolts in numerical order as shown in the figure.

- Tighten all bolts.

: **98.1 N·m (10 kg-m, 72 ft-lb)**

- Completely loosen.

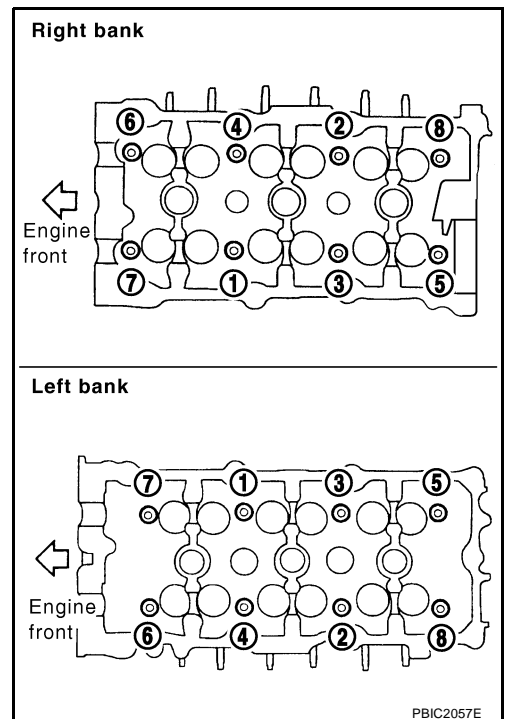
: **0 N·m (0 kg-m, 0 ft-lb)**

CAUTION:

In step "b", loosen bolts in reverse order of that indicated in the figure.

- Tighten all bolts.

: **34.3 - 44.1 N·m (3.5 - 4.4 kg-m, 26 - 32 ft-lb)**



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CYLINDER HEAD

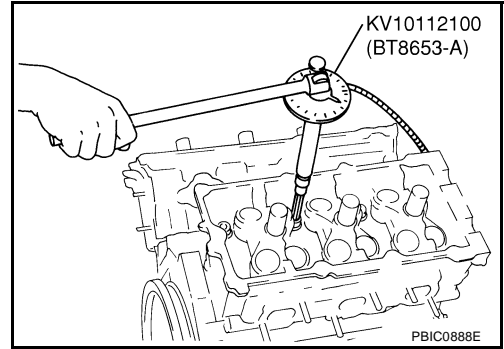
- d. Turn all bolts 90 to 95 degrees clockwise [target: 90 degrees (angle tightening)].

CAUTION:

Check the tightening angle by using angle wrench (SST). Avoid judgment by visual inspection without tool.

- Check tightening angle indicated on angle wrench indicator plate.

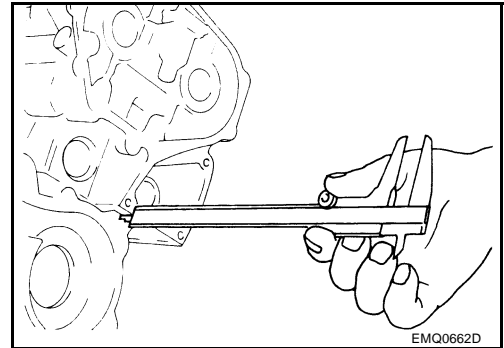
- e. Turn all bolts 90 to 95 degrees clockwise again [target: 90 degrees (angle tightening)].



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

Standard : 14.1 - 14.9 mm (0.555 - 0.587 in)

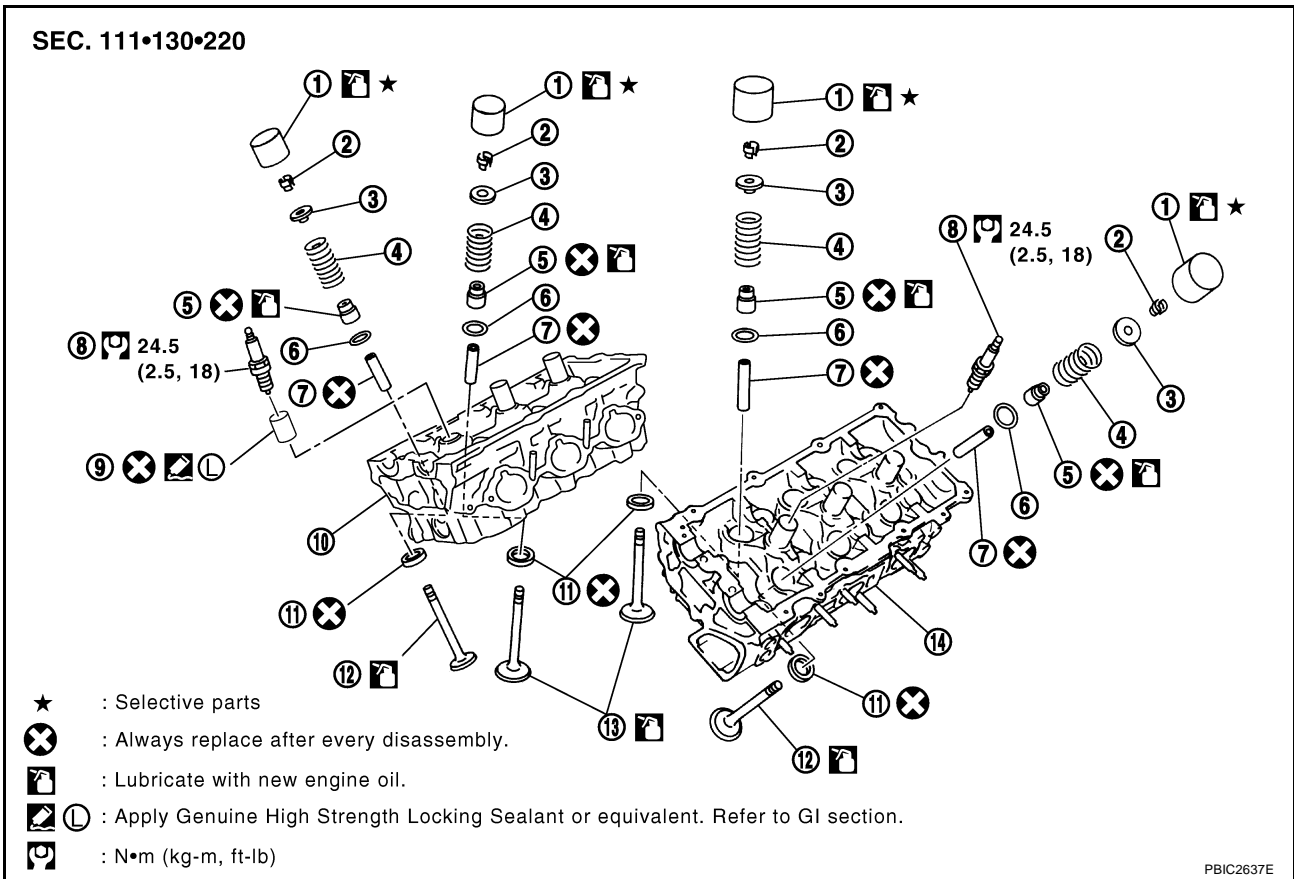
- If measured value is out of the standard, re-install cylinder head.



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

Disassembly and Assembly

ABS00A12



PBIC2637E

- | | | |
|-----------------|-------------------|--------------------------|
| 1. Valve lifter | 2. Valve collet | 3. Valve spring retainer |
| 4. Valve spring | 5. Valve oil seal | 6. Valve spring seat |
| 7. Valve guide | 8. Spark plug | 9. Spark plug tube |

CYLINDER HEAD

- 10. Cylinder head (right bank)
- 13. Valve (INT)

- 11. Valve seat
- 14. Cylinder head (left bank)

- 12. Valve (EXH)

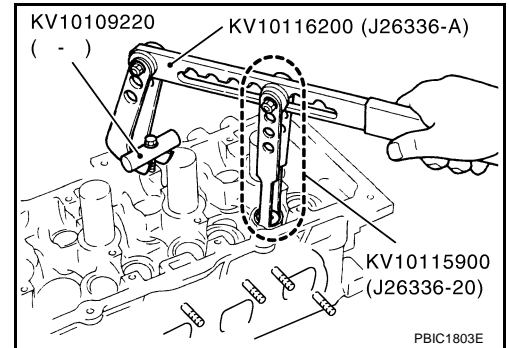
A

DISASSEMBLY

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

CAUTION:

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



EM

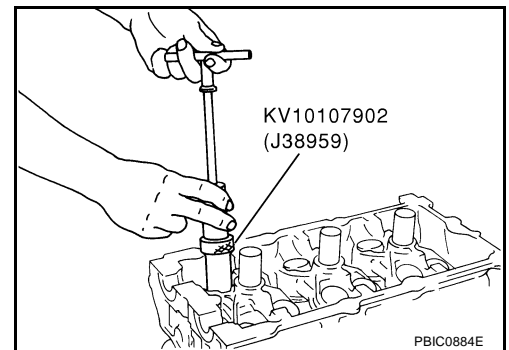
C

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4. Remove valve spring retainer and valve spring.
5. Push valve stem to combustion chamber side, and remove valve.
 - Identify installation positions, and store them without mixing them up.
6. Remove valve oil seal using valve oil seal puller (SST).



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7. Remove valve spring seat.
8. If valve seat must be replaced, refer to [EM-101, "VALVE SEAT REPLACEMENT"](#).
9. If valve guide must be replaced, refer to [EM-99, "VALVE GUIDE REPLACEMENT"](#).
10. Remove spark plug tube, as necessary.
 - Using pliers, pull spark plug tube out of cylinder head.

CAUTION:

● Take care not to damage cylinder head.

● Once removed, spark plug tube will be deformed and cannot be reused. Do not remove it unless absolutely necessary.

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ASSEMBLY

1. When valve guide is removed, install it. Refer to [EM-99, "VALVE GUIDE REPLACEMENT"](#).
2. When valve seat is removed, install it. Refer to [EM-101, "VALVE SEAT REPLACEMENT"](#).

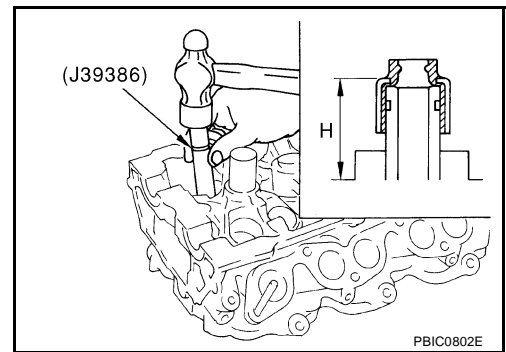
CYLINDER HEAD

3. Install valve oil seal.

- Install with valve oil seal drift (SST) to match dimension in the figure.

Height “H” (Without valve spring seat installed)

Intake and exhaust : 14.3 - 14.9 mm (0.563 - 0.587 in)



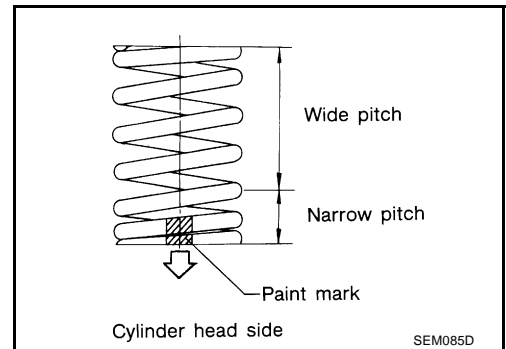
4. Install valve spring seat.

5. Install valve.

- Larger diameter valve is for intake side.

6. Install valve spring (uneven pitch type).

- Install narrow pitch end (paint mark) to cylinder head side (valve spring seat side).



7. Install valve spring retainer.

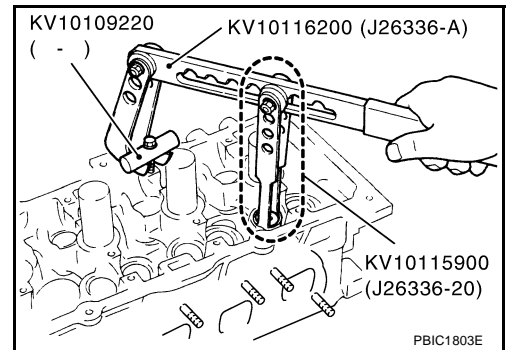
8. Install valve collet.

- Compress valve spring with valve spring compressor, attachment and adapter (SST). Install valve collet with magnet hand.

CAUTION:

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

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



9. Install valve lifter.

10. Install spark plug tube.

- Press-fit spark plug tube as follows:

a. Remove old high strength locking sealant adhering to cylinder head mounting hole.

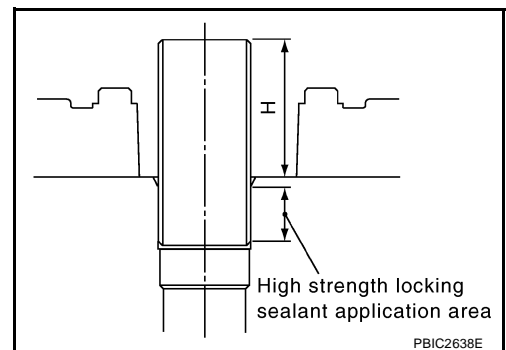
b. Apply high strength locking sealant to area within approximately 12 mm (0.47 in) from edge of spark plug tube press-fit side.

Use Genuine High Strength Locking Sealant or equivalent. Refer to [GI-46, "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS"](#) .

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

Standard press-fit height “H”

: 38.1 - 39.1 mm (1.500 - 1.539 in)



CYLINDER HEAD

CAUTION:

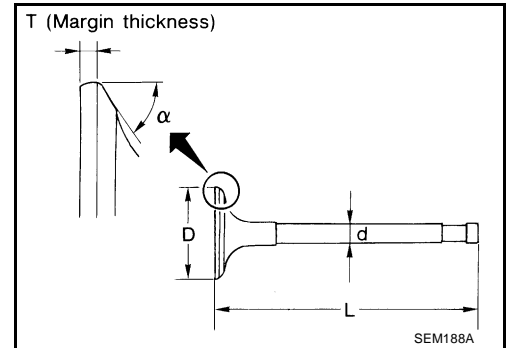
- When press-fitting, take care not to deform spark plug tube.
- After press-fitting, wipe off high strength locking sealant protruding onto cylinder-head upper face.

11. Install spark plug.

Inspection After Disassembly VALVE DIMENSIONS

ABS00A13

- Check dimensions of each valve. For dimensions, refer to [EM-143, "Valve Dimensions"](#).
- If dimensions are out of the standard, replace valve.



VALVE GUIDE CLEARANCE

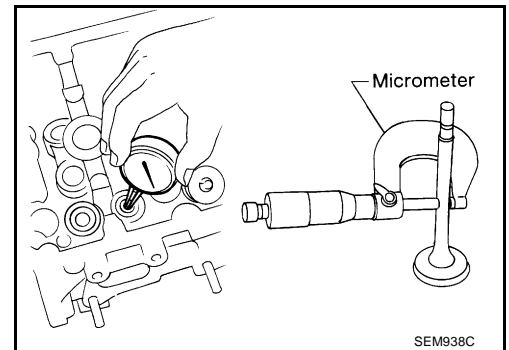
Valve Stem Diameter

Measure the diameter of valve stem with micrometer.

Standard

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

Exhaust : 5.955 - 5.970 mm (0.2344 - 0.2350 in)



Valve Guide Inner Diameter

Measure the inner diameter of valve guide with bore gauge.

Standard

Intake and Exhaust : 6.000 - 6.018 mm (0.2362 - 0.2369 in)

Valve Guide Clearance

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

Valve guide clearance:

Standard

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

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

Limit

Intake : 0.08 mm (0.003 in)

Exhaust : 0.09 mm (0.004 in)

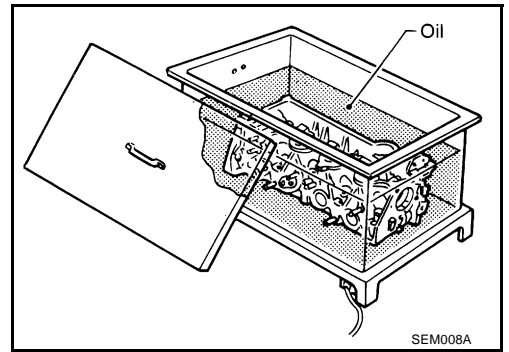
- If it exceeds the limit, replace valve and/or valve guide.

VALVE GUIDE REPLACEMENT

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

CYLINDER HEAD

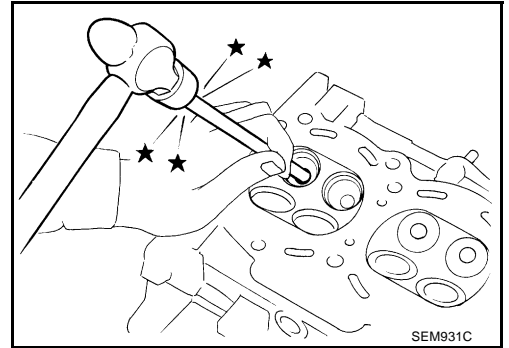
1. To remove valve guide, heat cylinder head to 110 to 130°C (230 to 266°F) by soaking in heated oil.



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

CAUTION:

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

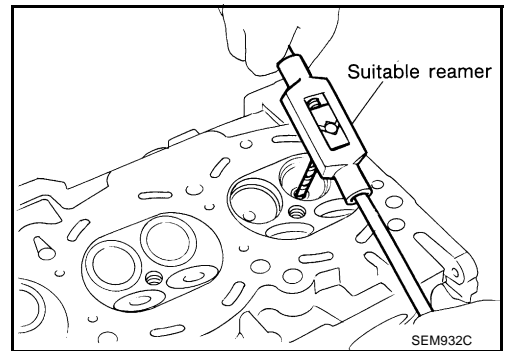


3. Using valve guide reamer (commercial service tool), ream cylinder head valve guide hole.

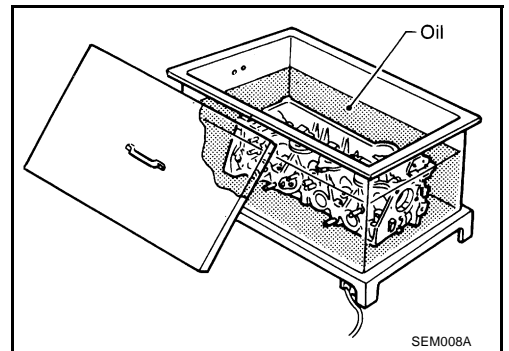
Valve guide hole diameter (for service parts):

Intake and exhaust

: 10.175 - 10.196 mm (0.4006 - 0.4014 in)



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



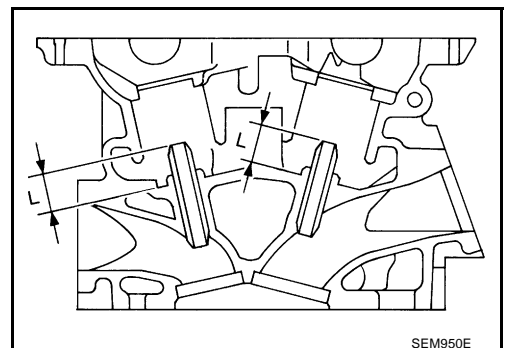
5. Press valve guide from camshaft side to dimensions as in the figure.

