

CONTENTS

QR

PRECAUTIONS	5	REMOVAL	17
Precautions for Drain Engine Coolant	5	INSTALLATION	18
Precautions for Disconnecting Fuel Piping	5	INSPECTION AFTER INSTALLATION	19
Precautions for Removal and Disassembly	5	Removal and Installation (QR25DE)	20
Precautions for Inspection, Repair and Replacement	5	REMOVAL	20
Precautions for Assembly and Installation	5	INSPECTION AFTER REMOVAL	21
Parts Requiring Angle Tightening	5	INSTALLATION	22
Precautions for Liquid Gasket	6	INSPECTION AFTER INSTALLATION	22
REMOVAL OF LIQUID GASKET	6		
LIQUID GASKET APPLICATION PROCEDURE....	6		
PREPARATION	7		
Special Service Tools	7	EXHAUST MANIFOLD AND THREE WAY CATALYST	23
Commercial Service Tools	9	Removal and Installation	23
NOISE, VIBRATION AND HARSHNESS (NVH)		REMOVAL	23
TROUBLESHOOTING	11	INSPECTION AFTER REMOVAL	24
NVH Troubleshooting — Engine Noise	11	INSTALLATION	24
Use the Chart Below to Help You Find the Cause of the Symptom.	12		
DRIVE BELTS	13	OIL PAN AND OIL STRAINER	25
Checking Drive Belts	13	Removal and Installation	25
Tension Adjustment	13	REMOVAL	25
Removal and Installation	13	INSPECTION AFTER REMOVAL	27
REMOVAL	13	INSTALLATION	27
INSTALLATION	14	INSPECTION AFTER INSTALLATION	28
Removal and Installation of Drive Belt Auto-Tensioner	14		
REMOVAL	14	IGNITION COIL	29
INSTALLATION	14	Removal and Installation	29
		REMOVAL	29
AIR CLEANER AND AIR DUCT	15	INSTALLATION	29
Removal and Installation	15		
REMOVAL	15	SPARK PLUG	30
INSTALLATION	16	Removal and Installation	30
Changing Air Cleaner Filter	16	REMOVAL	30
REMOVAL	16	INSPECTION AFTER REMOVAL	30
INSTALLATION	16	INSTALLATION	31
INTAKE MANIFOLD	17		
Removal and Installation (QR20DE)	17	FUEL INJECTOR AND FUEL TUBE	32

ROCKER COVER	42	ING	93
Removal and Installation	42	HOW TO SELECT MAIN BEARING	95
REMOVAL	42	Inspection After Disassembly	99
INSTALLATION	43	CRANKSHAFT END PLAY	99
TIMING CHAIN	44	CONNECTING ROD SIDE CLEARANCE	99
Removal and Installation	44	PISTON TO PISTON PIN OIL CLEARANCE	99
REMOVAL	44	PISTON RING SIDE CLEARANCE	100
INSPECTION AFTER REMOVAL	48	PISTON RING END GAP	100
INSTALLATION	49	CONNECTING ROD BEND AND TORSION	101
CAMSHAFT	53	CONNECTING ROD BIG END DIAMETER	101
Removal and Installation	53	CONNECTING ROD BUSHING OIL CLEAR-	
REMOVAL	53	ANCE	101
INSPECTION AFTER REMOVAL	55	CYLINDER BLOCK DISTORTION	102
INSTALLATION	58	MAIN BEARING HOUSING INNER DIAMETER	103
Valve Clearance	61	PISTON TO CYLINDER BORE CLEARANCE	103
INSPECTION	61	CRANKSHAFT MAIN JOURNAL DIAMETER	104
ADJUSTMENT	62	CRANKSHAFT PIN JOURNAL DIAMETER	105
OIL SEAL	64	OUT-OF-ROUND AND TAPER OF CRANK-	
Removal and Installation of Valve Oil Seal	64	SHAFT	105
REMOVAL	64	CRANKSHAFT RUNOUT	105
INSTALLATION	64	CONNECTING ROD BEARING OIL CLEAR-	
Removal and Installation of Front Oil Seal	64	ANCE	105
REMOVAL	64	MAIN BEARING OIL CLEARANCE	106
INSTALLATION	65	MAIN BEARING CRUSH HEIGHT	107
Removal and Installation of Rear Oil Seal	65	CONNECTING ROD BEARING CRUSH	
REMOVAL	65	HEIGHT	107
INSTALLATION	65	LOWER CYLINDER BLOCK MOUNTING BOLT	
CYLINDER HEAD	67	OUTER DIAMETER	107
On-Vehicle Service	67	CONNECTING ROD BOLT OUTER DIAMETER	107
CHECKING COMPRESSION PRESSURE	67	FLYWHEEL DEFLECTION (M/T MODELS)	108
Removal and Installation	68	MOVEMENT AMOUNT OF FLYWHEEL (M/T	
REMOVAL	68	MODELS)	108
INSPECTION AFTER REMOVAL	69	SERVICE DATA AND SPECIFICATIONS (SDS)	109
INSTALLATION	69	Standard and Limit	109
Disassembly and Assembly	71	GENERAL SPECIFICATIONS	109
DISASSEMBLY	71	DRIVE BELT	109
ASSEMBLY	72	INTAKE MANIFOLD AND EXHAUST MANI-	
Inspection After Disassembly	73	FOLD	109
VALVE DIMENSIONS	73	SPARK PLUG	109
VALVE GUIDE CLEARANCE	73	CYLINDER HEAD	109
VALVE GUIDE REPLACEMENT	74	VALVE	110
VALVE SEAT CONTACT	75	CAMSHAFT AND CAMSHAFT BEARING	113
VALVE SEAT REPLACEMENT	75	CYLINDER BLOCK	114
VALVE SPRING SQUARENESS	77	PISTON, PISTON RING AND PISTON PIN	115
VALVE SPRING DIMENSIONS AND VALVE		CONNECTING ROD	116
SPRING PRESSURE LOAD	77	CRANKSHAFT	116
ENGINE ASSEMBLY	78	MAIN BEARING	118
Removal and Installation	78	CONNECTING ROD BEARING	119
REMOVAL	78	Tightening Torque	119
INSTALLATION	81		
INSPECTION AFTER INSTALLATION	81		
CYLINDER BLOCK	82		
Disassembly and Assembly	82		
DISASSEMBLY	83		
ASSEMBLY	87		
How to Select Piston and Bearing	92		
DESCRIPTION	92		
HOW TO SELECT PISTON	92		
HOW TO SELECT CONNECTING ROD BEAR-			

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PRECAUTIONS	122
Precautions for Draining Engine Coolant	122
Precautions for Disconnecting Fuel Piping	122
Precautions for Removal and Disassembly	122
Precautions for Inspection, Repair and Replace-	
ment	122
Precautions for Assembly and Installation	122