Projection "L"

Intake and exhaust : 12.6 - 12.8 mm (0.496 - 0.504 in)

CAUTION:

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



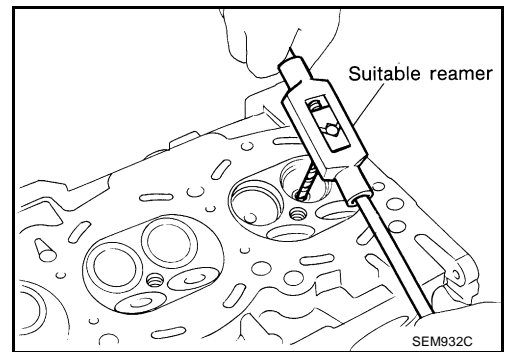
CYLINDER HEAD

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

Standard:

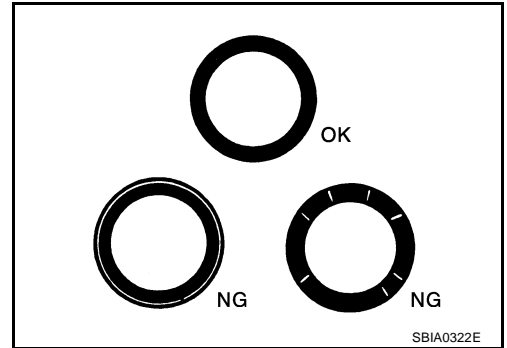
Intake and exhaust

: 6.000 - 6.018 mm (0.2362 - 0.2369 in)



VALVE SEAT CONTACT

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



VALVE SEAT REPLACEMENT

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

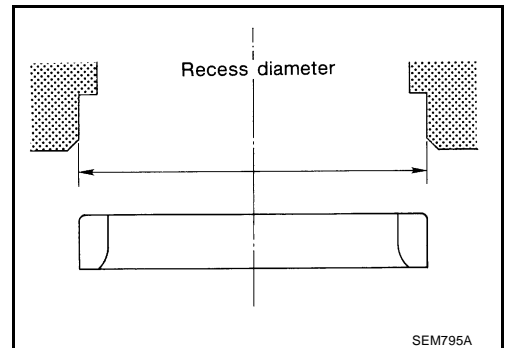
- Bore out old seat until it collapses. Boring should not continue beyond the bottom face of the seat recess in cylinder head. Set the machine depth stop to ensure this.
- Ream cylinder head recess diameter for service valve seat.

Oversize [0.5 mm (0.020 in)]

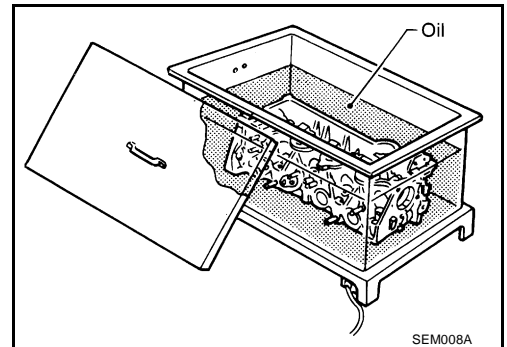
Intake : 38.500 - 38.516 mm (1.5157 - 1.5164 in)

Exhaust : 32.700 - 32.716 mm (1.2874 - 1.2880 in)

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



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



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

CAUTION:

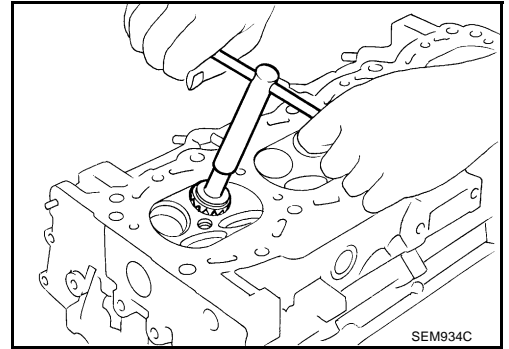
- Avoid directly touching cold valve seats.
- Cylinder head contains heat. When working, wear protective equipment to avoid getting burned.

CYLINDER HEAD

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

CAUTION:

When using 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 with cutter or cutting many different times may result in stage valve seat.



Grind to obtain the dimensions indicated in the figure.

Standard:

D1 dia.: 35 mm (1.38 in)^{*1}

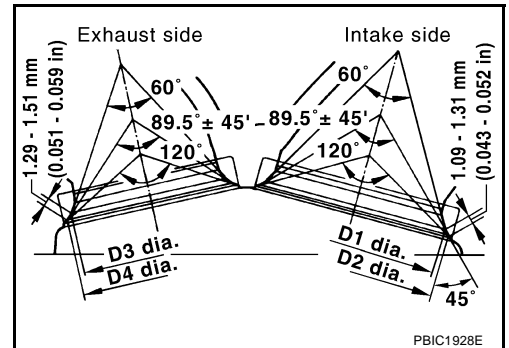
D2 dia.: 36.6 - 36.8 mm (1.441 - 1.449 in)^{*2}

D3 dia.: 28.7 mm (1.130 in)^{*1}

D4 dia.: 30.6 - 30.8 mm (1.205 - 1.213 in)^{*2}

*1: Diameter made by intersection point of conic angles 60 degrees and 89.5 degrees

*2: Diameter made by intersection point of conic angles 89.5 degrees and 120 degrees



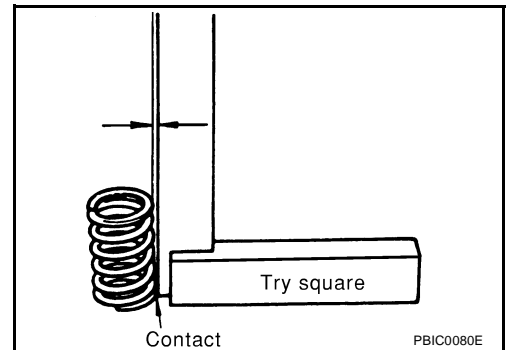
- Using compound, grind to adjust valve fitting.
- Check again for normal contact.

VALVE SPRING SQUARENESS

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

Limit : 2.0 mm (0.079 in)

- If it exceeds the limit, replace valve spring.



VALVE SPRING DIMENSIONS AND VALVE SPRING PRESSURE LOAD

- Check valve spring pressure at specified spring height.

Standard:

Intake and exhaust

Free height:

47.07 mm (1.8531 in)

Installation height:

37.00 mm (1.4567 in)

Installation load:

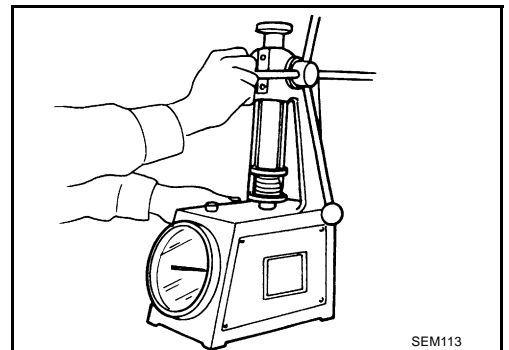
166 - 188 N (16.9 - 19.2 kg, 37.3 - 42.3 lb)

Height during valve open:

27.20 mm (1.0709 in)

Load with valve open:

373 - 421 N (38.0 - 42.9 kg, 83.9 - 94.6 lb)



CYLINDER HEAD

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

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ENGINE ASSEMBLY

REMOVAL

Outline

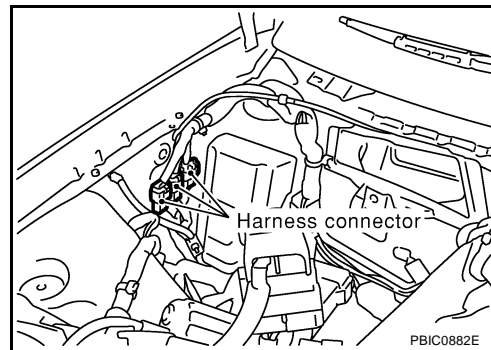
At first, remove engine and transmission assembly with suspension member downward. Then separate engine from transmission.

Preparation

1. Release fuel pressure. Refer to [EC-91, "FUEL PRESSURE RELEASE"](#) .
2. Disconnect both battery terminal. Refer to [SC-4, "BATTERY"](#) .
3. Remove the following parts:
 - Hood assembly; Refer to [BL-12, "HOOD"](#) .
 - Engine cover; Refer to [EM-17, "INTAKE MANIFOLD COLLECTOR"](#) .
 - Front wiper arm and cowl top cover; Refer to [EI-19, "COWL TOP"](#) .
 - Undercover
 - Drive belts; Refer to [EM-13, "DRIVE BELTS"](#) .
 - Front road wheels and tires
4. Drain engine coolant from radiator. Refer to [CO-10, "Changing Engine Coolant"](#) .
5. Remove air cleaner case and air duct. Refer to [EM-15, "AIR CLEANER AND AIR DUCT"](#) .
6. Discharge refrigerant from A/C circuit. Refer to [ATC-138, "REFRIGERANT LINES"](#) .
7. Remove radiator cooling fan assembly, reservoir tank and hoses. Refer to [CO-21, "COOLING FAN"](#) and [CO-13, "RADIATOR"](#) .

Engine Room

1. Disconnect heater hose at engine-side, and fit a plug onto hose end to prevent engine coolant leak.
2. Disconnect ground cable (between vehicle to left cylinder head).
3. Disconnect battery positive cable harness at vehicle side and temporarily fasten it on engine.
4. Disconnect A/C piping from A/C compressor, and temporarily fasten it on vehicle with a rope.
5. Remove engine room harness connectors as shown in the figure.



6. Disconnect two body ground cables.
7. Disconnect brake booster vacuum hose.
8. Disconnect fuel feed hose (with damper) and EVAP hose. Refer to [EM-37, "FUEL INJECTOR AND FUEL TUBE"](#) .

CAUTION:

Fit plugs onto disconnected hoses to prevent fuel leak.

9. Remove reservoir tank of power steering oil pump, and piping from vehicle, and temporarily secure them on engine.

CAUTION:

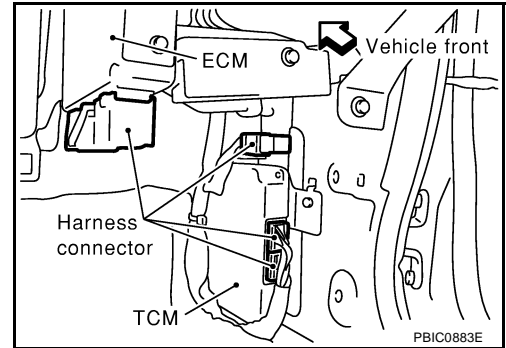
When temporarily securing, keep the reservoir tank upright to avoid a fluid leak.

ENGINE ASSEMBLY

Passenger Room Side

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

1. Remove passenger-side kicking plate, dash side finisher, and glove box. Refer to [EI-31, "BODY SIDE TRIM"](#) and [IP-10, "INSTRUMENT PANEL ASSEMBLY"](#).



2. Disconnect engine room harness connectors at unit sides TCM (A/T models), ECM and other.
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 foreign material adhesion.

Vehicle Underbody

1. Remove exhaust front tube. Refer to [EX-3, "EXHAUST SYSTEM"](#).
2. Disconnect steering lower joint at power steering gear assembly side, and release steering lower shaft. Refer to [PS-11, "STEERING COLUMN"](#).
3. Remove propeller shaft. Refer to [PR-4, "REAR PROPELLER SHAFT"](#).

CAUTION:

Do not impact or damage propeller shaft tube.

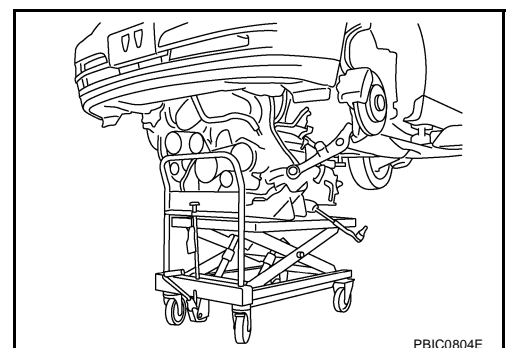
4. Disengage A/T control rod at control device assembly side. Then, temporarily secure it on transmission, so that it does not sag (A/T models). Refer to [AT-236, "SHIFT CONTROL SYSTEM"](#).
5. Disengage shift lever and clutch operating cylinder (M/T models). Refer to [MT-19, "TRANSMISSION ASSEMBLY"](#) and [CL-11, "OPERATING CYLINDER"](#).
6. Remove rear plate cover from oil pan (upper). Then, remove bolts fixing drive plate to torque converter (A/T models). Refer to [AT-274, "TRANSMISSION ASSEMBLY"](#).
7. Remove bolts fixing transmission to lower rear side of oil pan (upper). Refer to [MT-19, "TRANSMISSION ASSEMBLY"](#) (M/T models) or [AT-274, "TRANSMISSION ASSEMBLY"](#) (A/T models).
8. Remove front stabilizer. Refer to [FSU-18, "STABILIZER BAR"](#).
9. Remove outer sockets from steering knuckle. Refer to [PS-17, "POWER STEERING GEAR AND LINKAGE"](#).
10. Remove lower ends of left and right shock absorber from transverse links. Refer to [FSU-19, "FRONT SUSPENSION MEMBER"](#).

Removal Work

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

CAUTION:

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



ENGINE ASSEMBLY

2. Remove rear engine mounting member bolts.
3. Remove suspension member mounting bolts and nuts. Refer to [FSU-19, "FRONT SUSPENSION MEMBER"](#).
4. Carefully lower jack, or raise lift to remove engine, transmission and suspension member assembly. When performing work, observe the following caution.

CAUTION:

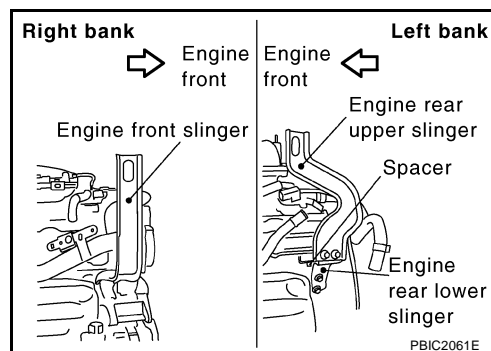
- Confirm there is no interference with vehicle.
- Make sure that all connection points have been disconnected.
- Keep in mind the center of vehicle gravity changes. If necessary, use jack(s) to support vehicle at rear jacking point(s) to prevent it from falling it off the lift.

Separation Work

1. Install engine slingers into front of right bank cylinder head and rear of left bank cylinder head.

Slinger bolts:

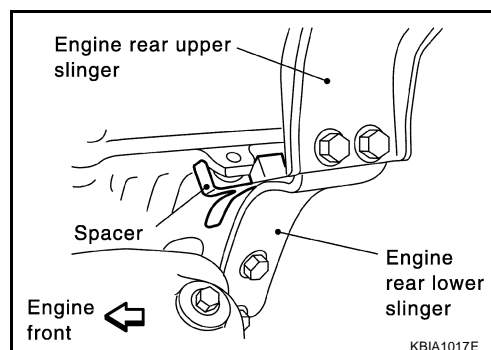
: 24.5 - 31.4 N·m (2.5 - 3.2 kg·m, 18 - 23 ft·lb)



- To protect rocker cover against damage caused by tilting of engine slinger, insert spacer between cylinder head and engine rear lower slinger, in direction shown in the figure.

NOTE:

Spacer is a component part of engine rear upper slinger assembly.



2. Remove power steering oil pump from engine side. Refer to [PS-29, "POWER STEERING OIL PUMP"](#).
3. Remove engine mounting insulators (RH and LH) under side nut.
4. Lift with hoist and separate engine and transmission assembly from suspension member.

CAUTION:

- Before and during this lifting, always check if any harnesses are left connected.
- Avoid damage to and oil/grease smearing or spills onto engine mounting insulator.

5. Remove alternator. Refer to [SC-21, "CHARGING SYSTEM"](#).
6. Remove starter motor. Refer to [SC-10, "STARTING SYSTEM"](#).
7. Separate engine from transmission. Refer to [MT-19, "TRANSMISSION ASSEMBLY"](#) (M/T models) or [AT-274, "TRANSMISSION ASSEMBLY"](#) (A/T models).
8. Remove engine mounting insulators (RH and LH) and brackets (RH and LH) from engine.
9. Remove engine mounting insulator (rear) and bracket (rear) from transmission.

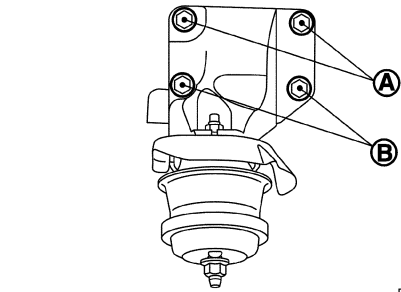
INSTALLATION

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

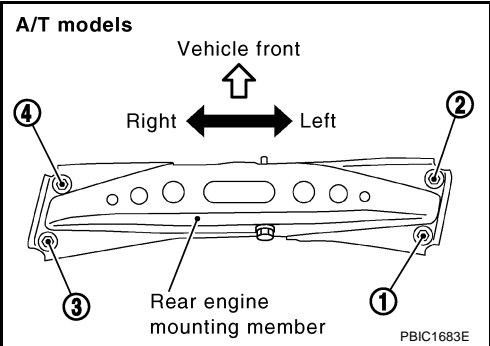
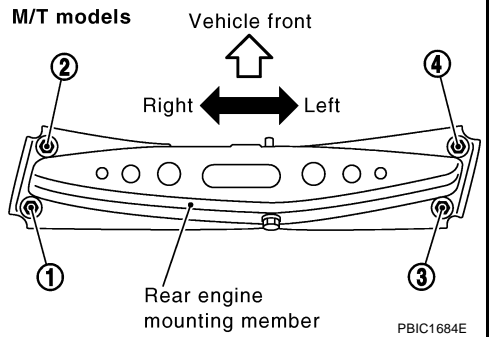
ENGINE ASSEMBLY

- For a location with a positioning pin, insert it securely into hole of mating part.
- For a part with a specified installation orientation, refer to component figure in [EM-104, "Removal and Installation"](#).
- When installing engine mounting brackets (RH and LH) on cylinder block, tighten two upper bolts (shown as "A" in the figure) first. Then tighten two lower bolts (shown as "B" in the figure).

Example: Left



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



INSPECTION AFTER INSTALLATION

Inspection for Leaks

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

- Before starting engine, check oil/fluid levels including engine coolant and engine oil. If less than required quantity, fill to the specified level. Refer to [MA-9, "RECOMMENDED FLUIDS AND LUBRICANTS"](#).
- Use procedure below to check for fuel leakage.
 - Turn ignition switch "ON" (with engine stopped). With fuel pressure applied to fuel piping, check for fuel leakage at connection points.
 - Start engine. With engine speed increased, check again for fuel leakage at connection points.
- Run engine to check for unusual noise and vibration.
- Warm up engine thoroughly to make sure there is no leakage of fuel, exhaust gases, or any oil/fluids including engine oil and engine coolant.
- Bleed air from lines and hoses of applicable lines, such as in cooling system.
- After cooling down engine, again check oil/fluid levels including engine oil and engine coolant. Refill to the specified level, if necessary.

ENGINE ASSEMBLY

Summary of the inspection items:

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

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

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CYLINDER BLOCK

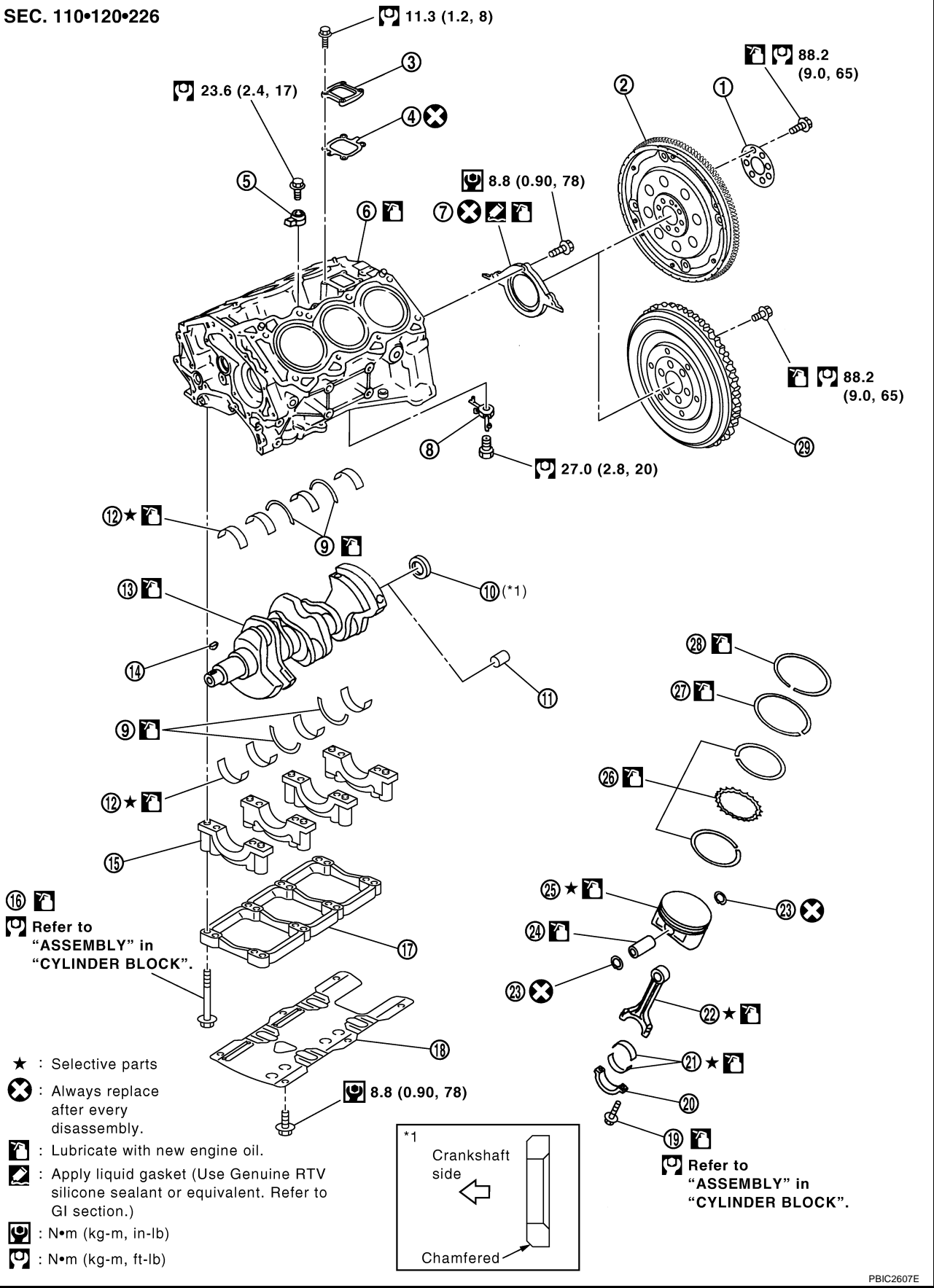
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CYLINDER BLOCK

Disassembly and Assembly

ABS00A15

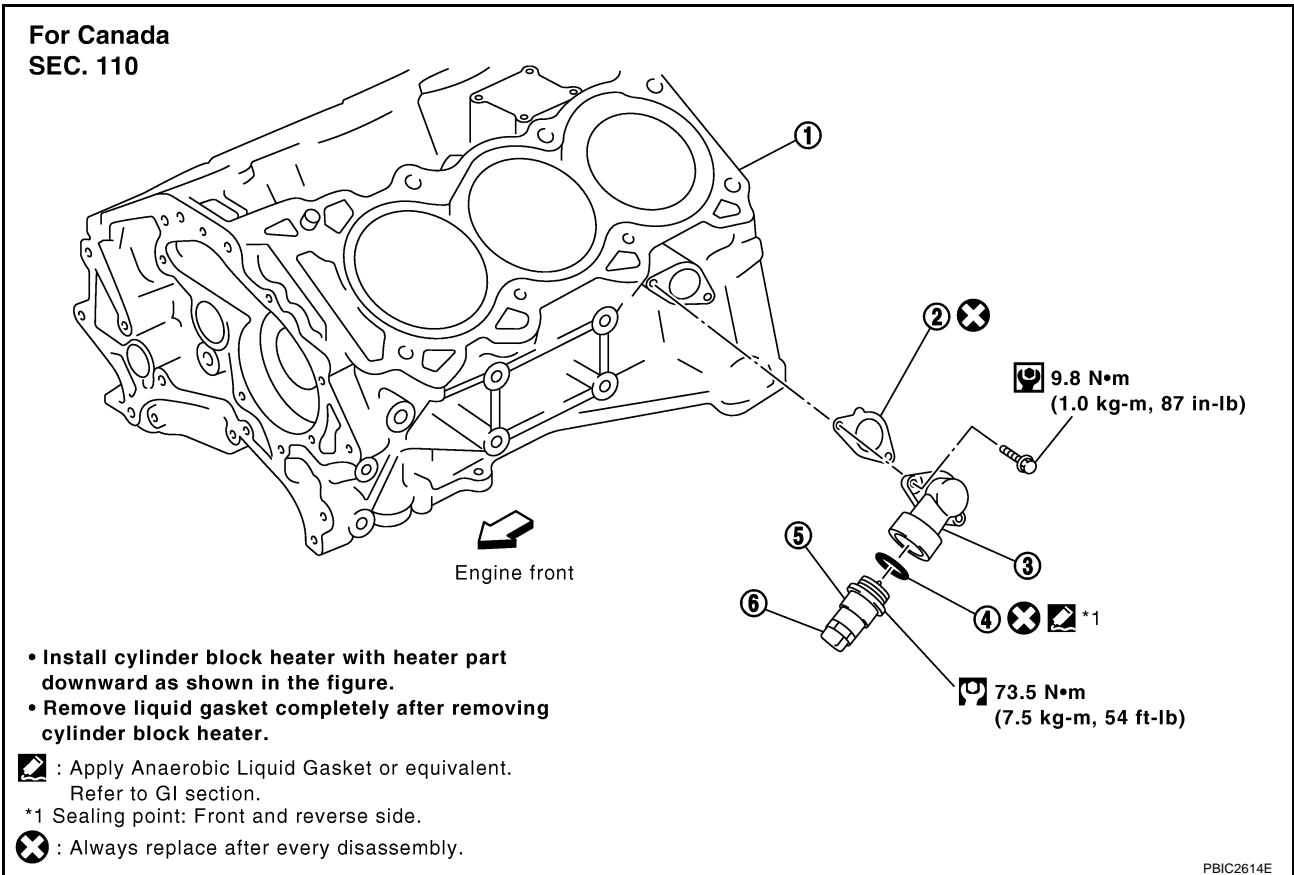
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CYLINDER BLOCK

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|----------------------------------|--------------------------------|----------------------------|
| 1. Reinforcement plate | 2. Drive plate (A/T models) | 3. Cover |
| 4. Gasket | 5. Knock sensor | 6. Cylinder block |
| 7. Rear oil seal retainer | 8. Oil jet | 9. Thrust bearing |
| 10. Pilot converter (A/T models) | 11. Pilot bushing (M/T models) | 12. Main bearing |
| 13. Crankshaft | 14. Crankshaft key | 15. Main bearing cap |
| 16. Main bearing cap bolt | 17. Main bearing beam | 18. Baffle plate |
| 19. Connecting rod bolt | 20. Connecting rod bearing cap | 21. Connecting rod bearing |
| 22. Connecting rod | 23. Snap ring | 24. Piston pin |
| 25. Piston | 26. Oil ring | 27. Second ring |
| 28. Top ring | 29. Flywheel (M/T models) | |



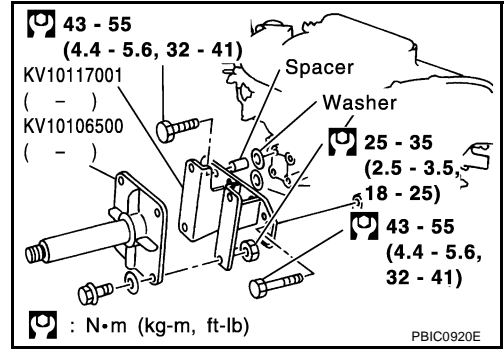
- | | | |
|-------------------|--------------------------|----------------------------|
| 1. Cylinder block | 2. Gasket | 3. Water connector |
| 4. Gasket | 5. Cylinder block heater | 6. Connector protector cap |

DISASSEMBLY

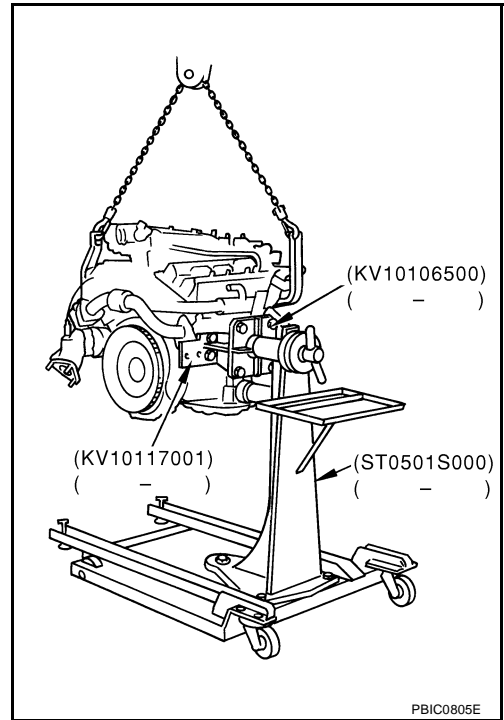
1. Remove engine assembly from vehicle, and separate suspension member and transmission from engine. Refer to [EM-104, "ENGINE ASSEMBLY"](#).
2. Remove engine mounting brackets. Refer to [EM-104, "ENGINE ASSEMBLY"](#).
3. Remove exhaust manifold (right bank). Refer to [EM-24, "EXHAUST MANIFOLD AND THREE WAY CATALYST"](#).

CYLINDER BLOCK

4. Install engine sub-attachment with engine stand shaft (SST) to right side of cylinder block.
 - Use spacer to engine rear side.



5. Lift engine, and mount it onto engine stand (SST).



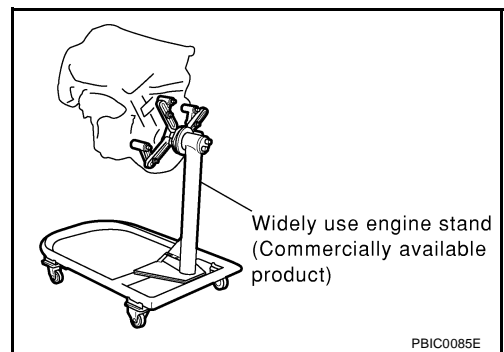
- A widely use engine stand can be used.

CAUTION:

Use engine stand that has a load capacity [approximately 220 kg (441 lb) or more] large enough for supporting the engine weight.

NOTE:

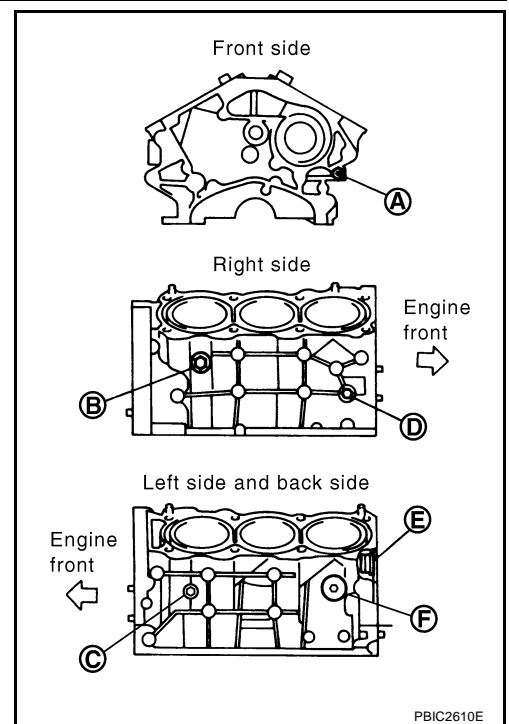
This example is engine stand for holding at transmission mounting side with flywheel (M/T models) or drive plate (A/T models) removed.



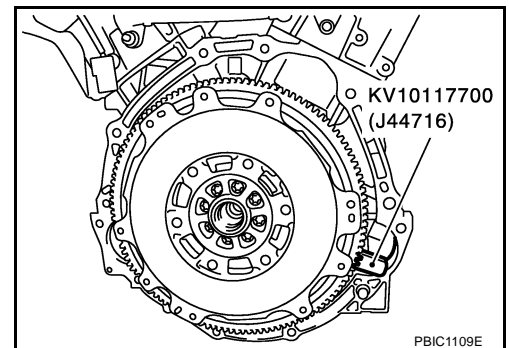
6. Drain engine oil. Refer to [LU-8, "Changing Engine Oil"](#).

CYLINDER BLOCK

7. Drain engine coolant by removing water drain plugs from cylinder block both sides at "B" and "C" and cylinder block front side at "A" as shown in the figure.

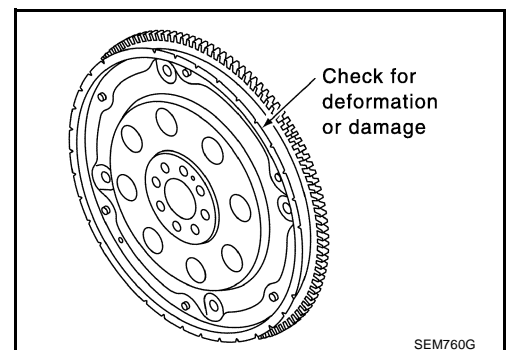


8. Remove clutch cover and clutch disc (M/T models). Refer to [CL-15, "CLUTCH DISC, CLUTCH COVER"](#).
9. Remove flywheel (M/T models) or drive plate (A/T models). Fix crankshaft with ring gear stopper (SST), and remove mounting bolts.
- Loosen mounting bolts in diagonal order.
 - Use TORX socket (size: T55, commercial service tool) for flywheel mounting bolts.



CAUTION:

- Do not disassemble flywheel (M/T models) or drive plate (A/T models).
- Never place flywheel (M/T models) or drive plate (A/T models) with signal plate facing down.
- When handling signal plate, take care not to damage or scratch it.
- Handle signal plate in a manner that prevents it from becoming magnetized.



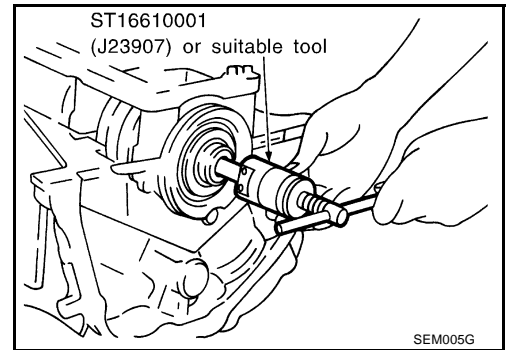
10. Remove cylinder head. Refer to [EM-92, "CYLINDER HEAD"](#).
11. Remove knock sensor.

CAUTION:

Carefully handle sensor avoiding shocks.

CYLINDER BLOCK

12. Remove pilot bushing (M/T models) or pilot converter (A/T models) using pilot bushing puller (SST) or suitable tool as necessary.



13. Remove rear oil seal retainer.

- Remove by inserting flat-bladed screwdriver between main bearing cap and rear oil seal retainer.

CAUTION:

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

NOTE:

Rear oil seal and retainer from a single part are handled as assembly.

14. Remove baffle plate from main bearing beam.

15. Remove piston and connecting rod assembly as follows:

- Before removing piston and connecting rod assembly, check the connecting rod side clearance. Refer to [EM-128, "CONNECTING ROD SIDE CLEARANCE"](#).

- a. Position crankshaft pin corresponding to connecting rod to be removed onto the bottom dead center.

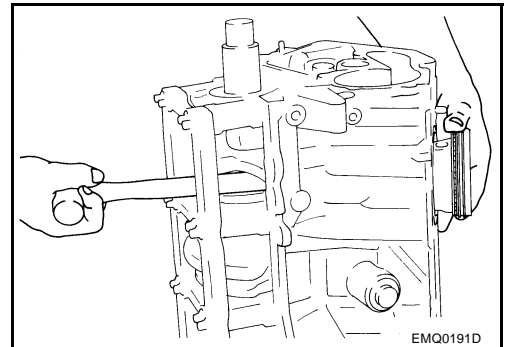
- b. Remove connecting rod cap.

- c. Using hammer handle or similar tool, push piston and connecting rod assembly out to the cylinder head side.

16. Remove connecting rod bearings from connecting rod and connecting rod cap.

CAUTION:

When removing them, note the installation position. Keep them in the correct order.



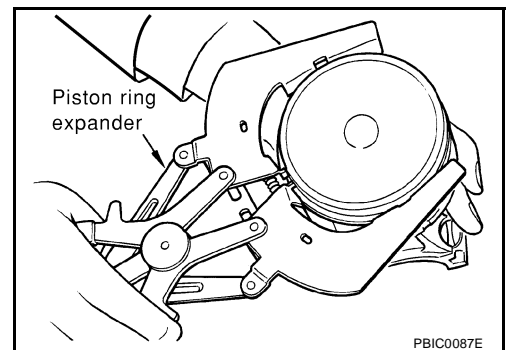
17. Remove piston rings from piston.

- Use piston ring expander (commercial service tool).

CAUTION:

- When removing piston rings, be careful not to damage piston.

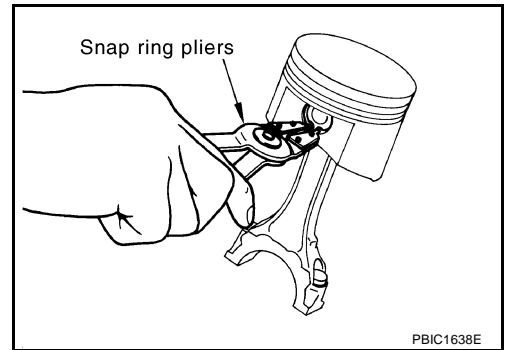
- Be careful not to damage piston rings by expanding them excessively.



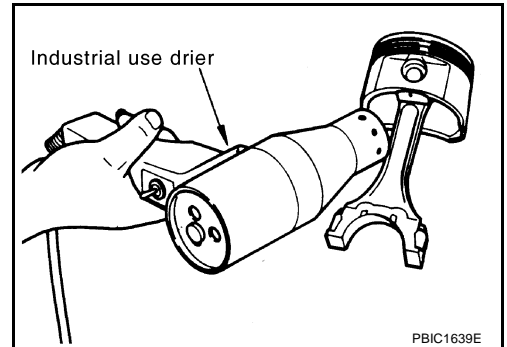
18. Remove piston from connecting rod as follows:

CYLINDER BLOCK

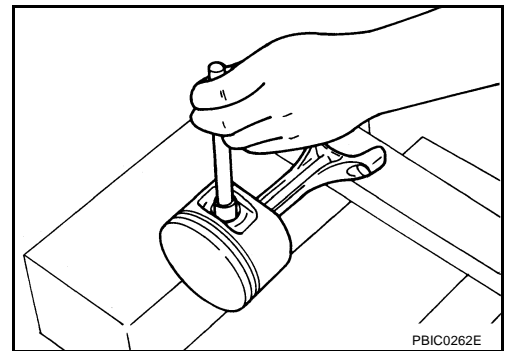
- a. Using snap ring pliers, remove snap ring.