Parts Requiring Angle Tightening	122
Precautions For Liquid Gasket	123
REMOVAL OF LIQUID GASKET	123
LIQUID GASKET APPLICATION PROCEDURE	123
PREPARATION	124
Special Service Tools	124
Commercial Service Tools	127
NOISE, VIBRATION AND HARSHNESS (NVH)	
TROUBLESHOOTING	129
NVH Troubleshooting — Engine Noise	129
Use the Chart Below to Help You Find the Cause of the Symptom.	130
DRIVE BELTS	131
Checking Drive Belts	131
Tension Adjustment	131
A/C COMPRESSOR BELT	132
ALTERNATOR AND WATER PUMP BELT	132
Removal and Installation	132
REMOVAL	132
INSTALLATION	132
AIR CLEANER AND AIR DUCT	133
Removal and Installation	133
REMOVAL	133
INSTALLATION	133
CHANGING AIR CLEANER FILTER	134
CHARGE AIR COOLER	135
Removal and Installation	135
REMOVAL	135
INSPECTION AFTER REMOVAL	135
INSTALLATION	135
INTAKE MANIFOLD	136
Removal and Installation	136
REMOVAL	136
INSPECTION AFTER REMOVAL	137
INSTALLATION	137
INSPECTION AFTER INSTALLATION	138
CATALYST	139
Removal and Installation	139
REMOVAL	139
INSTALLATION	140
EXHAUST MANIFOLD AND TURBOCHARGER .	141
Removal and Installation	141
REMOVAL	141
INSTALLATION	142
INSPECTION AFTER INSTALLATION	142
Disassembly and Assembly	143
DISASSEMBLY	143
ASSEMBLY	143
INSPECTION AFTER DISASSEMBLY	143
Turbocharger	144
ROTOR SHAFT CLEARANCE	144
ROTOR SHAFT END PLAY	144
TURBINE WHEEL	145
COMPRESSOR WHEEL	145
TURBOCHARGER BOOST CONTROL ACTUATOR	145
TROUBLE DIAGNOSIS OF TURBOCHARGER	146
OIL PAN AND OIL STRAINER	147
Removal and Installation	147
REMOVAL	147
INSPECTION AFTER REMOVAL	149
INSTALLATION	149
INSPECTION AFTER INSTALLATION	151
GLOW PLUG	152
Removal and Installation	152
REMOVAL	152
INSTALLATION	152
VACUUM PUMP	153
Removal and Installation	153
INSPECTION BEFORE REMOVAL	153
REMOVAL	153
INSTALLATION	154
INSPECTION AFTER INSTALLATION	155
Disassembly and Assembly	155
DISASSEMBLY	155
ASSEMBLY	156
INJECTION TUBE AND FUEL INJECTOR	157
Removal and Installation	157
REMOVAL	157
INSTALLATION	159
INSPECTION AFTER INSTALLATION	160
FUEL PUMP	161
Removal and Installation	161
REMOVAL	161
INSPECTION AFTER REMOVAL	165
INSTALLATION	165
ROCKER COVER	168
Removal and Installation	168
REMOVAL	168
INSTALLATION	169
INSPECTION AFTER INSTALLATION	169
CAMSHAFT	170
Removal and Installation	170
REMOVAL	170
INSPECTION AFTER REMOVAL	171
INSTALLATION	174
Valve Clearance	175
INSPECTION	175
ADJUSTMENTS	177
SECONDARY TIMING CHAIN	180
Removal and Installation	180
REMOVAL	180
INSPECTION AFTER REMOVAL	182
INSTALLATION	182
PRIMARY TIMING CHAIN	185
Removal and Installation	185
REMOVAL	187
INSPECTION AFTER REMOVAL	190
INSTALLATION	190
CYLINDER HEAD	196
On-Vehicle Service	196
CHECKING COMPRESSION PRESSURE	196
Removal and Installation	197
REMOVAL	197
INSPECTION AFTER REMOVAL	198

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

INSTALLATION	199	TION	229
Disassembly and Assembly	201	MAIN BEARING HOUSING INNER DIAMETER	229
DISASSEMBLY	201	PISTON TO CYLINDER BORE CLEARANCE	.230
ASSEMBLY	202	CRANKSHAFT JOURNAL OUTER DIAMETER	.231
INSPECTION AFTER DISASSEMBLY	203	CRANKSHAFT PIN OUTER DIAMETER231
ENGINE ASSEMBLY	208	CRANKSHAFT OUT-OF-ROUND AND TAPER	.231
Removal and Installation	208	CRANKSHAFT RUNOUT232
REMOVAL	209	CONNECTING ROD BEARING OIL CLEAR-	
INSTALLATION	211	ANCE232
INSPECTION AFTER INSTALLATION	211	MAIN BEARING OIL CLEARANCE233
CYLINDER BLOCK	212	CRUSH HEIGHT OF MAIN BEARING233
Disassembly and Assembly	212	CRUSH HEIGHT OF CONNECTING ROD	
DISASSEMBLY	213	BEARING233
ASSEMBLY	217	MAIN BEARING CAP BOLT DEFORMATION	.234
How to Select Piston and Bearing	222	CONNECTING ROD BOLT DEFORMATION	.234
DESCRIPTION	222	OIL JET234
HOW TO SELECT PISTON	222	OIL JET RELIEF VALVE234
HOW TO SELECT CONNECTING ROD BEAR-		FLYWHEEL DEFLECTION235
ING	223	MOVEMENT AMOUNT OF FLYWHEEL235
HOW TO SELECT MAIN BEARING	224	SERVICE DATA AND SPECIFICATIONS (SDS)	236
Inspection After Disassembly	226	Standard and Limit	236
CRANKSHAFT END PLAY	226	GENERAL SPECIFICATIONS	236
CONNECTING ROD SIDE CLEARANCE	226	INTAKE MANIFOLD AND EXHAUST MANI-	
PISTON TO PISTON PIN CLEARANCE	226	FOLD236
PISTON RING SIDE CLEARANCE	227	DRIVE BELTS236
PISTON RING END GAP	227	CYLINDER HEAD237
CONNECTING ROD BEND AND TORSION	228	VALVE237
CONNECTING ROD BIG END INNER DIAME-		CAMSHAFT241
TER	228	CYLINDER BLOCK241
CONNECTING ROD BUSHING OIL CLEAR-		PISTON, PISTON RING AND PISTON PIN242
ANCE	228	CONNECTING ROD243
CYLINDER BLOCK TOP SURFACE DISTOR-		CRANKSHAFT243
		AVAILABLE MAIN BEARING244
		AVAILABLE CONNECTING ROD BEARING244
		MISCELLANEOUS COMPONENTS244
		Tightening Torque245

PRECAUTIONS

PFP:00001

Precautions for Drain Engine Coolant

Drain engine coolant when engine is cooled.

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Precautions for Disconnecting Fuel Piping

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

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Precautions for Removal and Disassembly

EBS00KN2

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

Precautions for Inspection, Repair and Replacement

EBS00KN3

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

G

Precautions for Assembly and Installation

EBS00MRZ

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

H

Parts Requiring Angle Tightening

EBS00KN5

- Use an angle wrench (special service tool: KV10112100) for the final tightening of the following engine parts.
 - Cylinder head bolts
 - Lower cylinder block bolts
 - Connecting rod cap bolts
 - Crankshaft pulley bolt (No angle wrench is required as the bolt flange is provided with notches for angular tightening)
 - Balancer unit
- 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.

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PRECAUTIONS

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Precautions for Liquid Gasket

REMOVAL OF LIQUID GASKET

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

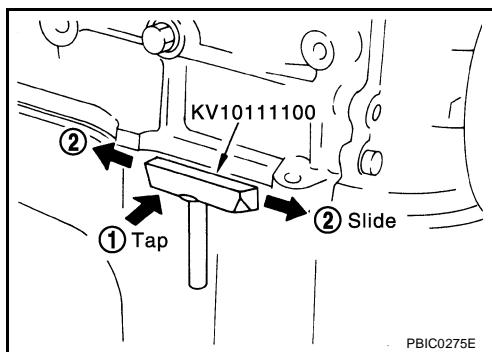
CAUTION:

Be careful not to damage the mating surfaces.

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

CAUTION:

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



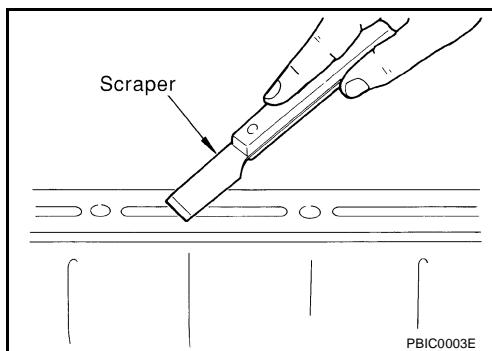
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LIQUID GASKET APPLICATION PROCEDURE

- Using a scraper, remove the old liquid gasket adhering to the liquid gasket application surface and the mating surface.