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



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

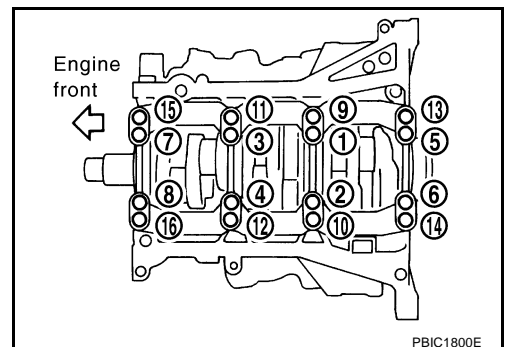


19. Remove main bearing cap bolts.

NOTE:

Use TORX socket (size E14).

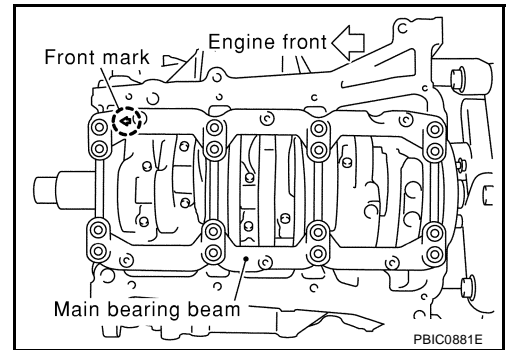
- Before loosening main bearing cap bolts, measure the crankshaft end play. Refer to [EM-128, "CRANK-SHAFT END PLAY"](#).
- Loosen bolts in reverse order shown in the figure in several different steps.



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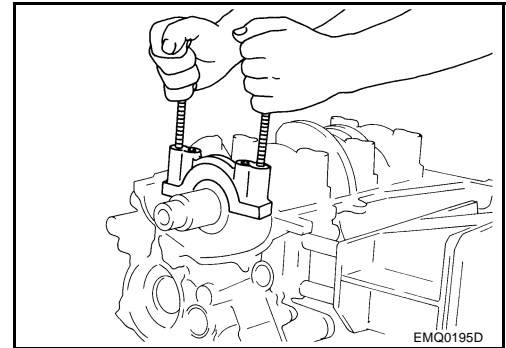
CYLINDER BLOCK

20. Remove main bearing beam.



21. Remove main bearing caps.

- Using main bearing cap bolts, remove main bearing cap while shaking it back-and-forth.



22. Remove crankshaft.

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

CAUTION:

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

24. Remove oil jet.

ASSEMBLY

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

CAUTION:

Use goggles to protect your eye.

2. Install each water drain plug to cylinder block as shown in the figure.

- Apply thread sealant to the thread of water drain plugs.
Use Genuine RTV Silicone Sealant or equivalent. Refer to [GI-46, "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS"](#).

Water drain plug (front) "A":

9.8 N·m (1.0 kg-m, 87 in-lb)

Water drain plug (RH) "B":

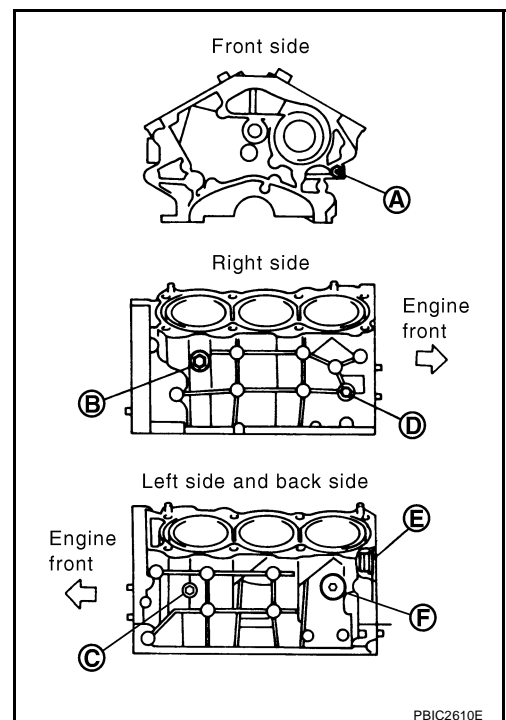
19.6 N·m (2.0 kg-m, 14 ft-lb)

Water drain plug (LH) "C":

19.6 N·m (2.0 kg-m, 14 ft-lb)


3. Install each plug to cylinder block as shown in the figure if removed.

- Apply thread sealant to the thread of plugs and install plugs with new gaskets.
Use Genuine High Strength Thread Locking Sealant or equivalent. Refer to [GI-46, "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS"](#).



CYLINDER BLOCK

Plug (RH) "D":

: 12.3 N·m (1.3 kg-m, 9 ft-lb)

Plug (rear) "E":

: 62 N·m (6.3 kg-m, 46 ft-lb)

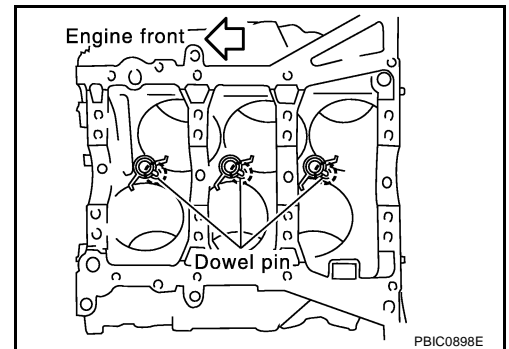
Use Anaerobic Liquid Gasket or equivalent. Refer to [GI-46, "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS"](#).

Plug (LH) "F":

: 62 N·m (6.3 kg-m, 46 ft-lb)

4. Install oil jet.

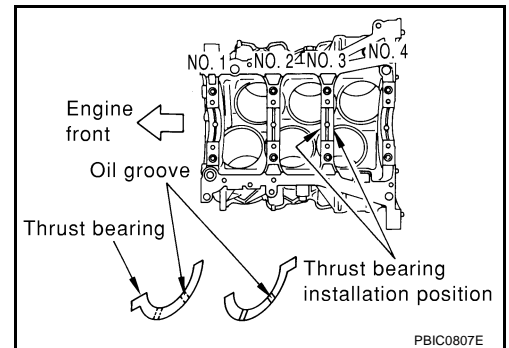
- Insert oil jet dowel pin into cylinder block dowel pin hole, and tighten mounting bolts.



5. Install main bearings and thrust bearings as follows:

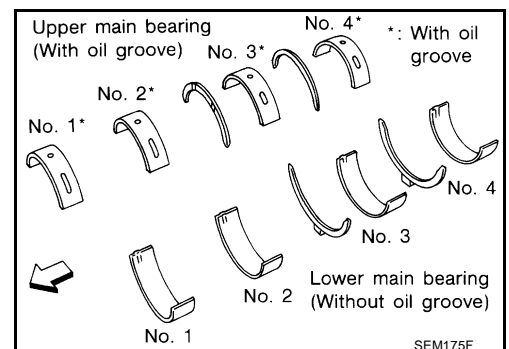
- Remove dust, dirt, and engine oil on bearing mating surfaces of cylinder block and main bearing caps.
- Install thrust bearings to the both sides of the No. 3 journal housing on cylinder block and main bearing cap.

- Install thrust bearings with the oil groove facing crankshaft arm (outside).
- Install bearing with a projection on one end on cylinder block, and bearing with a projection at center on cap. Align each projection with mating notch.



- Install main bearings paying attention to the direction.

- Main bearing with oil hole and groove goes on cylinder block. The one without them goes on main bearing cap.
- Before installing main bearings, apply engine oil to the bearing surface (inside). Do not apply engine oil to the back surface, but thoroughly clean it.
- When installing, align main bearing stopper protrusion to cut-out of cylinder block and main bearing caps.
- 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.

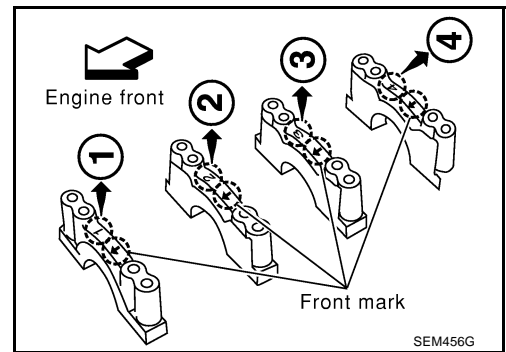
7. Install main bearing cap.

CYLINDER BLOCK

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

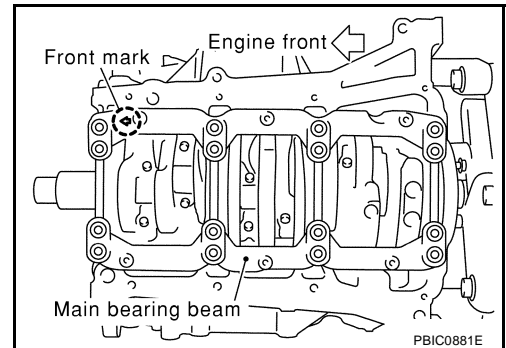
NOTE:

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



8. Install main bearing beam.


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

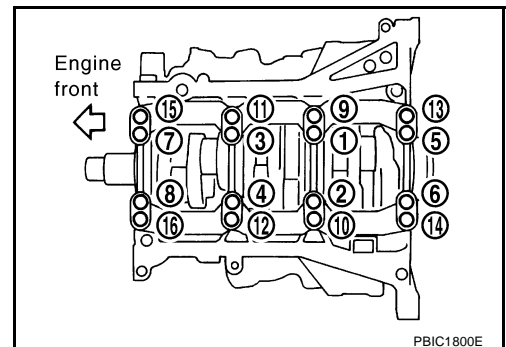


9. Inspect outer diameter of main bearing cap bolt. Refer to [EM-136. "MAIN BEARING CAP BOLT OUTER DIAMETER"](#).

10. Install main bearing cap bolt as follows:

- Apply new engine oil to threads and seat surfaces of mounting bolts.
- Tighten bolts in numerical order as shown in the figure in several different steps.

: 32.3 - 38.3 N·m (3.3 - 3.9 kg·m, 24 - 28 ft·lb)

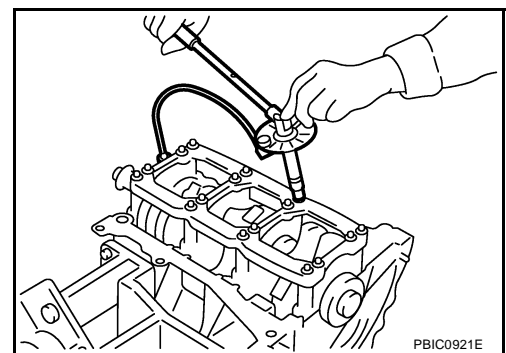


c. Turn all bolts another 90 to 95 degrees clockwise [Target: 90 degrees (Angle tightening)].

CAUTION:

Use angle wrench [SST: KV10112100 (BT8653-A)] to check tightening angle. Do not make judgment by visual inspection.

- After installing mounting bolts, make sure that crankshaft can be rotated smoothly by hand.
- Check crankshaft end play. Refer to [EM-128. "CRANKSHAFT END PLAY"](#).



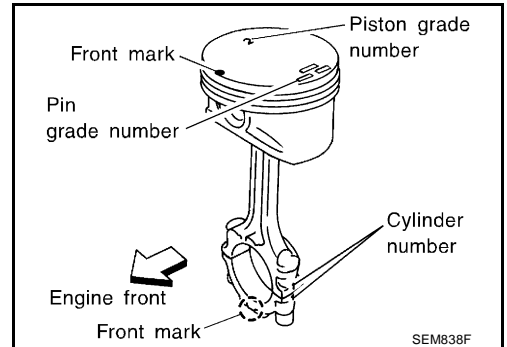
11. Inspect outer diameter of connecting rod bolt. Refer to [EM-137. "CONNECTING ROD BOLT OUTER DIAMETER"](#).

12. Install piston to connecting rod as follows:

- Using snap ring pliers, install new snap ring to the groove of piston rear side.

CYLINDER BLOCK

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



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

CAUTION:

Be careful not to damage piston.

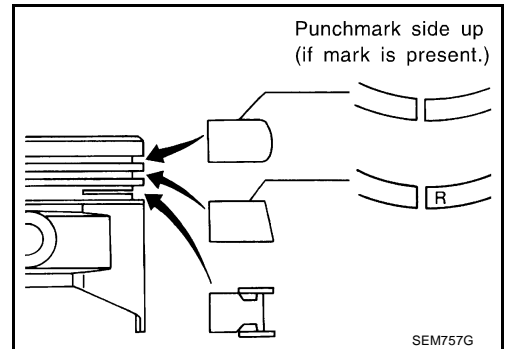
- If there is stamped mark on ring, mount it with marked side up.

NOTE:

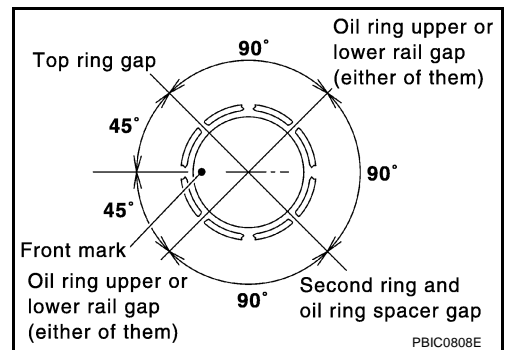
If there is no stamp on ring, no specific orientation is required for installation.

Stamped mark:

- Top ring** : —
- Second ring** : R

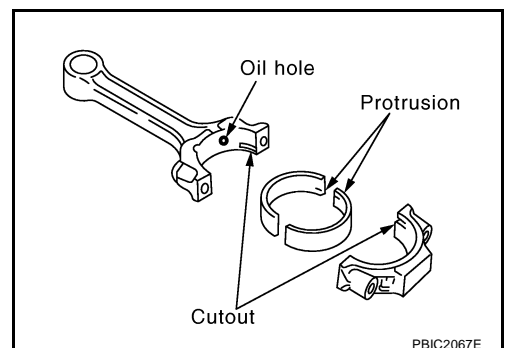


- Position each ring with the gap as shown in the figure referring to the piston front mark.



14. Install connecting rod bearings to connecting rod and connecting rod cap.

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



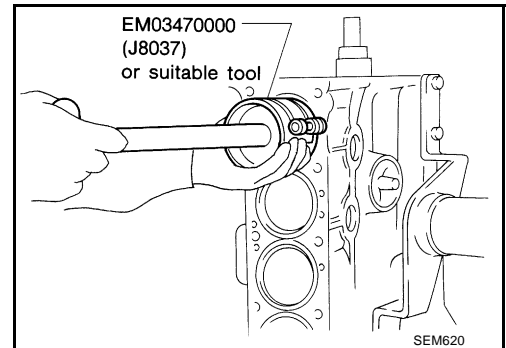
CYLINDER BLOCK

15. Install piston and connecting rod assembly to crankshaft.

- Position crankshaft pin corresponding to connecting rod to be installed onto the bottom dead center.
- Apply engine oil sufficiently to the cylinder bore, piston and crankshaft pin.
- Match the cylinder position with the cylinder number on connecting rod to install.
- Be sure that front mark on piston head is facing front of engine.
- Using piston ring compressor (SST) or suitable tool, install piston with the front mark on the piston head facing the front of engine.

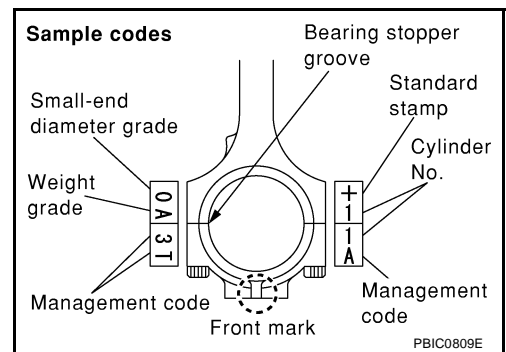
CAUTION:

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




16. Install connecting rod cap.

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



17. Tighten connecting rod bolt as follows:

- Apply engine oil to the threads and seats of connecting rod bolts.
- Tighten bolts.

 **18.6 - 20.6 N-m (1.9 - 2.1 kg-m, 14 - 15 ft-lb)**

- Then tighten all bolts 90 to 95 degrees clockwise [target: 90 degrees (Angle tightening)].

CAUTION:

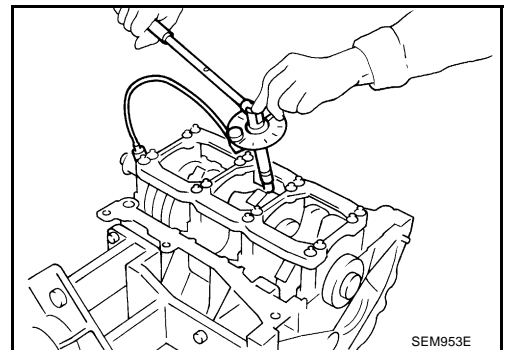
Always use angle wrench [SST: KV10112100 (BT8653-A)]. Avoid tightening based on visual check alone.

- After tightening bolt, make sure that crankshaft rotates smoothly.
- Check the connecting rod side clearance. Refer to [EM-128, "CONNECTING ROD SIDE CLEARANCE"](#).

18. Install baffle plate to main bearing beam.

19. Install rear oil seal retainer to cylinder block.

- Apply new engine oil to the oil and dust seal lips.



CYLINDER BLOCK

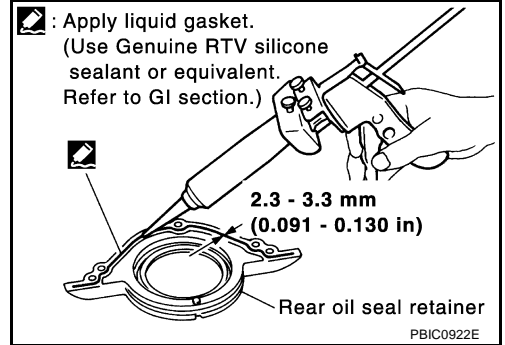
- Apply liquid gasket to rear oil seal retainer using tube presser [SST: WS39930000 (—)] as shown in the figure.
Use Genuine RTV Silicone Sealant or equivalent. Refer to [GI-46, "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS"](#).

CAUTION:

Replace with new parts.

NOTE:

Rear oil seal and retainer from a single part are handled as assembly.

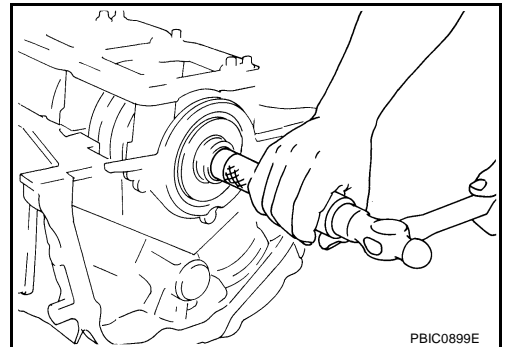


20. Install pilot bushing (M/T models) or pilot converter (A/T models).

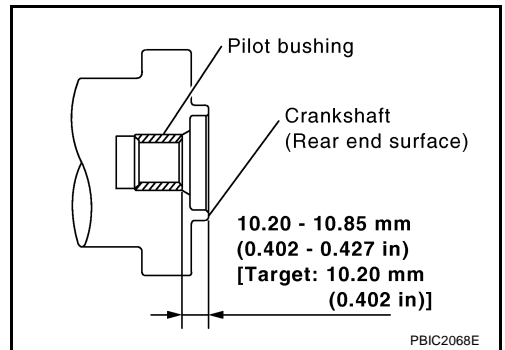
- With drift of the following outer diameter, press-fit as far as it will go.

Pilot bushing : Approx. 17 mm (0.67 in)

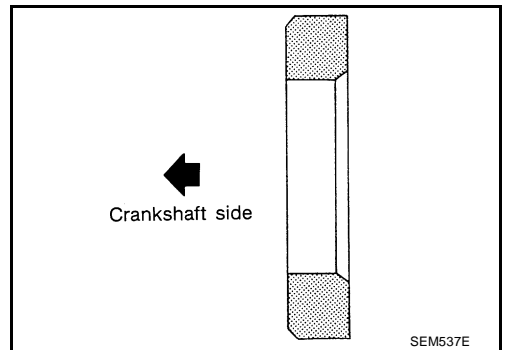
Pilot converter : Approx. 33 mm (1.30 in)



- Press-fit pilot bushing as the dimension in the figure. (M/T models)



- Press-fit pilot converter with its chamfer facing crankshaft as shown in the figure. (A/T models)



21. Install knock sensor.

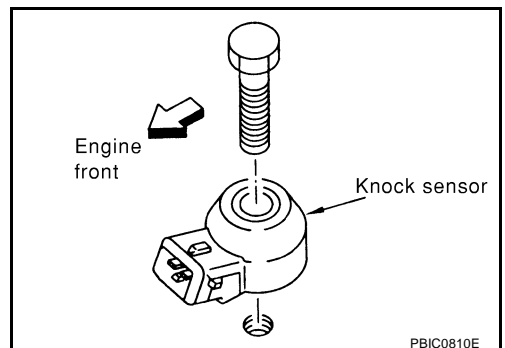
- Install knock sensor so that connector faces front of engine.
- After installing knock sensor, connect harness connector, and lay it out to rear of engine.

CAUTION:

- Do not tighten mounting bolts while holding connector.
- If any impact by dropping is applied to knock sensor, replace it with new one.

NOTE:

- Make sure that there is no foreign material on the cylinder block mating surface and the back surface of knock sensor.



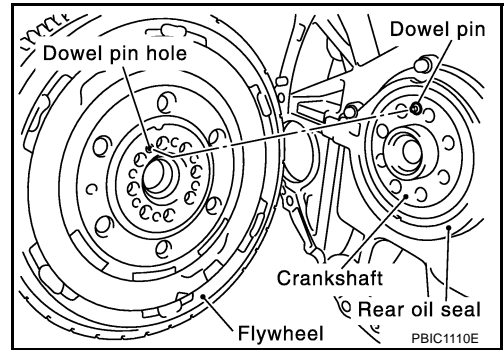
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CYLINDER BLOCK

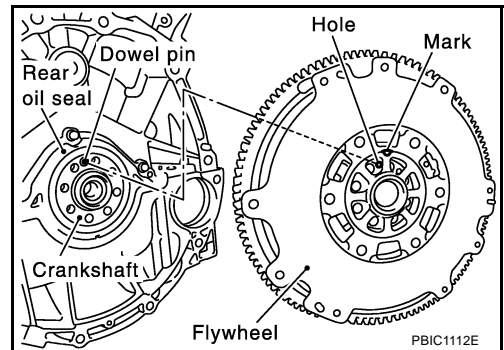
- Make sure that knock sensor does not interfere with other parts.
22. Note the following, and assemble in the reverse order of disassembly after this step.

Flywheel (M/T models)

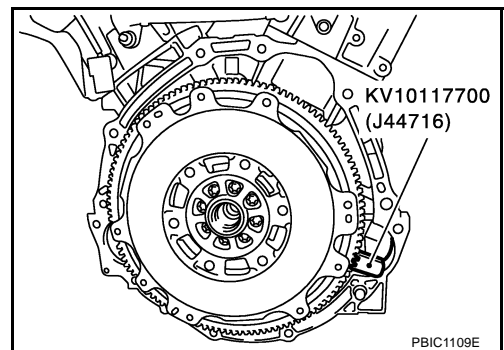
- When installing flywheel to crankshaft, be sure to correctly align crankshaft side dowel pin and flywheel side dowel pin hole.



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

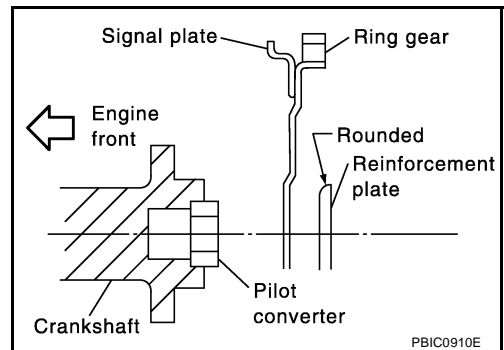


- Holding ring gear with ring gear stopper (SST), tighten securing bolts with TORX socket (size: T55, commercial service tool).
- Tighten mounting bolts crosswise over several times.



Drive plate (A/T models)

- Install drive plate and reinforcement plate as shown in the figure.
- Holding ring gear with ring gear stopper [SST: KV10117700 (J44716)].
- Tighten mounting bolts crosswise over several times.



CYLINDER BLOCK

ABS00A16

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)	Combining service grades for connecting rod big end diameter and crankshaft pin outer diameter determine connecting rod bearing selection.
Between cylinder block and piston	Piston and piston pin assembly (Piston is available together with piston pin as assembly.)	Piston grade (piston outer diameter)	Piston grade = cylinder bore grade (inner diameter of bore)
Between piston and connecting rod*	—	—	—

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

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

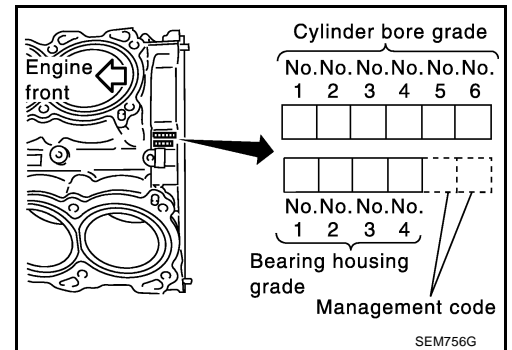
HOW TO SELECT PISTON

When New Cylinder Block is Used

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

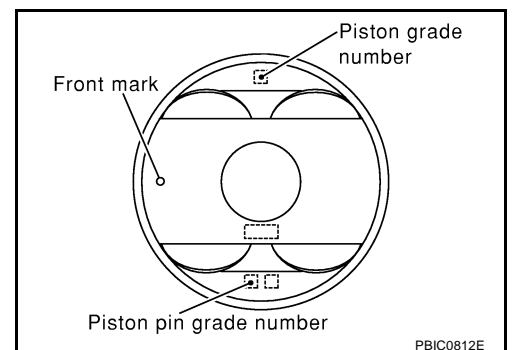
NOTE:

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



When Cylinder Block is Reused

1. Measure the cylinder bore inner diameter. Refer to [EM-132, "Cylinder Bore Inner Diameter"](#).
2. Determine the bore grade by comparing the measurement with the values under the cylinder bore inner diameter of the "Piston Selection Table".



3. Select piston of the same grade.

CYLINDER BLOCK

Piston Selection Table

Unit: mm (in)

Grade	1	2 (or no mark)	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.
- The piston pin (piston pin hole) grade is provided only for the parts installed at the plant. For service parts, no piston pin grades can be selected. (Only "0" grade is available.)
- No second grade mark is available on piston.

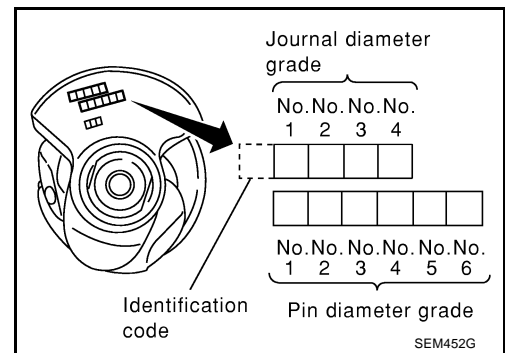
HOW TO SELECT CONNECTING ROD BEARING

When New Connecting Rod and Crankshaft are Used

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

NOTE:

There is no grading for connecting rod big end diameter.



When Crankshaft and Connecting Rod are Reused

1. Measure the connecting rod big end diameter. Refer to [EM-130, "CONNECTING ROD BIG END DIAMETER"](#).
2. Make sure the connecting rod big end diameter is within the standard value.
3. Measure the crankshaft pin journal diameter. Refer to [EM-134, "CRANKSHAFT PIN JOURNAL DIAMETER"](#).
4. Determine the grade of crankshaft pin journal diameter grade by corresponding to the measured dimension in "Crankshaft pin journal diameter" column of "Connecting Rod Bearing Selection Table".
5. Select connecting rod bearing of the same grade.

Connecting Rod Bearing Selection Table

Unit: mm (in)

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

Unit: mm (in)

Crankshaft pin journal diameter	Grade (Mark)	Dimension (Bearing thickness range)	Bearing grade No.	Color
51.968 - 51.974 (2.0460 - 2.0462)	0	1.500 - 1.503 (0.0591 - 0.0592)	STD 0	Black
51.962 - 51.968 (2.0457 - 2.0460)	1	1.503 - 1.506 (0.0592 - 0.0593)	STD 1	Brown
51.956 - 51.962 (2.0455 - 2.0457)	2	1.506 - 1.509 (0.0593 - 0.0594)	STD 2	Green

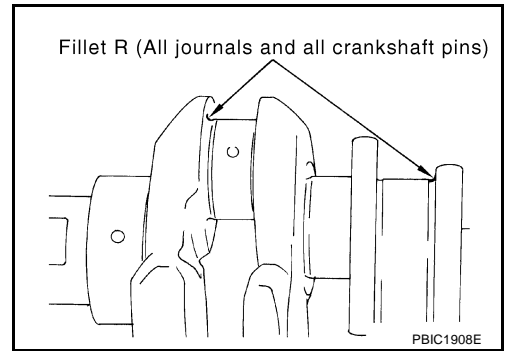
Undersize Bearings Usage Guide

- When the specified connecting rod bearing oil clearance is not obtained with standard size connecting rod bearings, use undersize (US) bearings.
- When using undersize 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.

CYLINDER BLOCK

CAUTION:

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



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Bearing undersize table

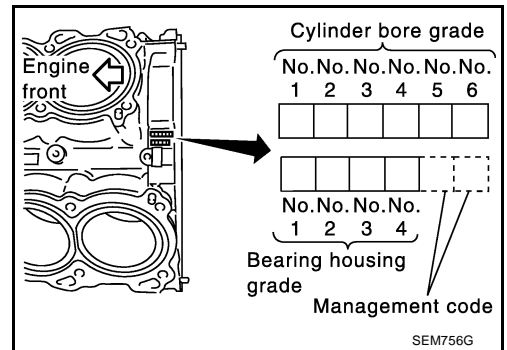
Unit: mm (in)

Size	Thickness
US 0.25 (0.0098)	1.626 - 1.634 (0.0640 - 0.0643)

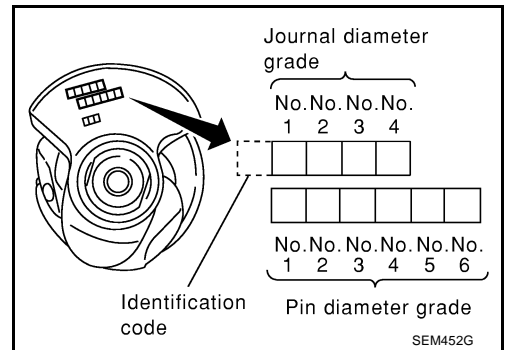
HOW TO SELECT MAIN BEARING

When New Cylinder Block and Crankshaft are Used

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



2. "Main Bearing Selection Table" columns correspond to journal diameter grade on front side of crankshaft.



3. Select main bearing grade at the point where selected row and column meet in "Main Bearing Selection Table".

When Cylinder Block and Crankshaft are Reused

1. Measure the cylinder block main bearing housing inner diameter and crankshaft main journal diameter. Refer to [EM-132, "MAIN BEARING HOUSING INNER DIAMETER"](#) and [EM-133, "CRANKSHAFT MAIN JOURNAL DIAMETER"](#).
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. Select main bearing grade at the point where selected row and column meet in the following selection table.

CYLINDER BLOCK

Main Bearing Selection Table

Cylinder block main bearing housing inner diameter Unit: mm (in)		Crankshaft main journal diameter Unit: mm (in)		Hole diameter																											
				Mark																											
Mark	Axle diameter	A	B	C	D	E	F	G	H	J	K	L	M	N	P	R	S	T	U	V	W	X	Y	4	7						
A	59.975 - 59.974 (2.3612 - 2.3612)	0	0	0	0	01	01	01	1	1	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34					
B	59.974 - 59.973 (2.3612 - 2.3611)	0	0	01	01	01	1	1	1	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4					
C	59.973 - 59.972 (2.3611 - 2.3611)	0	01	01	01	1	1	1	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4					
D	59.972 - 59.971 (2.3611 - 2.3611)	01	01	01	1	1	1	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4					
E	59.971 - 59.970 (2.3611 - 2.3610)	01	01	1	1	1	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45					
F	59.970 - 59.969 (2.3610 - 2.3610)	01	1	1	1	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	4	45					
G	59.969 - 59.968 (2.3610 - 2.3609)	1	1	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	4	45	45	45					
H	59.968 - 59.967 (2.3609 - 2.3609)	1	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	4	45	45	45	5					
J	59.967 - 59.966 (2.3609 - 2.3609)	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	4	45	45	45	5	5					
K	59.966 - 59.965 (2.3608 - 2.3608)	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	4	45	45	45	5	5	5					
L	59.965 - 59.964 (2.3608 - 2.3608)	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	4	45	45	45	5	5	5	56					
M	59.964 - 59.963 (2.3608 - 2.3607)	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	4	45	45	45	5	5	5	5	56					
N	59.963 - 59.962 (2.3607 - 2.3607)	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45	5	5	5	5	5	5	56					
P	59.962 - 59.961 (2.3607 - 2.3607)	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45	5	5	5	5	5	5	5	56					
R	59.961 - 59.960 (2.3607 - 2.3606)	2	23	23	23	3	3	3	34	34	34	4	4	4	4	45	45	45	5	5	5	5	5	5	5	56					
S	59.960 - 59.959 (2.3606 - 2.3606)	23	23	23	3	3	3	34	34	34	4	4	4	4	45	45	45	5	5	5	5	5	5	5	5	56					
T	59.959 - 59.958 (2.3606 - 2.3605)	23	23	3	3	3	34	34	34	4	4	4	4	45	45	45	5	5	5	5	5	5	5	5	5	56					
U	59.958 - 59.957 (2.3605 - 2.3605)	23	3	3	3	34	34	34	4	4	4	4	45	45	45	5	5	5	5	5	5	5	5	5	5	56					
V	59.957 - 59.956 (2.3605 - 2.3605)	3	3	3	34	34	34	4	4	4	4	45	45	45	5	5	5	5	5	5	5	5	5	5	5	56					
W	59.956 - 59.955 (2.3605 - 2.3604)	3	3	34	34	34	4	4	4	4	45	45	45	5	5	5	5	5	5	5	5	5	5	5	5	56					
X	59.955 - 59.954 (2.3604 - 2.3604)	3	34	34	34	4	4	4	4	45	45	45	5	5	5	5	5	5	5	5	5	5	5	5	5	56					
Y	59.954 - 59.953 (2.3604 - 2.3603)	34	34	34	4	4	4	4	45	45	45	5	5	5	5	5	5	5	5	5	5	5	5	5	5	56					
4	59.953 - 59.952 (2.3603 - 2.3603)	34	34	4	4	4	4	45	45	45	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	56					
7	59.952 - 59.951 (2.3603 - 2.3603)	34	4	4	4	4	45	45	45	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	56					

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CYLINDER BLOCK

Main Bearing Grade Table (All Journals)

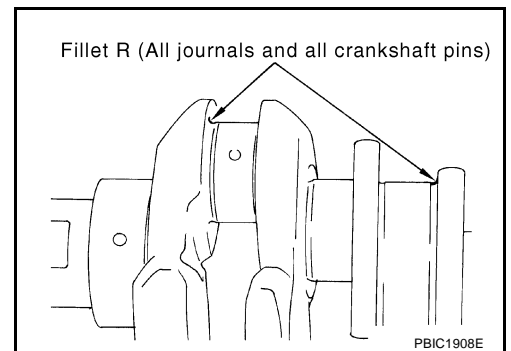
Grade number	Thickness Unit: mm (in)	Width Unit: mm (in)	Identification color	Remarks	
0	2.000 - 2.003 (0.0787 - 0.0789)	19.9 - 20.1 (0.783 - 0.791)	Black	Grade is the same for upper and lower bearings.	
1	2.003 - 2.006 (0.0789 - 0.0790)		Brown		
2	2.006 - 2.009 (0.0790 - 0.0791)		Green		
3	2.009 - 2.012 (0.0791 - 0.0792)		Yellow		
4	2.012 - 2.015 (0.0792 - 0.0793)		Blue		
5	2.015 - 2.018 (0.0793 - 0.0794)		Pink		
6	2.018 - 2.021 (0.0794 - 0.0796)		Purple		
7	2.021 - 2.024 (0.0796 - 0.0797)		White	Grade is different for upper and lower bearings.	
01	UPR		2.003 - 2.006 (0.0789 - 0.0790)		Brown
	LWR		2.000 - 2.003 (0.0787 - 0.0789)		Black
12	UPR		2.006 - 2.009 (0.0790 - 0.0791)		Green
	LWR		2.003 - 2.006 (0.0789 - 0.0790)		Brown
23	UPR		2.009 - 2.012 (0.0791 - 0.0792)		Yellow
	LWR		2.006 - 2.009 (0.0790 - 0.0791)		Green
34	UPR	2.012 - 2.015 (0.0792 - 0.0793)	Blue		
	LWR	2.009 - 2.012 (0.0791 - 0.0792)	Yellow		
45	UPR	2.015 - 2.018 (0.0793 - 0.0794)	Pink		
	LWR	2.012 - 2.015 (0.0792 - 0.0793)	Blue		
56	UPR	2.018 - 2.021 (0.0794 - 0.0796)	Purple		
	LWR	2.015 - 2.018 (0.0793 - 0.0794)	Pink		
67	UPR	2.021 - 2.024 (0.0796 - 0.0797)	White		
	LWR	2.018 - 2.021 (0.0794 - 0.0796)	Purple		

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 [1.5 mm (0.059 in)].