- Remove the liquid gasket completely from the groove of the liquid gasket application surface, mounting bolts and bolt holes.

- Wipe the liquid gasket application surface and the mating surface with white gasoline (lighting and heating use) to remove adhering moisture, grease and foreign materials.



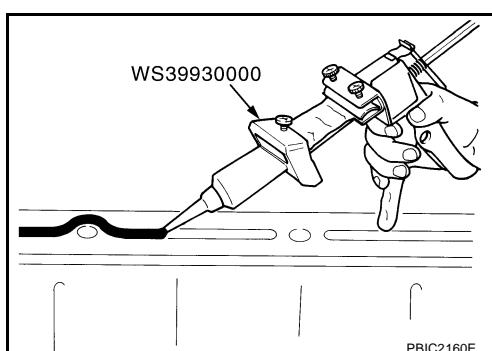
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- Attach liquid gasket tube to the tube presser (special service tool).

Use Genuine Liquid Gasket or equivalent.

- Apply the liquid gasket without breaks to the specified location with the specified dimensions.

- If there is a groove for the liquid gasket application, apply the liquid gasket to the groove.



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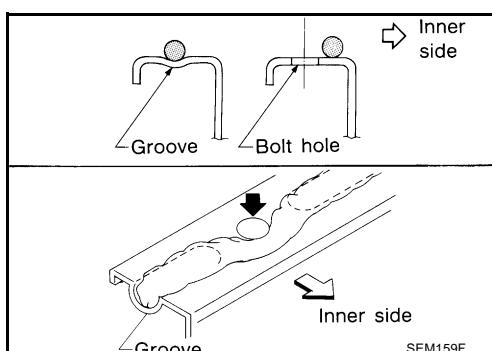
- As for the bolt holes, normally apply the liquid gasket inside the holes. Occasionally, it should be applied outside the holes. Make sure to read the text of service manual.

- Within five minutes of liquid gasket application, install the mating component.

- If the liquid gasket protrudes, wipe it off immediately.

- Do not retighten mounting bolts or nut after the installation.

- Wait 30 minutes or more after installation before refilling engine oil and engine coolant.



SEM159F

CAUTION:

If there are instructions in this manual, observe them.

PREPARATION

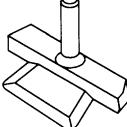
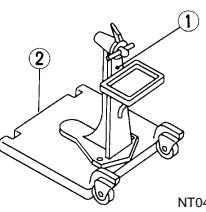
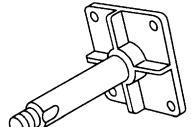
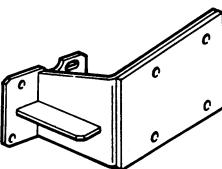
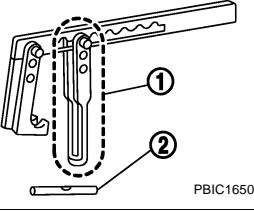
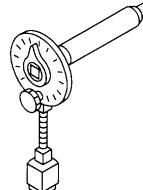
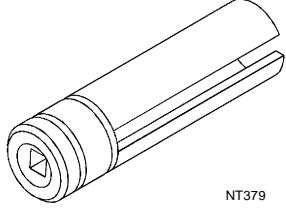
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PREPARATION

Special Service Tools

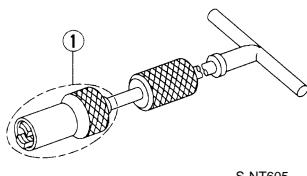
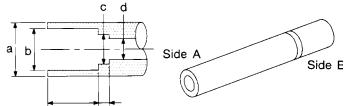
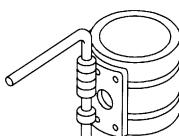
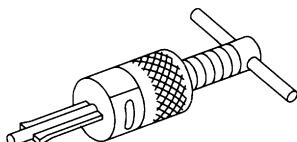
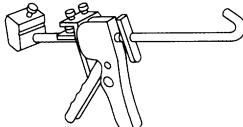
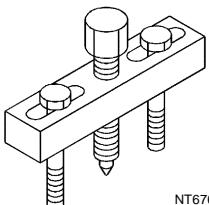
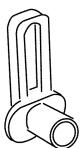
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Tool number Tool name	Description	
KV10111100 Seal cutter	Removing oil pan and timing chain case	EM
	 <p>S-NT046</p>	C D E F G H I J K L M
ST0501S000 Engine stand assembly 1. ST05011000 Engine stand 2. ST05012000 Base	Disassembling and assembling	
	 <p>NT042</p>	
KV10106500 Engine stand shaft		
	 <p>NT028</p>	
KV10115300 Engine sub-attachment		
	 <p>ZZA1078D</p>	
KV10116200 Valve spring compressor 1. KV10115900 Attachment 2. KV10109220 Adapter	Disassembling and assembling valve mechanism Part (1) is a component of KV10116200, but Part (2) is not so.	
	 <p>PBIC1650E</p>	
KV10112100 Angle wrench	Tightening bolts for bearing cap, cylinder head, etc.	
	 <p>S-NT014</p>	
KV10117100 Heated oxygen sensor wrench	Loosening or tightening heated oxygen sensors with 22 mm (0.87 in) hexagon nut	
	 <p>NT379</p>	

PREPARATION

[QR]

Tool number Tool name	Description
KV10107902 Valve oil seal puller 1. KV10116100 Valve oil seal puller adapter	 <p>S-NT605</p> <p>Removing valve oil seal</p>
KV10115600 Valve oil seal drift	 <p>Side A Side E</p> <p>S-NT603</p> <p>Installing valve oil seal Use side A. a: 20 (0.79) dia. d: 8 (0.31) dia. b: 13 (0.51) dia. e: 10.7 (0.421) dia. c: 10.3 (0.406) dia. f: 5 (0.20) dia. Unit: mm (in)</p>
EM03470000 Piston ring compressor	 <p>S-NT044</p> <p>Installing piston assembly into cylinder bore</p>
ST16610001 Pilot bushing puller	 <p>S-NT045</p> <p>Removing pilot convertor</p>
WS39930000 Tube presser	 <p>S-NT052</p> <p>Pressing the tube of liquid gasket</p>
KV11103000 Pulley puller	 <p>NT676</p> <p>Removing crankshaft pulley</p>
Quick connector release	 <p>PBIC0198E</p> <p>Removing fuel tube quick connectors in engine room (Available in SEC. 164 of PARTS CATALOG: Part No. 16441 6N210)</p>

PREPARATION

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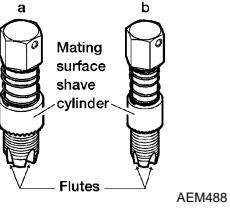
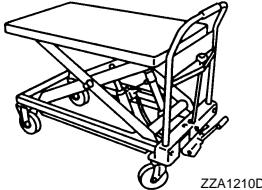
Commercial Service Tools

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Tool name	Description
Spark plug wrench	Removing and installing spark plug EM
Pulley holder	Crankshaft pulley removing and installing D
Valve seat cutter set	Finishing valve seat dimensions E
TORX socket	Removing and installing flywheel Size: T55 F
Piston ring expander	Removing and installing piston ring G
Valve guide drift	Removing and installing valve guide Intake & Exhaust: a: 9.5 mm (0.374 in) dia. b: 5.5 mm (0.217 in) dia. H
Valve guide reamer	1: Reaming valve guide inner hole 2: Reaming hole for oversize valve guide Intake & Exhaust: d1: 6.0 mm (0.236 in) dia. d2: 10.2 mm (0.402 in) dia. I

PREPARATION

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Tool name	Description
Oxygen sensor thread cleaner	 <p>Reconditioning the exhaust system threads before installing a new air fuel ratio sensor and heated oxygen sensor (Use with anti-seize lubricant shown below.)</p> <p>a = 18 mm (0.71 in) dia. for zirconia heated oxygen sensor and air fuel ratio sensor</p> <p>b = 12 mm (0.47 in) dia. for titania heated oxygen sensor</p>
Anti-seize lubricant i.e.: (Permatex™ 133AR or equivalent meeting MIL specification MIL-A-907)	Lubricating oxygen sensor thread cleaning tool when reconditioning exhaust system threads
Manual lift table caddy	 <p>Removing and installing engine</p>

NOISE, VIBRATION AND HARSHNESS (NVH) TROUBLESHOOTING

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NVH Troubleshooting — Engine Noise

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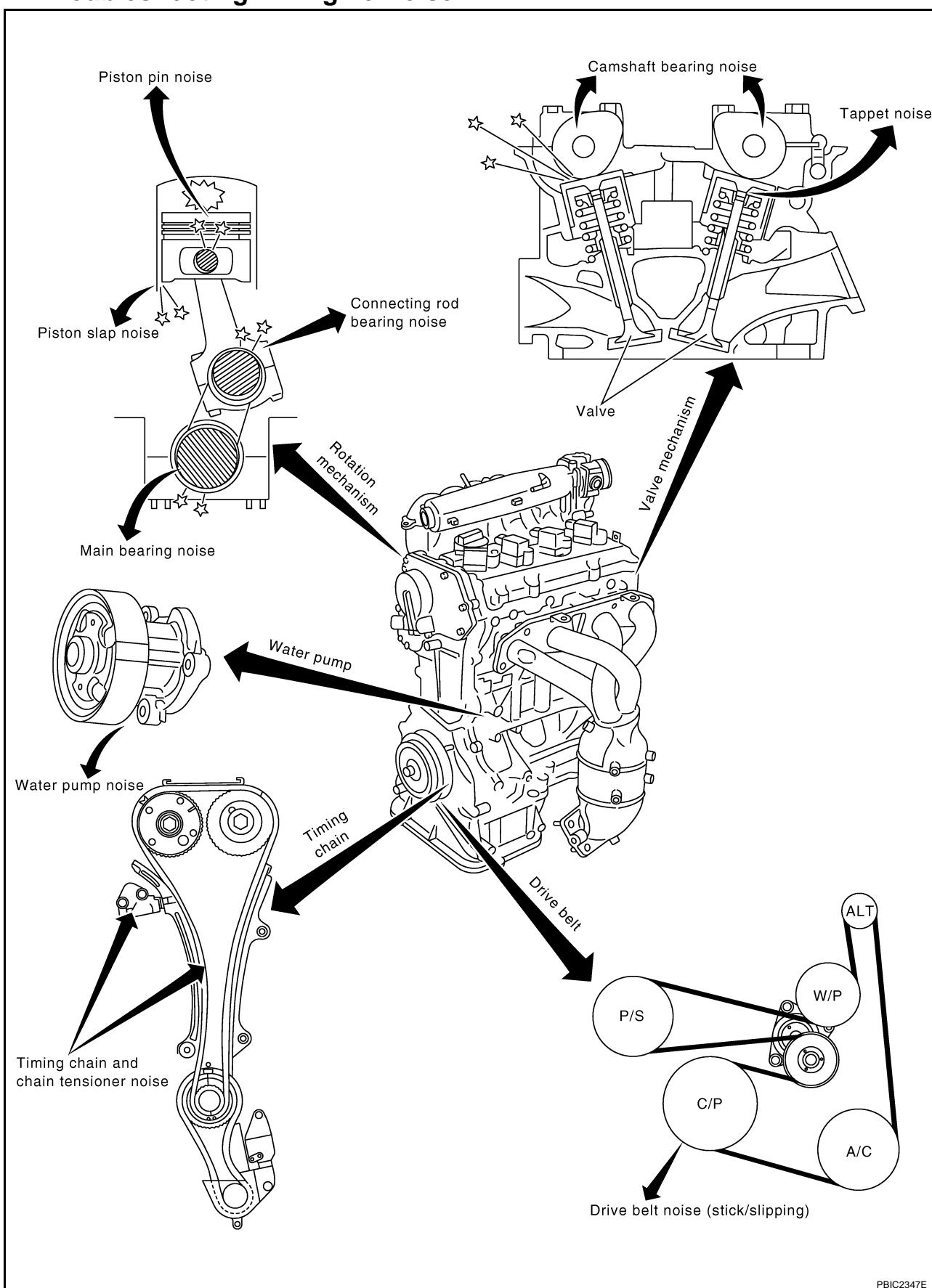
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NOISE, VIBRATION AND HARSHNESS (NVH) TROUBLESHOOTING

[QR]

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

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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-61
	Rattle	C	A	—	A	B	C	Camshaft bearing noise	Camshaft journal oil clearance Camshaft runout	EM-56 EM-55
Crank-shaft 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-99 EM-101
	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-104 EM-100 EM-100 EM-101
	Knock	A	B	C	B	B	B	Connecting rod bearing noise	Connecting rod bushing oil clearance Connecting rod bearing oil clearance	EM-101 EM-105
	Knock	A	B	—	A	B	C	Main bearing noise	Main bearing oil clearance Crankshaft runout	EM-106 EM-105
Front of engine Front cover	Tapping or ticking	A	A	—	B	B	B	Timing chain and chain tensioner noise	Timing chain cracks and wear Timing chain tensioner operation	EM-48 EM-44
Front of engine	Squeaking or fizzing	A	B	—	B	—	C	Drive belt (Sticking or slipping)	Drive belt deflection	EM-13
	Creaking	A	B	A	B	A	B	Drive belt (Slipping)	Idler pulley bearing operation	
	Squall Creak	A	B	—	B	A	B	Water pump noise	Water pump operation	CO-20. "WATER PUMP"

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

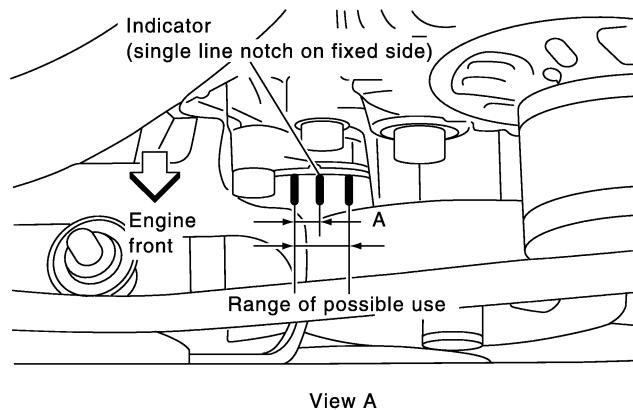
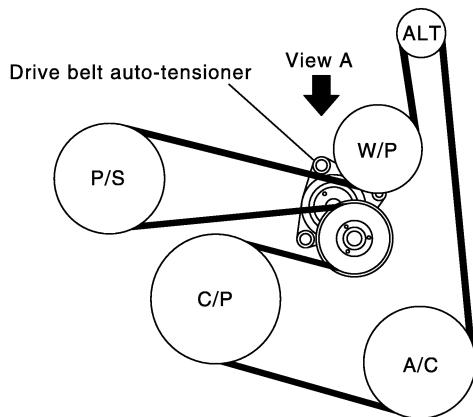
DRIVE BELTS

PFP:02117

Checking Drive Belts

EBS00KN7

SEC. 117



PBIC1234E

WARNING:**Be sure to perform this step when the engine is stopped.**

- Make sure that the indicator (single line notch on fixed side) of drive belt auto-tensioner is within the possible use range (between three line notches on moving side).