Bearing undersize table

Unit: mm (in)

Size	Thickness
US 0.25 (0.0098)	2.132 - 2.140 (0.0839 - 0.0843)

CYLINDER BLOCK

ABS00A17

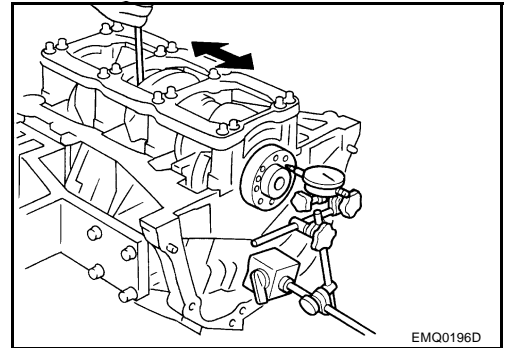
Inspection After Disassembly CRANKSHAFT END PLAY

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

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

Limit : 0.30 mm (0.0118 in)

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



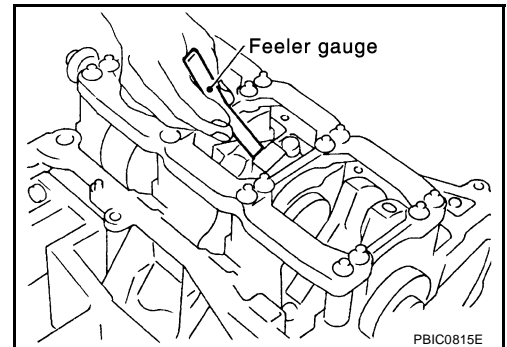
CONNECTING ROD SIDE CLEARANCE

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

Standard : 0.20 - 0.35 mm (0.0079 - 0.0138 in)

Limit : 0.40 mm (0.0157 in)

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

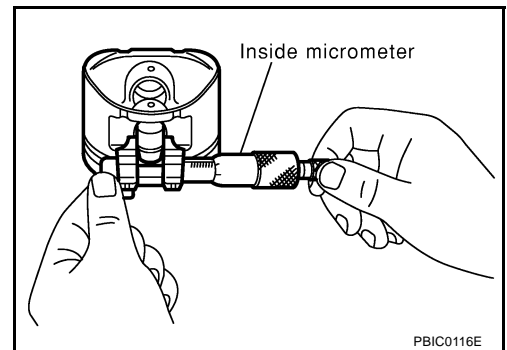


PISTON TO PISTON PIN OIL CLEARANCE

Piston Pin Hole Diameter

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

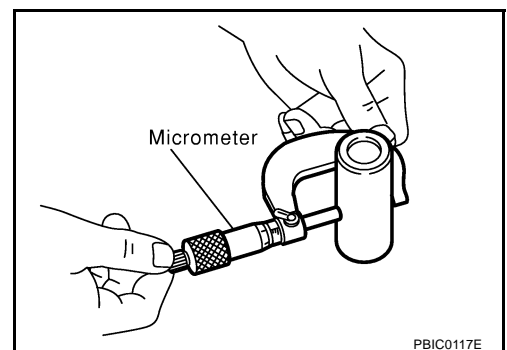
Standard : 21.993 - 22.005 mm (0.8659 - 0.8663 in)



Piston Pin Outer Diameter

Measure the outer diameter of piston pin with micrometer.

Standard : 21.989 - 22.001 mm (0.8657 - 0.8662 in)



Piston to Piston Pin Oil Clearance

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

Standard : 0.002 - 0.006 mm (0.0001 - 0.0002 in)

- If clearance is out of the standard, replace piston and piston pin assembly.

CYLINDER BLOCK

- When replacing piston and piston pin assembly, refer to [EM-132, "PISTON TO CYLINDER BORE CLEARANCE"](#).

NOTE:

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

PISTON RING SIDE CLEARANCE

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

Standard:

Top ring : 0.045 - 0.080 mm (0.0018 - 0.0031 in)

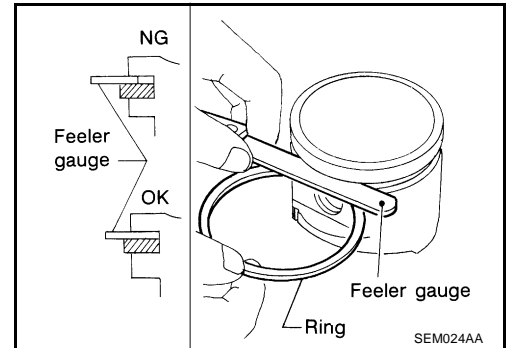
2nd ring : 0.030 - 0.070 mm (0.0012 - 0.0028 in)

Oil ring : 0.065 - 0.135 mm (0.0026 - 0.0053 in)

Limit:

Top ring : 0.11 mm (0.0043 in)

2nd ring : 0.1 mm (0.004 in)



- If the measured value exceeds the limit, replace piston ring, and measure again. If it still exceeds the limit, replace piston also.

PISTON RING END GAP

- Make sure that cylinder bore inner diameter is within specification. Refer to [EM-132, "Cylinder Bore Inner Diameter"](#).
- Lubricate with new engine oil to piston and piston ring, and then insert piston ring until middle of cylinder with piston, and measure the piston ring end gap with feeler gauge.

Standard:

Top ring : 0.23 - 0.33 mm (0.0091 - 0.0130 in)

2nd ring : 0.33 - 0.48 mm (0.0130 - 0.0189 in)

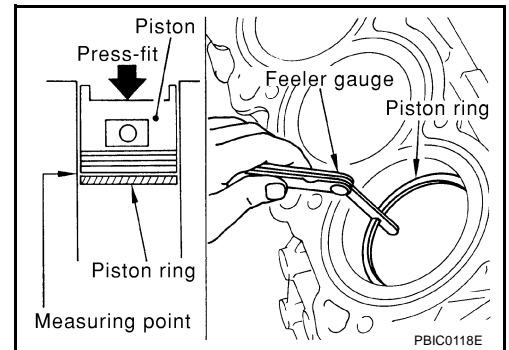
Oil ring : 0.20 - 0.50 mm (0.0079 - 0.0197 in)

Limit:

Top ring : 0.54 mm (0.0213 in)

2nd ring : 0.80 mm (0.0315 in)

Oil ring : 0.95 mm (0.0374 in)



- 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.

CYLINDER BLOCK

CONNECTING ROD BEND AND TORSION

- Check with connecting rod aligner.

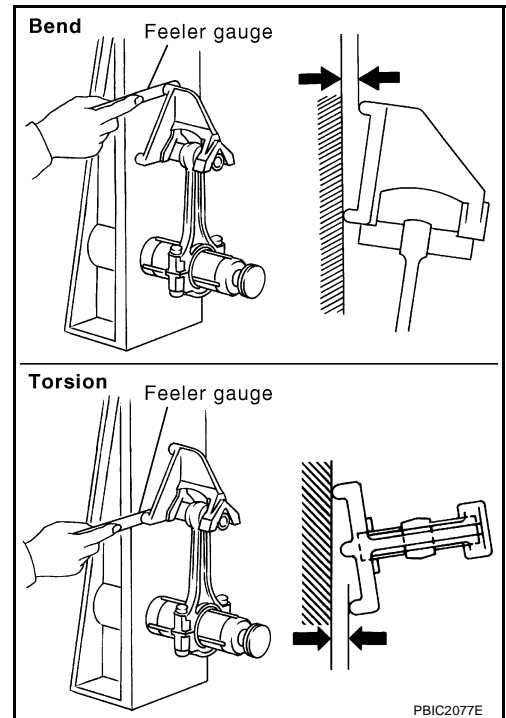
Bend:

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

Torsion:

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

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

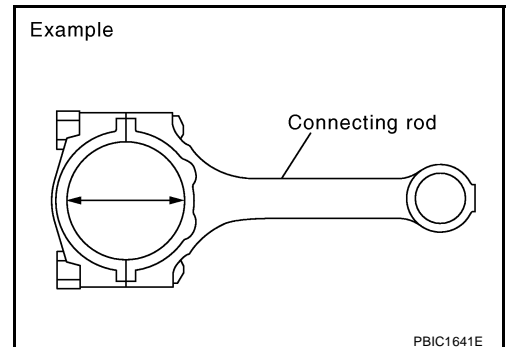


CONNECTING ROD BIG END DIAMETER

- Install connecting rod cap without connecting rod bearing installed, and tightening connecting rod bolts to the specified torque. Refer to [EM-116, "ASSEMBLY"](#) for the tightening procedure.
- Measure the inner diameter of connecting rod big end with inside micrometer.

Standard : 55.000 - 55.013 mm (2.1654 - 2.1659 in)

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

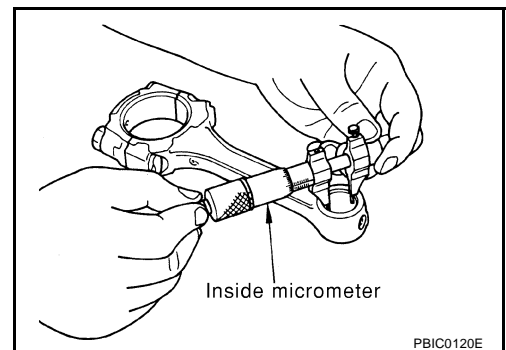


CONNECTING ROD BUSHING OIL CLEARANCE

Connecting Rod Bushing Inner Diameter

Measure the inner diameter of connecting rod bushing with inside micrometer.

Standard : 22.000 - 22.012 mm (0.8661 - 0.8666 in)

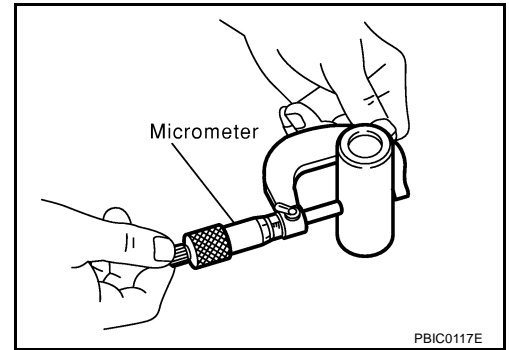


CYLINDER BLOCK

Piston Pin Outer Diameter

Measure the outer diameter of piston pin with micrometer.

Standard : 21.989 - 22.001 mm (0.8657 - 0.8662 in)



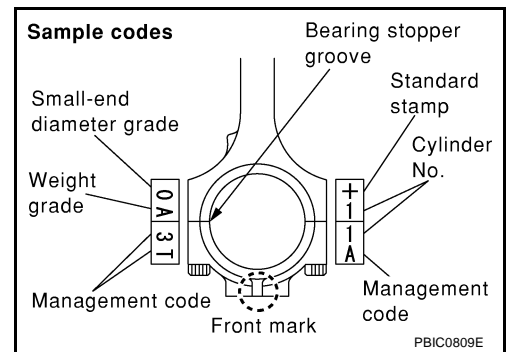
Connecting Rod Bushing Oil Clearance

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

Standard : 0.005 - 0.017 mm (0.0002 - 0.0007 in)

Limit : 0.030 mm (0.0012 in)

- If the measured value exceeds the limit, replace connecting rod assembly and/or piston and piston pin assembly.
- If replacing piston and piston pin assembly, refer to [EM-132, "PISTON TO CYLINDER BORE CLEARANCE"](#).
- If replacing connecting rod assembly, refer to [EM-134, "CONNECTING ROD BEARING OIL CLEARANCE"](#) to select connecting rod bearing.

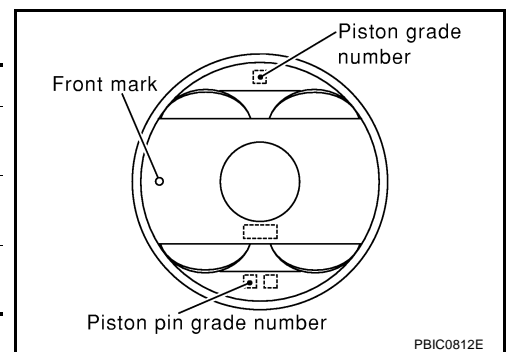


Factory installed parts grading:

- Service parts apply only to grade "0".

Grade	Unit: mm (in)	
	0	1
Connecting rod bushing inner diameter *	22.000 - 22.006 (0.8661 - 0.8664)	22.006 - 22.012 (0.8664 - 0.8666)
Piston pin hole diameter	21.993 - 21.999 (0.8659 - 0.8661)	21.999 - 22.005 (0.8661 - 0.8663)
Piston pin outer diameter	21.989 - 21.995 (0.8657 - 0.8659)	21.995 - 22.001 (0.8659 - 0.8662)

*: After installing in connecting rod



CYLINDER BLOCK DISTORTION

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

CAUTION:

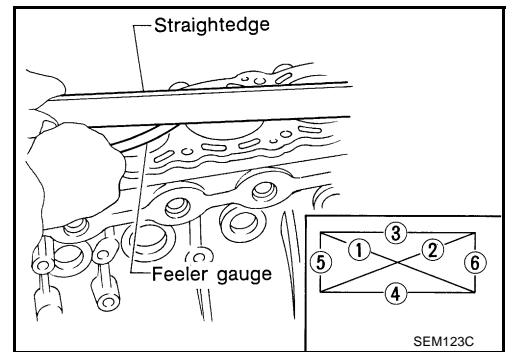
Be careful not to allow gasket flakes to enter engine oil or engine coolant passages.

CYLINDER BLOCK

- Measure the distortion on the cylinder block upper face at some different points in six directions with straightedge and feeler gauge.

Limit : 0.1 mm (0.004 in)

- If it exceeds the limit, replace cylinder block.



MAIN BEARING HOUSING INNER DIAMETER

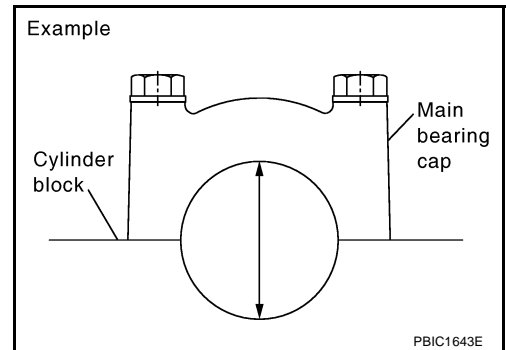
- Install main bearing caps and main bearing beam without installing main bearings, and tighten main bearing cap bolts to the specified torque. Refer to [EM-116, "ASSEMBLY"](#) for the tightening procedure.
- Measure the inner diameter of main bearing housing with bore gauge.

Standard : 63.993 - 64.017 mm (2.5194 - 2.5203 in)

- If out of the standard, replace cylinder block and main bearing caps as assembly.

NOTE:

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



PISTON TO CYLINDER BORE CLEARANCE

Cylinder Bore Inner Diameter

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

Standard inner diameter:

95.500 - 95.530 mm (3.7598 - 3.7610 in)

Wear limit:

0.2 mm (0.008 in)

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

0.015 mm (0.0006 in)

Taper limit (Difference between "A" and "C"):

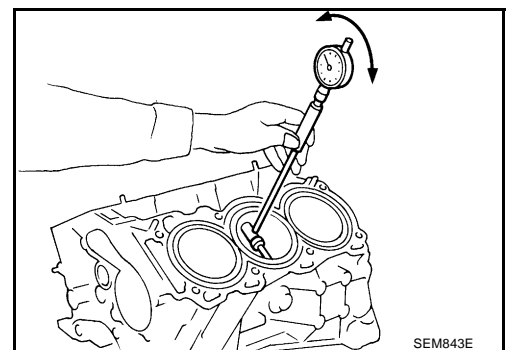
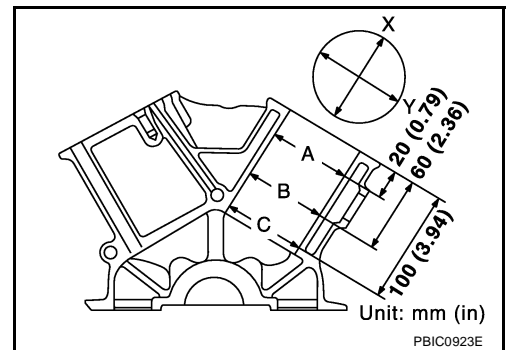
0.01 mm (0.0004 in)

- If the measured value exceeds the limit, or if there are scratches and/or seizure on the cylinder inner wall, hone or 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 it for all cylinders with oversize piston rings.

Oversize (OS) : 0.2 mm (0.008 in)



CYLINDER BLOCK

Piston Skirt Diameter

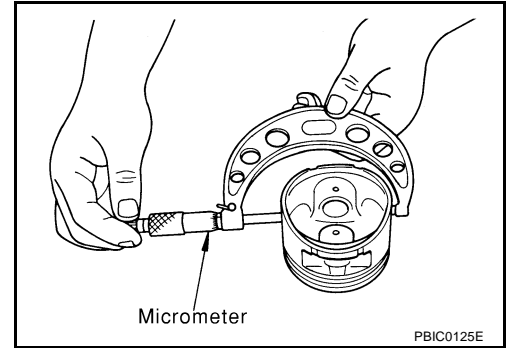
Measure the outer diameter of piston skirt with micrometer.

Measure point

: Distance from the top 41.0 mm (1.614 in)

Standard

: 95.480 - 95.510 mm (3.7590 - 3.7602 in)



Piston to Cylinder Bore Clearance

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

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

Limit : 0.08 mm (0.0031 in)

- If it exceeds the limit, replace piston and piston pin assembly. Refer to [EM-123, "HOW TO SELECT PISTON"](#).

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,

D: Bored diameter

A: Piston skirt diameter as measured

B: Piston to cylinder bore clearance (standard value)

C: Honing allowance 0.02 mm (0.0008 in)

2. Install main bearing caps and main bearing beam, 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 specified piston to cylinder bore clearance.

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

NOTE:

Measurement should be done after cylinder bore cools down.

CRANKSHAFT MAIN JOURNAL DIAMETER

- Measure the outer diameter of crankshaft main journals with micrometer.

Standard : 59.951 - 59.975 mm (2.3603 - 2.3612 in) dia.

- If out of the standard, measure the main bearing oil clearance. Then use undersize bearing. Refer to [EM-135, "MAIN BEARING OIL CLEARANCE"](#).

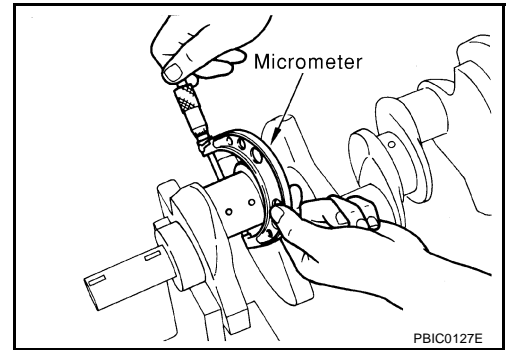
CYLINDER BLOCK

CRANKSHAFT PIN JOURNAL DIAMETER

- Measure the outer diameter of crankshaft pin journal with micrometer.

Standard : 51.956 - 51.974 mm (2.0455 - 2.0462 in) dia.

- If out of the standard, measure the connecting rod bearing oil clearance. Then use undersize bearing. Refer to [EM-134](#), "[CONNECTING ROD BEARING OIL CLEARANCE](#)".



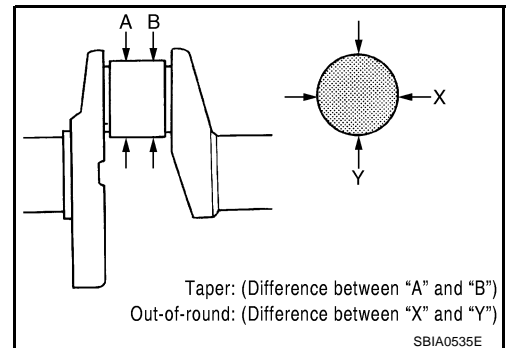
CRANKSHAFT OUT-OF-ROUND AND TAPER

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

Limit:

**Out-of-round (Difference between "X" and "Y")
: 0.002 mm (0.0001 in)**

**Taper (Difference between "A" and "B")
: 0.002 mm (0.0001 in)**



- If the measured value exceeds the limit, correct or replace crankshaft.
- If corrected, measure the bearing oil clearance of the corrected main journal and/or pin journal. Then select the main bearing and/or connecting rod bearing. Refer to [EM-135](#), "[MAIN BEARING OIL CLEARANCE](#)" and/or [EM-134](#), "[CONNECTING ROD BEARING OIL CLEARANCE](#)".

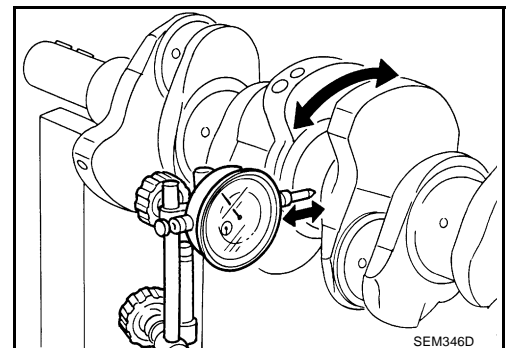
CRANKSHAFT RUNOUT

- Place V-block on precise flat table, and support the journals on the both end of crankshaft.
- Place dial indicator straight up on the No. 3 journal.
- While rotating crankshaft, read the movement of the pointer on dial indicator. (Total indicator reading)

Standard : Less than 0.05 mm (0.002 in)

Limit : 0.10 mm (0.0039 in)

- If it exceeds the limit, replace crankshaft.