NOTE:

- Check the drive belt auto-tensioner indicator (single line notch on fixed side) when engine is cold.
- When new drive belt is installed, the indicator (single line notch on fixed side) should be within the range "A" in the figure.
- Visually check entire belt for wear, damage or cracks.
- If the indicator (single line notch on fixed side) is out of the possible use range or belt is damaged, replace drive belt.

Tension Adjustment

EBS00KN8

Belt tensioning is not necessary, as it is automatically adjusted by drive belt auto-tensioner.

Removal and Installation

EBS00KN9

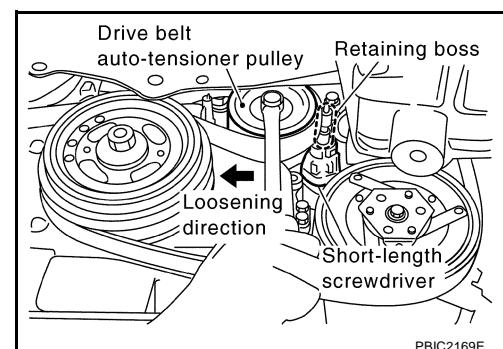
REMOVAL

- Remove splash guard on RH undercover.
- With box wrench, and while securely holding the hexagonal part in center of drive belt auto-tensioner pulley, move the wrench handle in the direction of arrow (loosening direction of tensioner).

CAUTION:

Avoid placing hand in a location where pinching may occur if the holding tool accidentally comes off.

- Insert a rod approximately 6 mm (0.24 in) in diameter such as short-length screwdriver into the hole of the retaining boss to fix drive belt auto-tensioner pulley.
- Loosen drive belt from water pump pulley in sequence, and remove it.



PBIC2169E

INSTALLATION

- With box wrench, and while securely holding the hexagonal part in center of drive belt auto-tensioner pulley, move the wrench handle in the direction of arrow (loosening direction of tensioner).

CAUTION:

Avoid placing hand in a location where pinching may occur if the holding tool accidentally comes off.

- Insert a rod approximately 6 mm (0.24 in) in diameter such as short-length screwdriver into the hole of retaining boss to fix drive belt auto-tensioner pulley.
- Hook drive belt onto all pulleys except for water pump, and then onto water pump pulley finally.

CAUTION:

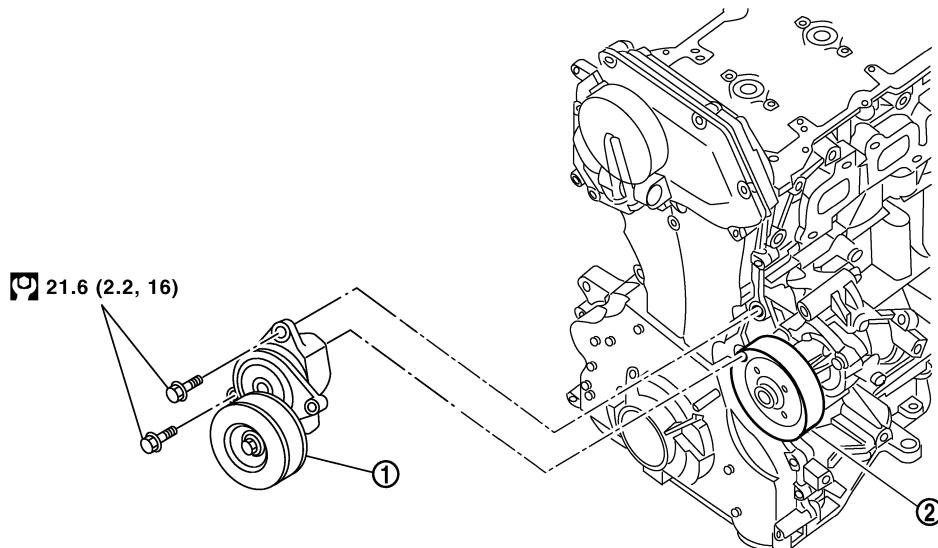
Confirm belt is completely set to pulleys.

- Release drive belt auto-tensioner, and apply tension to drive belt.
- Turn crankshaft pulley clockwise several times to equalize tension between each pulley.
- Confirm tension of drive belt at indicator is within the range of possible use. Refer to [EM-13, "Checking Drive Belts"](#).

Removal and Installation of Drive Belt Auto-Tensioner

EBS00KNA

SEC. 117



PBIC2170E

1. Drive belt auto-tensioner 2. Water pump pulley

REMOVAL

- Remove splash guard on RH undercover.
- Remove drive belt. Refer to [EM-13, "Removal and Installation"](#).
- Remove drive belt auto-tensioner.

INSTALLATION

Install in the reverse order of removal.

CAUTION:

When installing drive belt auto-tensioner, be careful not to damage water pump pulley.

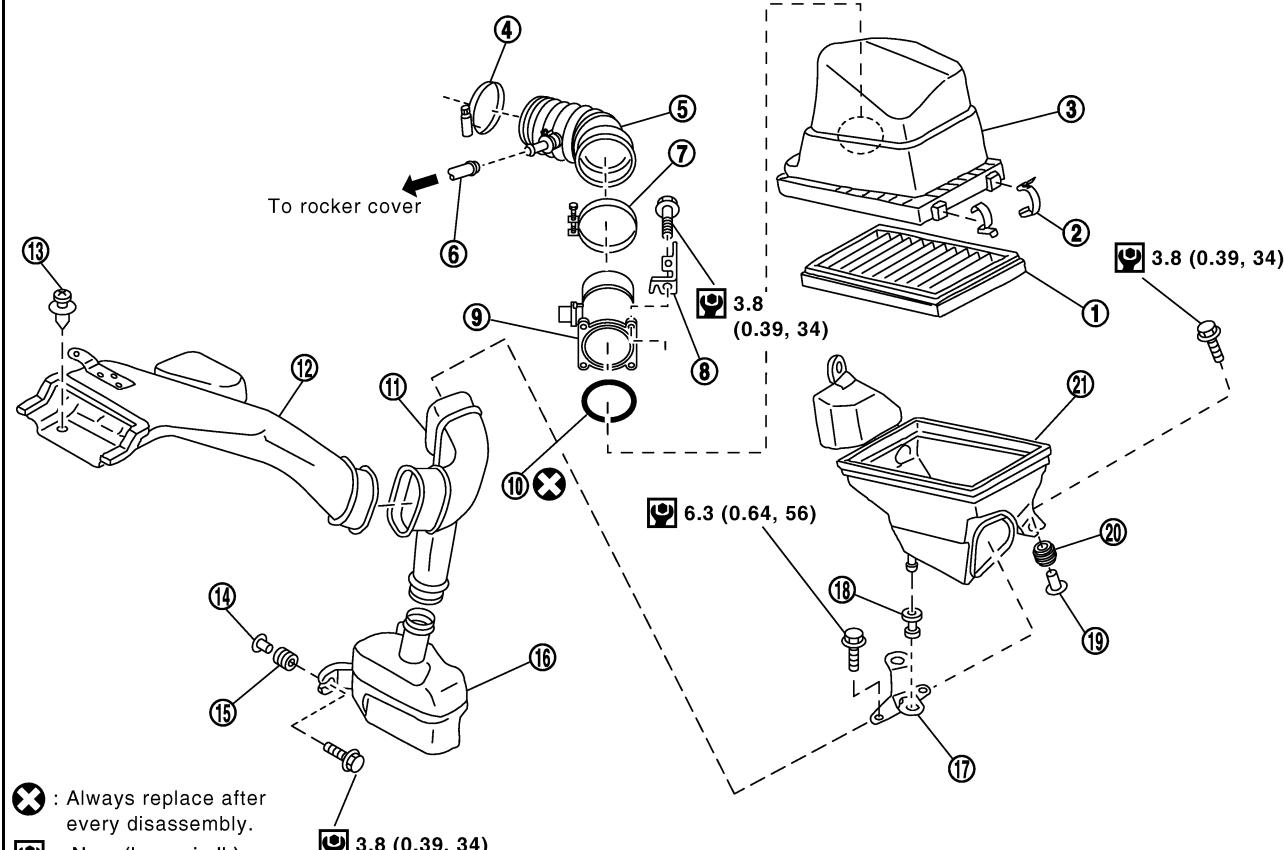
AIR CLEANER AND AIR DUCT

PFP:16500

Removal and Installation

EBS00KNB

SEC. 118•165



PBIC2171E

- | | | |
|-----------------------|--------------------------|----------------------------|
| 1. Air cleaner filter | 2. Clip | 3. Air cleaner case upper |
| 4. Clamp | 5. Air duct | 6. PCV hose |
| 7. Clamp | 8. Bracket | 9. Mass air flow sensor |
| 10. O-ring | 11. Air duct | 12. Air duct (inlet) |
| 13. Clip | 14. Collar | 15. Grommet |
| 16. Resonator | 17. Bracket (A/T models) | 18. Mounting rubber |
| 19. Collar | 20. Grommet | 21. Air cleaner case lower |

REMOVAL

1. Remove mass air flow sensor harness clamp.
2. Disconnect harness connector from mass air flow sensor.
3. Remove air duct (inlet), air ducts and air cleaner case/mass air flow sensor assembly disconnecting their joints.
 - Add marks as necessary for easier installation.
4. Remove mass air flow sensor from air cleaner case upper.

CAUTION:

Handle mass air flow sensor with following cares.

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

5. Remove resonator in fender lifting left fender protector.

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M

INSTALLATION

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

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

Changing Air Cleaner Filter

REMOVAL

1. Unfasten clips and lift up air cleaner case upper.
2. Remove air cleaner filter.

INSTALLATION

Install in the reverse order of removal.

EBS0123Q

INTAKE MANIFOLD

PFP:14003

Removal and Installation (QR20DE)

EBS00KNC

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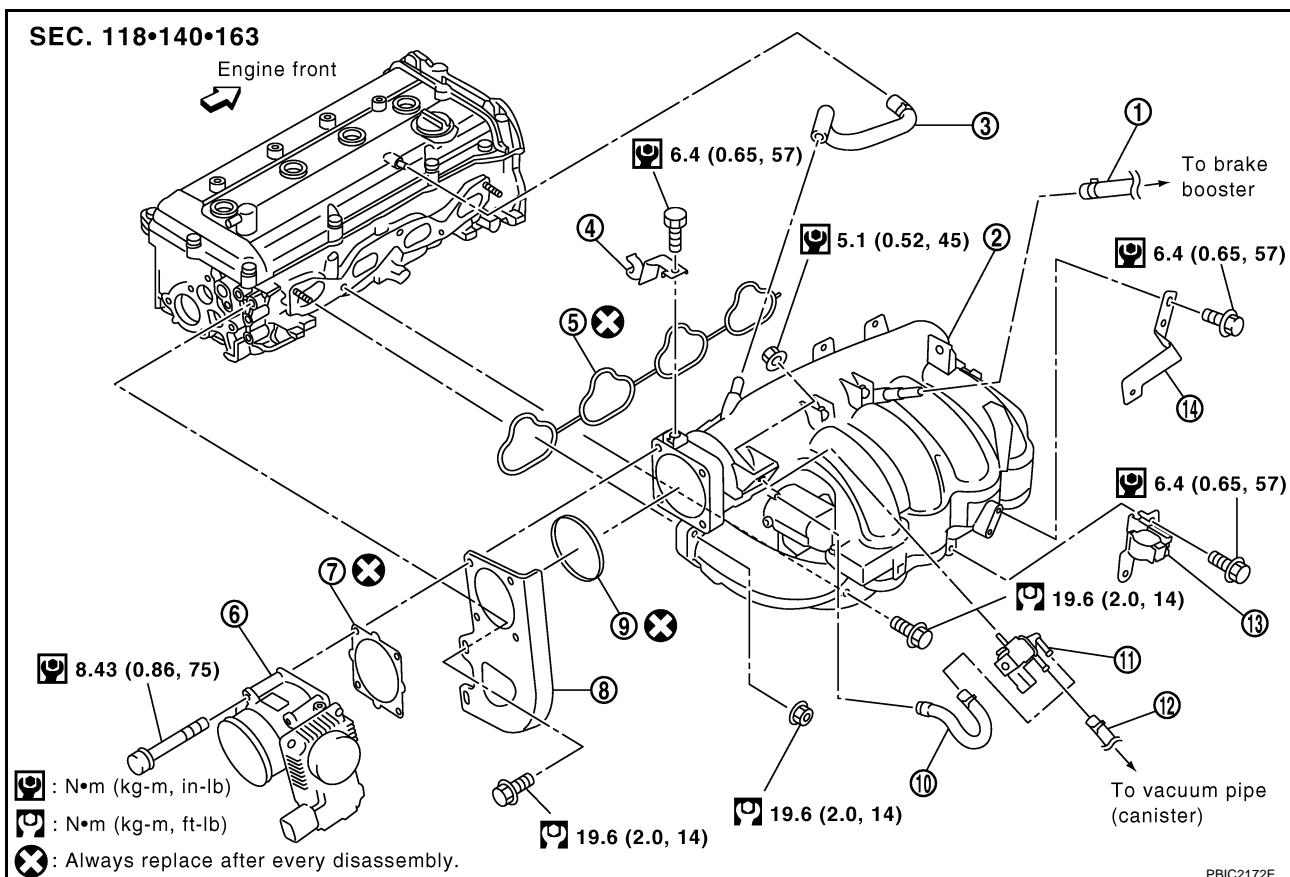
I

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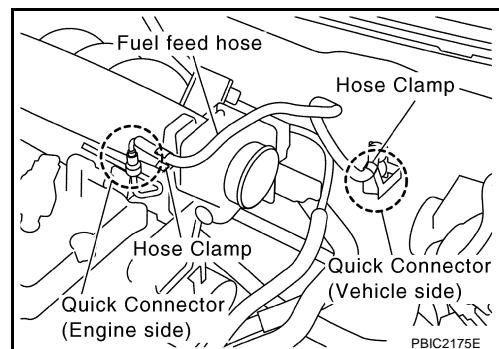
M



- | | | |
|-----------------|---|---------------------------------------|
| 1. Vacuum hose | 2. Intake manifold | 3. PCV hose |
| 4. Bracket | 5. Gasket | 6. Electric throttle control actuator |
| 7. Gasket | 8. Intake manifold support | 9. Gasket |
| 10. Vacuum hose | 11. EVAP canister purge volume control solenoid valve | 12. Vacuum hose |
| 13. Bracket | 14. Bracket | |

REMOVAL

- Release fuel pressure. Refer to [EC-48, "FUEL PRESSURE RELEASE"](#) (WITH EURO-OBD) or [EC-510, "FUEL PRESSURE RELEASE"](#) (WITHOUT EURO-OBD).
- Remove air cleaner case upper, mass air flow sensor and air duct assembly. Refer to [EM-15, "AIR CLEANER AND AIR DUCT"](#).
- Remove quick connector caps, and disconnect quick connectors at engine side and vehicle side. Refer to [EM-32, "Removal and Installation \(QR20DE\)"](#).



- Remove electric throttle control actuator with the following procedure:
 - Disconnect harness connector.

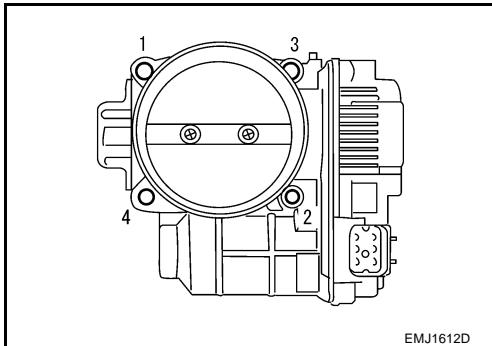
INTAKE MANIFOLD

[QR]

- b. Loosen mounting bolts in reverse order as shown in the figure, and remove electric throttle control actuator and gasket.