CONNECTING ROD BEARING OIL CLEARANCE

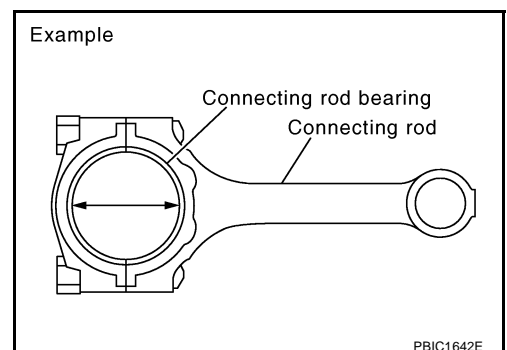
Method by Calculation

- Install connecting rod bearings to connecting rod and cap, and tighten connecting rod bolts to the specified torque. Refer to [EM-116](#), "[ASSEMBLY](#)" for the tightening procedure.
- Measure the inner diameter of connecting rod bearing with inside micrometer.

(Bearing oil clearance) = (Connecting rod bearing inner diameter) – (Crankshaft pin journal diameter)

**Standard : 0.034 - 0.059 mm (0.0013 - 0.0023 in)
(actual clearance)**

Limit : 0.070 mm (0.0028 in)



CYLINDER BLOCK

- If clearance exceeds the limit, select proper connecting rod bearing according to connecting rod big end diameter and crankshaft pin journal diameter to obtain specified bearing oil clearance. Refer to [EM-124, "HOW TO SELECT CONNECTING ROD BEARING"](#).

Method of Using Plastigage

- Remove engine oil and dust on crankshaft pin journal and the surfaces of each bearing completely.
- Cut Plastigage slightly shorter than the bearing width, and place it in crankshaft axial direction, avoiding oil holes.
- Install connecting rod bearings to connecting rod and cap, and tighten connecting rod bolts to the specified torque. Refer to [EM-116, "ASSEMBLY"](#) for the tightening procedure.

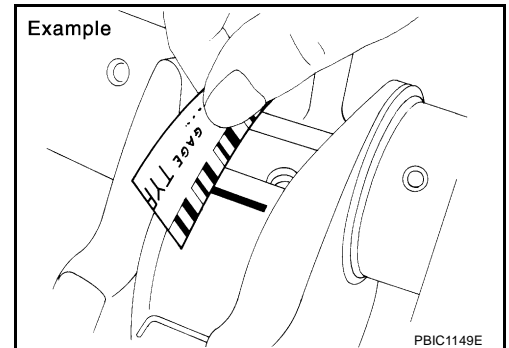
CAUTION:

Do not rotate crankshaft.

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

NOTE:

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



MAIN BEARING OIL CLEARANCE

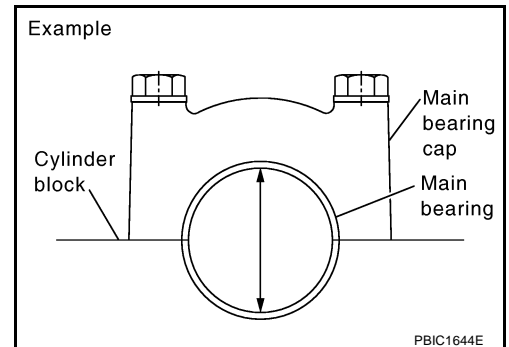
Method by Calculation

- Install main bearings to cylinder block and main bearing caps, and tighten main bearing cap bolts with main bearing beam to the specified torque. Refer to [EM-116, "ASSEMBLY"](#) for the tightening procedure.
- Measure the inner diameter of main bearing with bore gauge.
(Bearing oil clearance) = (Main bearing inner diameter) – (Crankshaft main journal diameter)

Standard : 0.035 - 0.045 mm (0.0014 - 0.0018 in)
(actual clearance)

Limit : 0.065 mm (0.0026 in)

- If clearance exceeds the limit, select proper main bearing according to main bearing inner diameter and crankshaft main journal diameter to obtain specified bearing oil clearance. Refer to [EM-125, "HOW TO SELECT MAIN BEARING"](#).



Method of Using Plastigage

- Remove engine oil and dust on crankshaft main journal and the surfaces of each bearing completely.
- Cut Plastigage slightly shorter than the bearing width, and place it in crankshaft axial direction, avoiding oil holes.
- Install main bearings to cylinder block and main bearing caps, and tighten main bearing bolts with main bearing beam to the specified torque. Refer to [EM-116, "ASSEMBLY"](#) for the tightening procedure.

CAUTION:

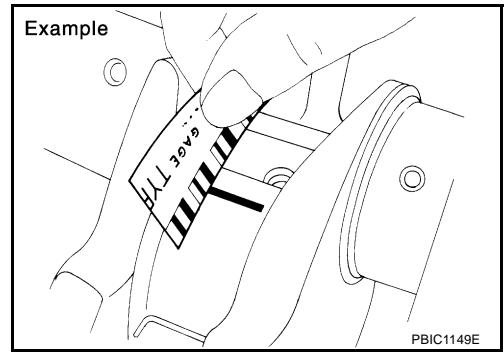
Do not rotate crankshaft.

CYLINDER BLOCK

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

NOTE:

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

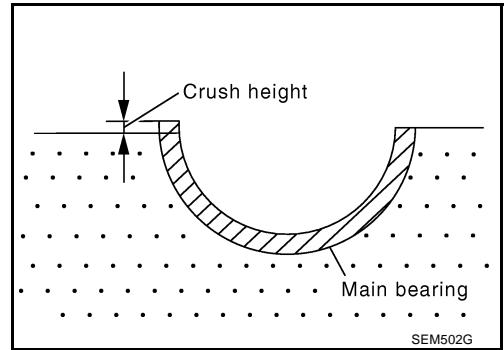


CRUSH HEIGHT OF MAIN BEARING

- When main bearing cap is removed after being tightened to the specified torque with main bearings installed, the tip end of bearing must protrude. Refer to [EM-116, "ASSEMBLY"](#) for the tightening procedure.

Standard : There must be crush height.

- If the standard is not met, replace main bearings.

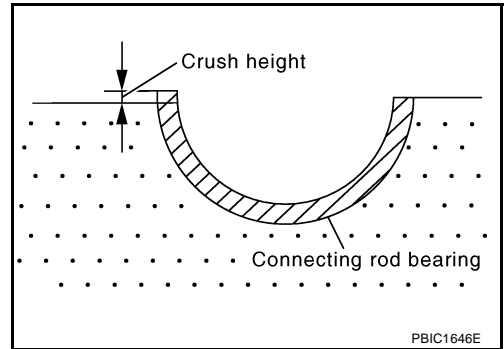


CRUSH HEIGHT OF CONNECTING ROD BEARING

- When connecting rod bearing cap is removed after being tightened to the specified torque with connecting rod bearings installed, the tip end of bearing must protrude. Refer to [EM-116, "ASSEMBLY"](#) for the tightening procedure.

Standard : There must be crush height.

- If the standard is not met, replace connecting rod bearings.

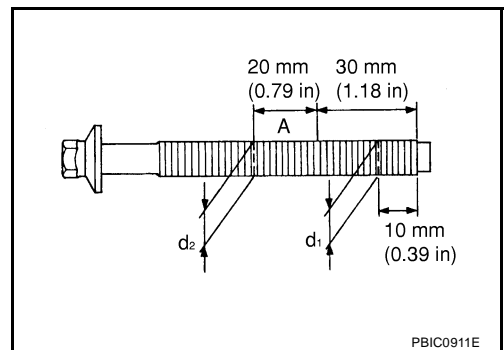


MAIN BEARING CAP BOLT OUTER DIAMETER

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

Limit ("d1" - "d2") : 0.11 mm (0.0051 in)

- If it exceeds the limit (large difference in dimensions), replace main bearing cap bolt with new one.



CYLINDER BLOCK

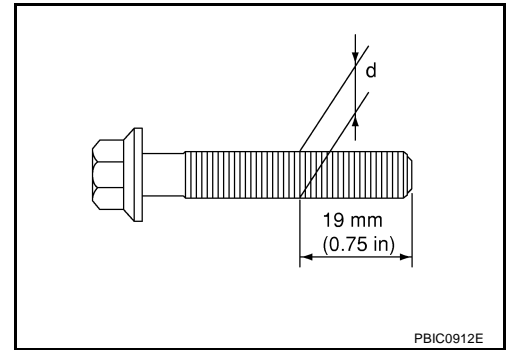
CONNECTING ROD BOLT OUTER DIAMETER

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

Standard : 7.90 - 8.00 mm (0.3110 - 0.3150 in)

Limit : 7.75 mm (0.3051 in)

- When “d” exceeds the limit (when it becomes thinner), replace bolt with new one.

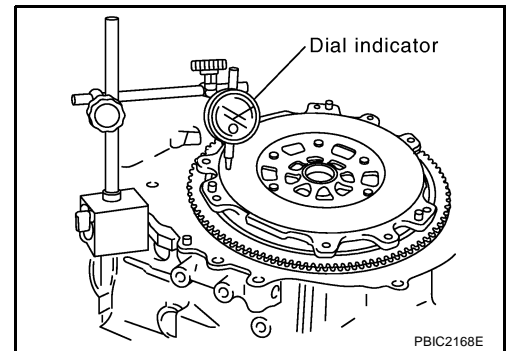


FLYWHEEL DEFLECTION

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

Standard : Less than 0.45 mm (0.0177 in)

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



MOVEMENT AMOUNT OF FLYWHEEL

CAUTION:

Do not disassembly double mass flywheel.

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

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

Standard : Less than 1.3 mm (0.051 in)

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

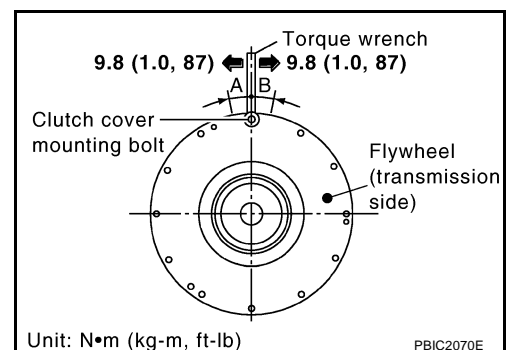
Movement Amount of Radial (Rotation) Direction

Check the movement amount of radial (rotation) direction as follows:

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

Standard : Less than 24 mm (0.94 in)

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



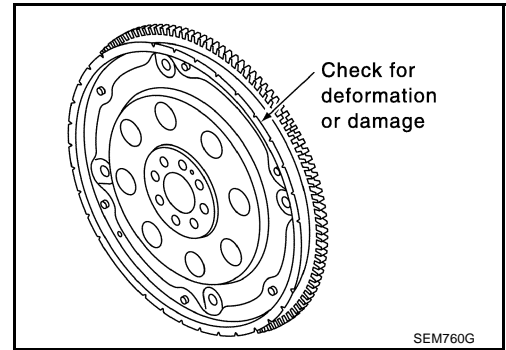
CYLINDER BLOCK

DRIVE PLATE (A/T MODELS)

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

CAUTION:

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

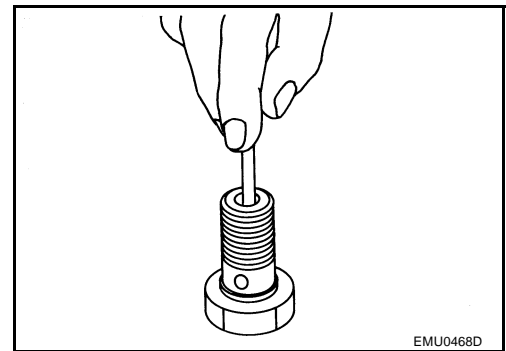


OIL JET

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

OIL JET RELIEF VALVE

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



SERVICE DATA AND SPECIFICATIONS (SDS)

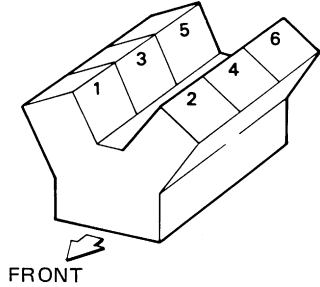
SERVICE DATA AND SPECIFICATIONS (SDS)

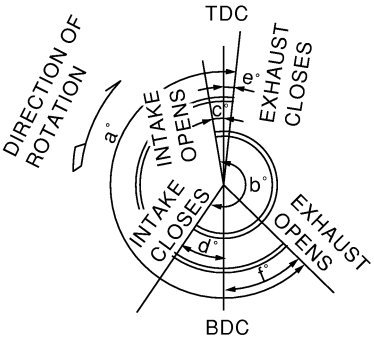
PFP:00100

Standard and Limit GENERAL SPECIFICATIONS

ABS00A18

Cylinder arrangement		V-6
Displacement cm ³ (cu in)		3,498 (213.45)
Bore and stroke mm (in)		95.5 x 81.4 (3.76 x 3.205)
Valve arrangement		DOHC
Firing order		1-2-3-4-5-6
Number of piston rings	Compression	2
	Oil	1
Number of main bearings		4
Compression ratio		10.3
Compression pressure kPa (kg/cm ² , psi)/300 rpm	Standard	1,270 (13.0, 184)
	Minimum	980 (10.0, 142)
	Differential limit between cylinders	100 (1.0, 15)

Cylinder number	 <p style="text-align: right;">SEM713A</p>
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Valve timing (Intake valve timing control - "OFF")	 <p style="text-align: right;">PBIC0187E</p>
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Unit: degree

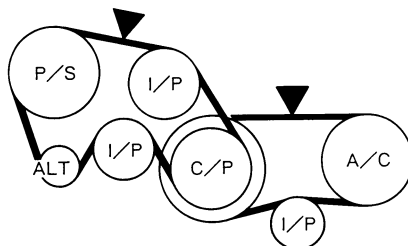
a	b	c	d	e	f
240	238	- 6	64	8	52

SERVICE DATA AND SPECIFICATIONS (SDS)

DRIVE BELT

	Deflection adjustment		Unit: mm (in)	Tension adjustment*		Unit: N (kg, lb)
	Used belt		New belt	Used belt		New belt
	Limit	After adjustment		Limit	After adjustment	
Alternator and power steering oil pump belt	7 (0.28)	4 - 5 (0.16 - 0.20)	3.5 - 4.5 (0.138 - 0.177)	294 (30, 66)	730 - 818 (74.5 - 83.5, 164 - 184)	838 - 926 (85.5 - 94.5, 188 - 208)
A/C compressor belt	12 (0.47)	9 - 10 (0.35 - 0.39)	8 - 9 (0.31 - 0.35)	196 (20, 44)	348 - 436 (35.5 - 44.5, 78 - 98)	470 - 559 (48 - 57, 106 - 126)
Applied pushing force	98 N (10 kg, 22 lb)			—		

SEC.117



KBIA1731J

* : If belt tension gauge cannot be installed at check points shown, check drive belt tension at different location on the belt.

INTAKE MANIFOLD COLLECTOR, INTAKE MANIFOLD AND EXHAUST MANIFOLD

Unit: mm (in)

Items	Limit	
Surface distortion	Intake manifold collector (upper)	0.1 (0.004)
	Intake manifold collector (lower)	0.1 (0.004)
	Intake manifold	0.1 (0.004)
	Exhaust manifold	0.3 (0.012)

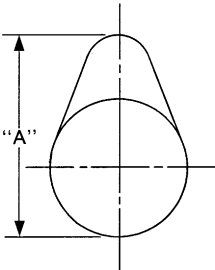
SPARK PLUG

Make	NGK
Standard type	PLFR5A-11
Hot type	PLFR4A-11
Cold type	PLFR6A-11
Gap (nominal)	1.1 mm (0.043 in)

SERVICE DATA AND SPECIFICATIONS (SDS)

CAMSHAFT AND CAMSHAFT BEARING

Unit: mm (in)

Items	Standard	Limit
		
SEM671		
Camshaft journal oil clearance	No. 1	0.045 - 0.086 (0.0018 - 0.0034)
	No. 2, 3, 4	0.035 - 0.076 (0.0014 - 0.0030)
Camshaft bracket inner diameter	No. 1	26.000 - 26.021 (1.0236 - 1.0244)
	No. 2, 3, 4	23.500 - 23.521 (0.9252 - 0.9260)
Camshaft journal diameter	No. 1	25.935 - 25.955 (1.0211 - 1.0218)
	No. 2, 3, 4	23.445 - 23.465 (0.9230 - 0.9238)
Camshaft end play		0.115 - 0.188 (0.0045 - 0.0074)
Camshaft cam height "A"	Intake and exhaust	44.865 - 45.055 (1.7663 - 1.7738)
Camshaft runout [TIR*]		Less than 0.02 (0.001)
Camshaft sprocket runout [TIR*]		—

*: Total indicator reading

Valve Lifter

Unit: mm (in)

Items	Standard
Valve lifter outer diameter	33.977 - 33.987 (1.3377 - 1.3381)
Valve lifter hole diameter	34.000 - 34.016 (1.3386 - 1.3392)
Valve lifter clearance	0.013 - 0.039 (0.0005 - 0.0015)

Valve Clearance

Unit: mm (in)

Items	Cold	Hot* (reference data)
Intake	0.26 - 0.34 (0.010 - 0.013)	0.304 - 0.416 (0.012 - 0.016)
Exhaust	0.29 - 0.37 (0.011 - 0.015)	0.308 - 0.432 (0.012 - 0.017)

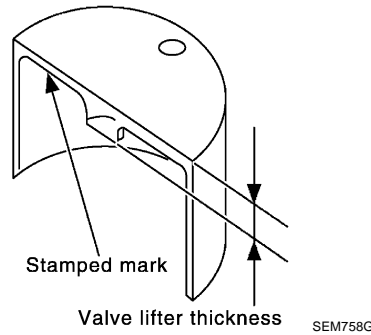
*: Approximately 80°C (176°F)

SERVICE DATA AND SPECIFICATIONS (SDS)

Available Valve Lifter

Unit: mm (in)

Identification (stamped) mark	Thickness
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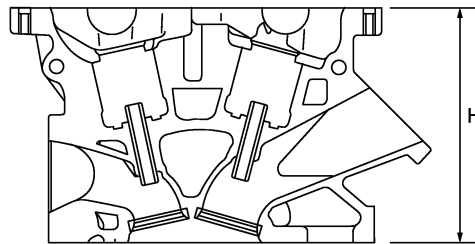
788U or 788R	7.88 (0.3102)
790U or 790R	7.90 (0.3110)
792U or 792R	7.92 (0.3118)
794U or 794R	7.94 (0.3126)
796U or 796R	7.96 (0.3134)
798U or 798R	7.98 (0.3142)
800U or 800R	8.00 (0.3150)
802U or 802R	8.02 (0.3157)
804U or 804R	8.04 (0.3165)
806U or 806R	8.06 (0.3173)
808U or 808R	8.08 (0.3181)
810U or 810R	8.10 (0.3189)
812U or 812R	8.12 (0.3197)
814U or 814R	8.14 (0.3205)
816U or 816R	8.16 (0.3213)
818U or 818R	8.18 (0.3220)
820U or 820R	8.20 (0.3228)
822U or 822R	8.22 (0.3236)
824U or 824R	8.24 (0.3244)
826U or 826R	8.26 (0.3252)
828U or 828R	8.28 (0.3260)
830U or 830R	8.30 (0.3268)
832U or 832R	8.32 (0.3276)
834U or 834R	8.34 (0.3283)
836U or 836R	8.36 (0.3291)
838U or 838R	8.38 (0.3299)
840U or 840R	8.40 (0.3307)