CAUTION:

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



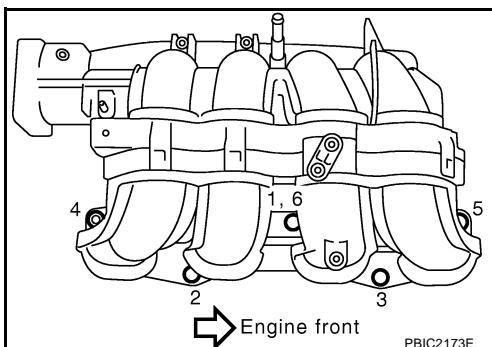
5. Disconnect harness, power steering piping, vacuum hose and PCV hose from intake manifold, and move them aside.
6. Remove intake manifold support and gasket.
7. Disconnect sub-harness from fuel injector. Refer to [EM-32, "Removal and Installation \(QR20DE\)"](#).
8. Loosen mounting bolts and nuts in reverse order as shown in the figure, and remove intake manifold (with fuel tube and fuel injector assembly) and gasket.

CAUTION:

- Do not disassemble intake manifold.
- Cover engine openings to avoid entry of foreign materials.

NOTE:

Disregard No. 6 when loosening.



9. Remove fuel tube and fuel injector assembly from intake manifold. Refer to [EM-32, "Removal and Installation \(QR20DE\)"](#).

INSTALLATION

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

Intake Manifold

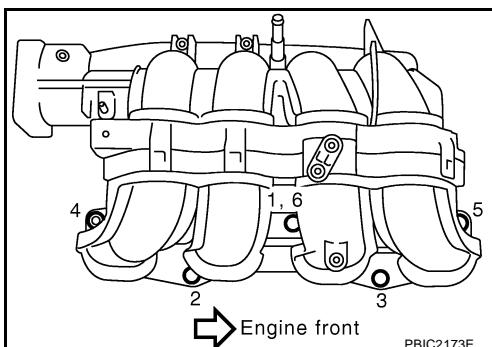
- If stud bolts were removed, install them and tighten to the specified torque below.

: 10.8 N·m (1.1 kg·m, 8 ft-lb)

- Check if gasket is not dropped from the installation groove of intake manifold.
- Tighten in numerical order as shown in the figure.

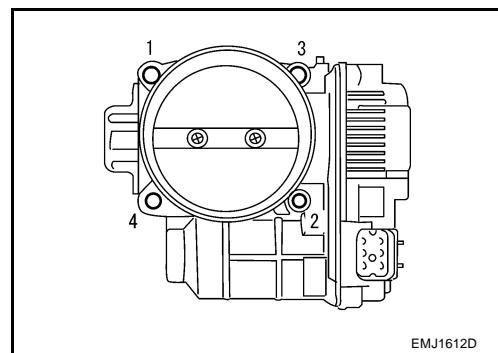
NOTE:

No. 6 means double tightening of bolt No. 1.



Electric Throttle Control Actuator

- Tighten mounting bolts equally and diagonally in several steps and 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-46, "Throttle Valve Closed Position Learning"](#) (WITH EURO-OBD) or [EC-508, "Throttle Valve Closed Position Learning"](#) (WITHOUT EURO-OBD).
- Perform the "Idle Air Volume Learning" and "Throttle Valve Closed Position Learning" when electric throttle control actuator is replaced. Refer to [EC-46, "Idle Air Volume Learning"](#) (WITH EURO-OBD) or [EC-508, "Idle Air Volume Learning"](#) (WITHOUT EURO-OBD).



EMJ1612D

INSPECTION AFTER INSTALLATION

Make sure there are no fuel leaks at connections with the following procedure:

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

NOTE:

Use mirrors for checking on invisible points.

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

CAUTION:

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

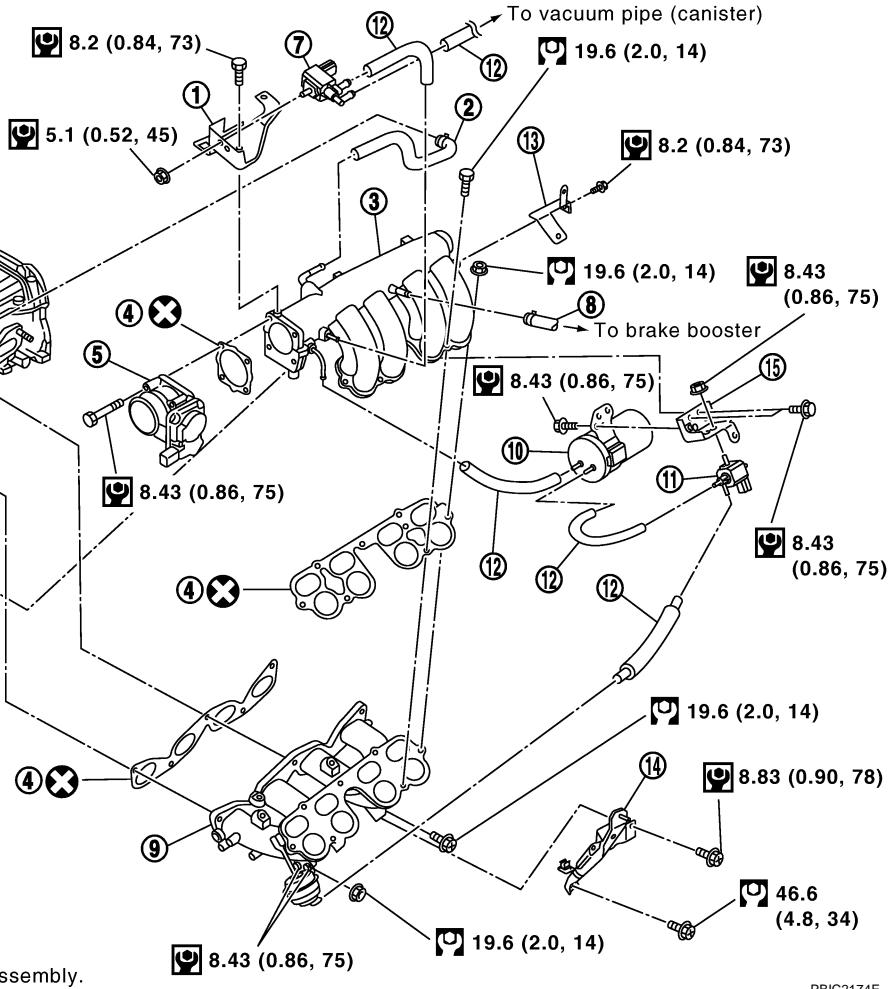
INTAKE MANIFOLD

[QR]

Removal and Installation (QR25DE)

EBS011TH

SEC. 118•140•163

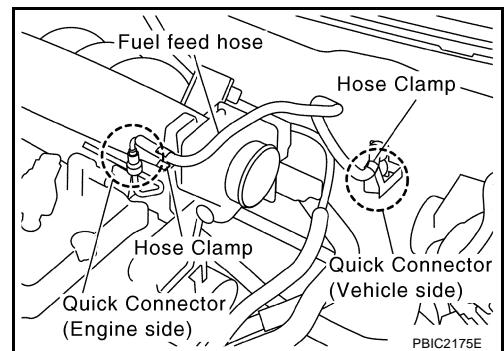


PBIC2174E

- | | | |
|--|---------------------------------------|-----------------------------------|
| 1. Bracket | 2. PCV hose | 3. Intake manifold collector |
| 4. Gasket | 5. Electric throttle control actuator | 6. Intake manifold rear support |
| 7. EVAP canister purge volume control solenoid valve | 8. Vacuum hose | 9. Intake manifold |
| 10. Vacuum reservoir tank | 11. VIAS control solenoid valve | 12. Vacuum hose |
| 13. Bracket | 14. Intake manifold support | 15. Vacuum reservoir tank bracket |

REMOVAL

1. Release fuel pressure. Refer to [EC-48, "FUEL PRESSURE RELEASE"](#) (WITH EURO-OBD) or [EC-510, "FUEL PRESSURE RELEASE"](#) (WITHOUT EURO-OBD).
 2. Remove air cleaner case upper, mass air flow sensor and air duct assembly. Refer to [EM-15, "AIR CLEANER AND AIR DUCT"](#).
 3. Remove quick connector caps, and disconnect quick connectors at engine side and vehicle side. Refer to [EM-37, "Removal and Installation \(QR25DE\)"](#).