SERVICE DATA AND SPECIFICATIONS (SDS)

CYLINDER HEAD

Unit: mm (in)

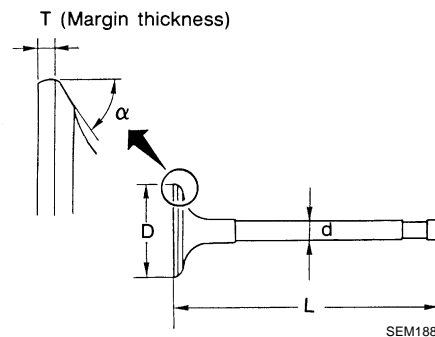
Items	Standard	Limit
Head surface distortion	Less than 0.03 (0.0012)	0.1 (0.004)
Normal cylinder head height "H"	126.3 - 126.5 (4.972 - 4.980)	



PBIC0924E

Valve Dimensions

Unit: mm (in)

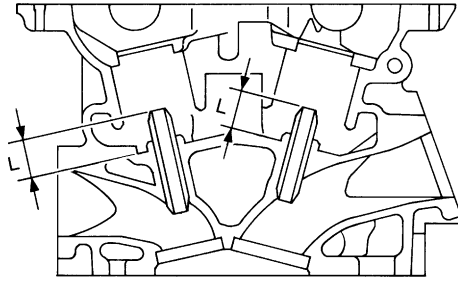


Valve head diameter "D"	Intake	37.0 - 37.3 (1.4567 - 1.4685)
	Exhaust	31.2 - 31.5 (1.228 - 1.240)
Valve length "L"	Intake	96.37 (3.7941)
	Exhaust	93.90 (3.6968)
Valve stem diameter "d"	Intake	5.965 - 5.980 (0.2348 - 0.2354)
	Exhaust	5.955 - 5.970 (0.2344 - 0.2350)
Valve seat angle " α "	Intake	45°15' - 45°45'
	Exhaust	
Valve margin "T"	Intake	1.1 (0.043)
	Exhaust	1.3 (0.051)
Valve margin "T" limit		More than 0.5 (0.020)
Valve stem end surface grinding limit		Less than 0.2 (0.008)

SERVICE DATA AND SPECIFICATIONS (SDS)

Valve Guide

Unit: mm (in)



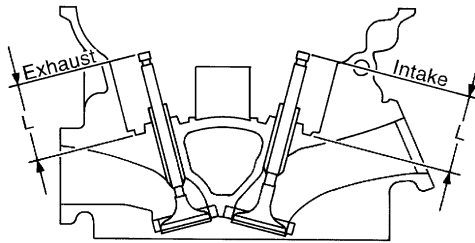
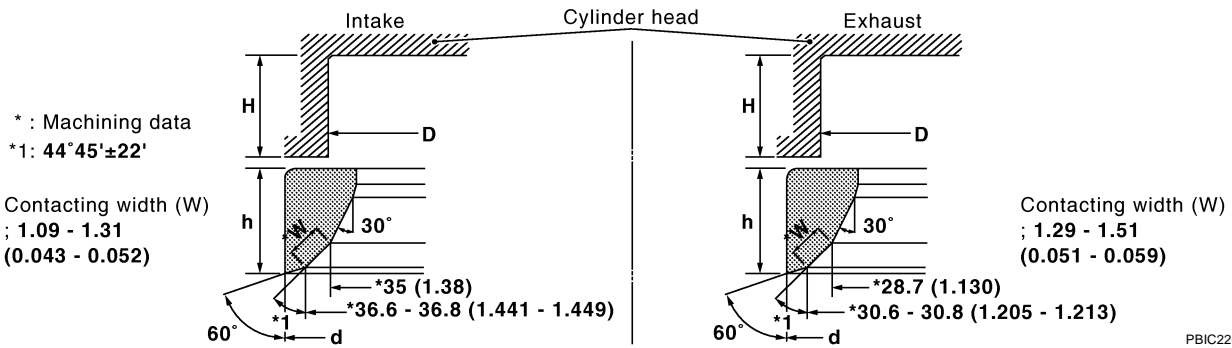
SEM950E

Items		Standard	0.2 (0.008) Oversize (Service)
Valve guide	Outer diameter	10.023 - 10.034 (0.3946 - 0.3950)	10.223 - 10.234 (0.4025 - 0.4029)
	Inner diameter (Finished size)	6.000 - 6.018 (0.2362 - 0.2369)	
Cylinder head valve guide hole diameter		9.975 - 9.996 (0.3927 - 0.3935)	10.175 - 10.196 (0.4006 - 0.4014)
Interference fit of valve guide		0.027 - 0.059 (0.0011 - 0.0023)	
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"		12.6 - 12.8 (0.496 - 0.504)	

SERVICE DATA AND SPECIFICATIONS (SDS)

Valve Seat

Unit: mm (in)



Items		Standard	Oversize [0.5 (0.020)] (Service)
Cylinder head seat recess diameter "D"	Intake	38.000 - 38.016 (1.4961 - 1.4967)	38.500 - 38.516 (1.5157 - 1.5164)
	Exhaust	32.200 - 32.216 (1.2677 - 1.2683)	32.700 - 32.716 (1.2874 - 1.2880)
Valve seat outer diameter "d"	Intake	38.097 - 38.113 (1.4999 - 1.5005)	38.597 - 38.613 (1.5196 - 1.5202)
	Exhaust	32.280 - 32.296 (1.2709 - 1.2715)	32.780 - 32.796 (1.2905 - 1.2912)
Valve seat interference fit	Intake	0.081 - 0.113 (0.0032 - 0.0044)	
	Exhaust	0.064 - 0.096 (0.0025 - 0.0038)	
Items		Standard	Service
Height "h"	Intake	5.9 - 6.0 (0.232 - 0.236)	5.05 - 5.15 (0.1988 - 0.2028)
	Exhaust	5.9 - 6.0 (0.232 - 0.236)	4.95 - 5.05 (0.1949 - 0.1988)
Depth "H"		5.9 - 6.1 (0.232 - 0.240)	
Depth "L"	Intake	41.07 - 41.67 (1.6169 - 1.6405)	
	Exhaust	41.00 - 41.60 (1.6142 - 1.6378)	

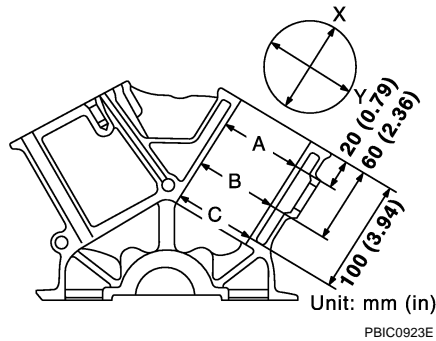
Valve Spring

Free height	mm (in)	47.07 (1.8531)
Pressure	N (kg, lb) at height mm (in)	166 - 188 (16.9 - 19.2, 37.3 - 42.3) at 37.00 (1.4567)
		373 - 421 (38.0 - 42.9, 83.9 - 94.6) at 27.20 (1.0709)
Out-of-square	mm (in)	Limit 2.0 (0.079)

SERVICE DATA AND SPECIFICATIONS (SDS)

CYLINDER BLOCK

Unit: mm (in)



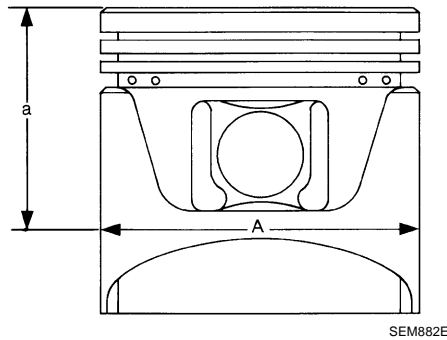
Surface flatness		Standard		Less than 0.03 (0.0012)
		Limit		0.1 (0.004)
Main bearing housing inner diameter		Standard		63.993 - 64.017 (2.5194 - 2.5203)
Cylinder bore	Inner diameter	Standard	Grade No. 1	95.500 - 95.510 (3.7598 - 3.7602)
			Grade No. 2	95.510 - 95.520 (3.7602 - 3.7606)
			Grade No. 3	95.520 - 95.530 (3.7606 - 3.7610)
		Wear limit		0.2 (0.008)
Out-of-round (Difference between "X" and "Y")		Limit	0.015 (0.0006)	
Taper (Difference between "A" and "C")			0.01 (0.0004)	
Main bearing housing inner diameter grade (Without bearing)		Grade No. A		63.993 - 63.994 (2.5194 - 2.5194)
		Grade No. B		63.994 - 63.995 (2.5194 - 2.5195)
		Grade No. C		63.995 - 63.996 (2.5195 - 2.5195)
		Grade No. D		63.996 - 63.997 (2.5195 - 2.5196)
		Grade No. E		63.997 - 63.998 (2.5196 - 2.5196)
		Grade No. F		63.998 - 63.999 (2.5196 - 2.5196)
		Grade No. G		63.999 - 64.000 (2.5196 - 2.5197)
		Grade No. H		64.000 - 64.001 (2.5197 - 2.5197)
		Grade No. J		64.001 - 64.002 (2.5197 - 2.5198)
		Grade No. K		64.002 - 64.003 (2.5198 - 2.5198)
		Grade No. L		64.003 - 64.004 (2.5198 - 2.5198)
		Grade No. M		64.004 - 64.005 (2.5198 - 2.5199)
		Grade No. N		64.005 - 64.006 (2.5199 - 2.5199)
		Grade No. P		64.006 - 64.007 (2.5199 - 2.5200)
		Grade No. R		64.007 - 64.008 (2.5200 - 2.5200)
		Grade No. S		64.008 - 64.009 (2.5200 - 2.5200)
		Grade No. T		64.009 - 64.010 (2.5200 - 2.5201)
Grade No. U		64.010 - 64.011 (2.5201 - 2.5201)		
Grade No. V		64.011 - 64.012 (2.5201 - 2.5202)		
Grade No. W		64.012 - 64.013 (2.5202 - 2.5202)		
Grade No. X		64.013 - 64.014 (2.5202 - 2.5202)		
Grade No. Y		64.014 - 64.015 (2.5202 - 2.5203)		
Grade No. 4		64.015 - 64.016 (2.5203 - 2.5203)		
Grade No. 7		64.016 - 64.017 (2.5203 - 2.5203)		
Difference in inner diameter between cylinders		Standard		Less than 0.03 (0.0012)

SERVICE DATA AND SPECIFICATIONS (SDS)

PISTON, PISTON RING AND PISTON PIN

Available Piston

Unit: mm (in)



SEM882E

Items		Standard	0.20 (0.0079) oversize
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		41.0 (1.614)	—
Piston pin hole diameter	Grade No. 0	21.993 - 21.999 (0.8659 - 0.8661)	—
	Grade No. 1	21.999 - 22.005 (0.8661 - 0.8663)	—
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	0.045 - 0.080 (0.0018 - 0.0031)	0.11 (0.0043)
	2nd	0.030 - 0.070 (0.0012 - 0.0028)	0.1 (0.004)
	Oil ring	0.065 - 0.135 (0.0026 - 0.0053)	—
End gap	Top	0.23 - 0.33 (0.0091 - 0.0130)	0.54 (0.0213)
	2nd	0.33 - 0.48 (0.0130 - 0.0189)	0.80 (0.0315)
	Oil (rail ring)	0.20 - 0.50 (0.0079 - 0.0197)	0.95 (0.0374)

Piston Pin

Unit: mm (in)

Items		Standard	Limit
Piston pin outer diameter	Grade No. 0	21.989 - 21.995 (0.8657 - 0.8659)	—
	Grade No. 1	21.995 - 22.001 (0.8659 - 0.8662)	—
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)

SERVICE DATA AND SPECIFICATIONS (SDS)

CONNECTING ROD

Unit: mm (in)

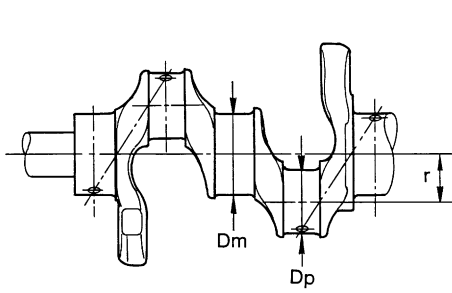
Items	Standard	Limit
Center distance	144.15 - 144.25 (5.6752 - 5.6791)	—
Bend [per 100 (3.94)]	—	0.15 (0.0059)
Torsion [per 100 (3.94)]	—	0.30 (0.0118)
Connecting rod bushing inner diameter*	Grade No. 0	22.000 - 22.006 (0.8661 - 0.8664)
	Grade No. 1	22.006 - 22.012 (0.8664 - 0.8666)
Connecting rod big end diameter (Without bearing)	55.000 - 55.013 (2.1654 - 2.1659)	—
Side clearance	0.20 - 0.35 (0.0079 - 0.0138)	0.40 (0.0157)

*: After installing in connecting rod

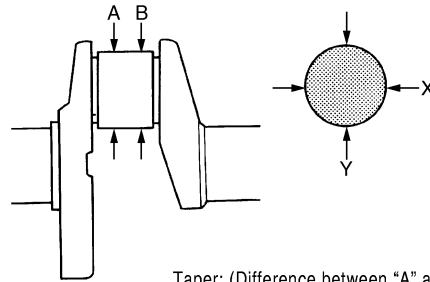
SERVICE DATA AND SPECIFICATIONS (SDS)

CRANKSHAFT

Unit: mm (in)



SEM645



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

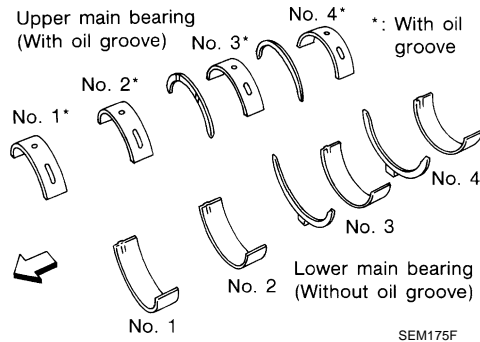
SBIA0535E

Main journal diameter. "Dm" grade	Standard	Grade No. A	59.975 - 59.974 (2.3612 - 2.3612)
		Grade No. B	59.974 - 59.973 (2.3612 - 2.3611)
		Grade No. C	59.973 - 59.972 (2.3611 - 2.3611)
		Grade No. D	59.972 - 59.971 (2.3611 - 2.3611)
		Grade No. E	59.971 - 59.970 (2.3611 - 2.3610)
		Grade No. F	59.970 - 59.969 (2.3610 - 2.3610)
		Grade No. G	59.969 - 59.968 (2.3610 - 2.3609)
		Grade No. H	59.968 - 59.967 (2.3609 - 2.3609)
		Grade No. J	59.967 - 59.966 (2.3609 - 2.3609)
		Grade No. K	59.966 - 59.965 (2.3609 - 2.3608)
		Grade No. L	59.965 - 59.964 (2.3608 - 2.3608)
		Grade No. M	59.964 - 59.963 (2.3608 - 2.3607)
		Grade No. N	59.963 - 59.962 (2.3607 - 2.3607)
		Grade No. P	59.962 - 59.961 (2.3607 - 2.3607)
		Grade No. R	59.961 - 59.960 (2.3607 - 2.3606)
		Grade No. S	59.960 - 59.959 (2.3606 - 2.3606)
Grade No. T	59.959 - 59.958 (2.3606 - 2.3605)		
Grade No. U	59.958 - 59.957 (2.3605 - 2.3605)		
Grade No. V	59.957 - 59.956 (2.3605 - 2.3605)		
Grade No. W	59.956 - 59.955 (2.3605 - 2.3604)		
Grade No. X	59.955 - 59.954 (2.3604 - 2.3604)		
Grade No. Y	59.954 - 59.953 (2.3604 - 2.3603)		
Grade No. 4	59.953 - 59.952 (2.3603 - 2.3603)		
Grade No. 7	59.952 - 59.951 (2.3603 - 2.3603)		
Pin journal diameter. "Dp"	Standard	Grade No. 0	51.968 - 51.974 (2.0460 - 2.0462)
		Grade No. 1	51.962 - 51.968 (2.0457 - 2.0460)
		Grade No. 2	51.956 - 51.962 (2.0455 - 2.0457)
Center distance "r"			40.36 - 40.44 (1.5890 - 1.5921)
Taper (Difference between "A" and "B")	Limit		0.002 (0.0001)
Out-of-round (Difference between "X" and "Y")			0.002 (0.0001)
Crankshaft runout [TIR*]	Standard		Less than 0.05 (0.002)
	Limit		0.10 (0.0039)
Crankshaft end play	Standard		0.10 - 0.25 (0.0039 - 0.0098)
	Limit		0.30 (0.0118)

*: Total indicator reading

SERVICE DATA AND SPECIFICATIONS (SDS)

MAIN BEARING



Grade number	UPR/LWR	Thickness "T" mm (in)	Width "W" mm (in)	Identification color	Remarks
0	—	2.000 - 2.003 (0.0787 - 0.0789)	19.9 - 20.1 (0.783 - 0.791)	Black	Grade is the same for upper and lower bearings.
1	—	2.003 - 2.006 (0.0789 - 0.0790)		Brown	
2	—	2.006 - 2.009 (0.0790 - 0.0791)		Green	
3	—	2.009 - 2.012 (0.0791 - 0.0792)		Yellow	
4	—	2.012 - 2.015 (0.0792 - 0.0793)		Blue	
5	—	2.015 - 2.018 (0.0793 - 0.0794)		Pink	
6	—	2.018 - 2.021 (0.0794 - 0.0796)		Purple	
7	—	2.021 - 2.024 (0.0796 - 0.0797)		White	Grade is different for upper and lower bearings.
01	UPR	2.003 - 2.006 (0.0789 - 0.0790)		Brown	
	LWR	2.000 - 2.003 (0.0787 - 0.0789)		Black	
12	UPR	2.006 - 2.009 (0.0790 - 0.0791)		Green	
	LWR	2.003 - 2.006 (0.0789 - 0.0790)		Brown	
23	UPR	2.009 - 2.012 (0.0791 - 0.0792)		Yellow	
	LWR	2.006 - 2.009 (0.0790 - 0.0791)		Green	
34	UPR	2.012 - 2.015 (0.0792 - 0.0793)	Blue		
	LWR	2.009 - 2.012 (0.0791 - 0.0792)	Yellow		
45	UPR	2.015 - 2.018 (0.0793 - 0.0794)	Pink		
	LWR	2.012 - 2.015 (0.0792 - 0.0793)	Blue		
56	UPR	2.018 - 2.021 (0.0794 - 0.0796)	Purple		
	LWR	2.015 - 2.018 (0.0793 - 0.0794)	Pink		
67	UPR	2.021 - 2.024 (0.0796 - 0.0797)	White		
	LWR	2.018 - 2.021 (0.0794 - 0.0796)	Purple		

Undersize

Unit: mm (in)

Items	Thickness	Main journal diameter "Dm"
0.25 (0.0098)	2.132 - 2.140 (0.0839 - 0.0843)	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)*	0.065 (0.0026)

*: Actual clearance

SERVICE DATA AND SPECIFICATIONS (SDS)

CONNECTING ROD BEARING

Grade number	Thickness "T" mm (in)	Identification color (mark)
0	1.500 - 1.503 (0.0591 - 0.0592)	Black
1	1.503 - 1.506 (0.0592 - 0.0593)	Brown
2	1.506 - 1.509 (0.0593 - 0.0594)	Green

Undersize

Unit: mm (in)

Items	Thickness	Crank pin journal diameter "Dp"
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	0.034 - 0.059 (0.0013 - 0.0023)*	0.070 (0.0028)

*: Actual clearance

SERVICE DATA AND SPECIFICATIONS (SDS)