4. Remove electric throttle control actuator with the following procedure:

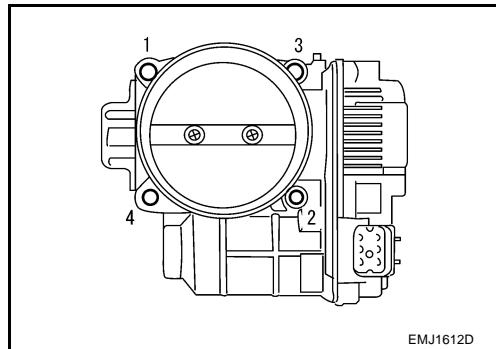
INTAKE MANIFOLD

[QR]

- a. Disconnect harness connector.
- b. Loosen mounting bolts in reverse order as shown in the figure, and remove electric throttle control actuator and gasket.

CAUTION:

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



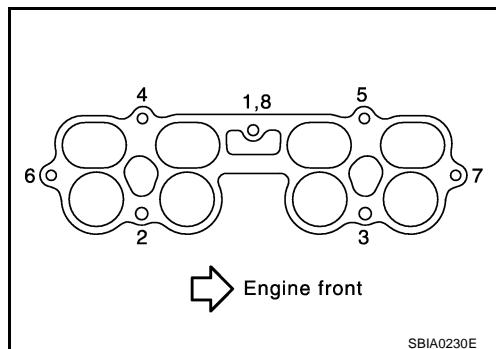
5. Disconnect harness, vacuum hose and PCV hose from intake manifold collector, and move them aside.
6. Remove intake manifold rear support and intake manifold support.
7. Loosen mounting bolts and nuts in reverse order as shown in the figure, and remove intake manifold collector and gasket.

CAUTION:

Cover engine openings to avoid entry of foreign materials.

NOTE:

Disregard No. 8 when loosening.



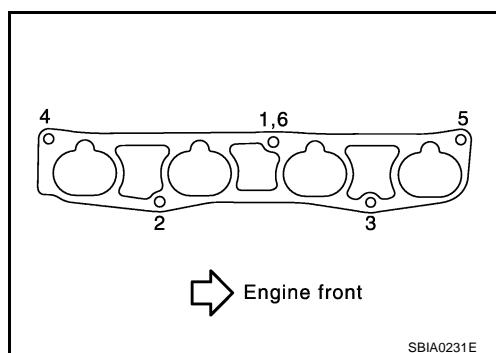
8. Disconnect power steering piping from intake manifold, and move them aside.
9. Disconnect sub-harness from fuel injector. Refer to [EM-37, "Removal and Installation \(QR25DE\)"](#).
10. Loosen mounting bolts and nuts in reverse order as shown in the figure, and remove intake manifold (with fuel tube and fuel injector assembly) and gasket.

CAUTION:

Cover engine openings to avoid entry of foreign materials.

NOTE:

Disregard No. 6 when loosening.



11. Remove fuel tube and fuel injector assembly from intake manifold. Refer to [EM-37, "Removal and Installation \(QR25DE\)"](#).

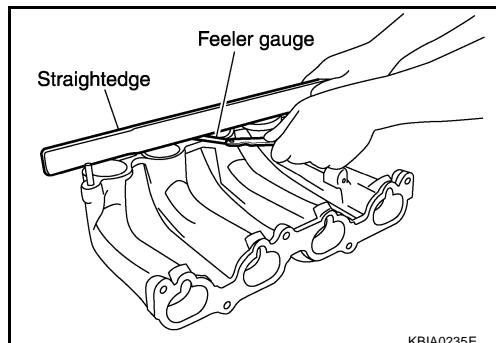
INSPECTION AFTER REMOVAL

Surface Distortion

- Using straightedge and feeler gauge, check the surface distortion of both the intake manifold collector mating surface and the intake manifold mating surfaces.

Limit : 0.1 mm (0.004 in)

- If it exceeds the limit, replace intake manifold and/or intake manifold collector.



INSTALLATION

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

Intake Manifold

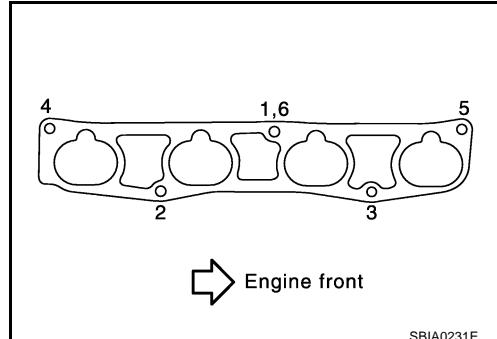
- If stud bolts were removed, install them and tighten to the specified torque below.

 : 10.8 N·m (1.1 kg·m, 8 ft-lb)

- Tighten in numerical order as shown in the figure.

NOTE:

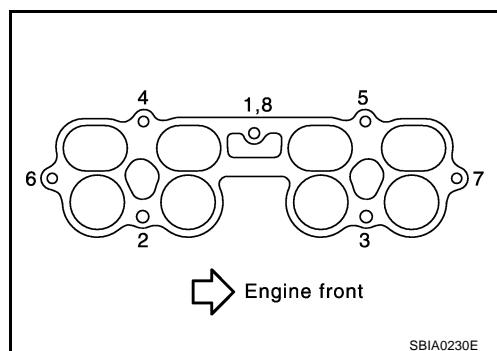
No. 6 means double tightening of bolt No. 1.

**Intake Manifold Collector**

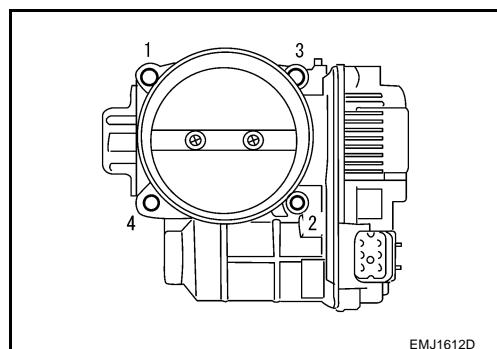
Tighten in numerical order as shown in the figure.

NOTE:

No. 8 means double tightening of bolt No. 1.

**Electric Throttle Control Actuator**

- Tighten mounting bolts equally and diagonally in several steps and 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-46, "Throttle Valve Closed Position Learning"](#) (WITH EURO-OBD) or [EC-508, "Throttle Valve Closed Position Learning"](#) (WITHOUT EURO-OBD).
- Perform the "Idle Air Volume Learning" and "Throttle Valve Closed Position Learning" when electric throttle control actuator is replaced. Refer to [EC-46, "Idle Air Volume Learning"](#) (WITH EURO-OBD) or [EC-508, "Idle Air Volume Learning"](#) (WITHOUT EURO-OBD).

**INSPECTION AFTER INSTALLATION**

Make sure there are no fuel leaks at connections with the following procedure:

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

NOTE:

Use mirrors for checking on invisible points.

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

CAUTION:

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

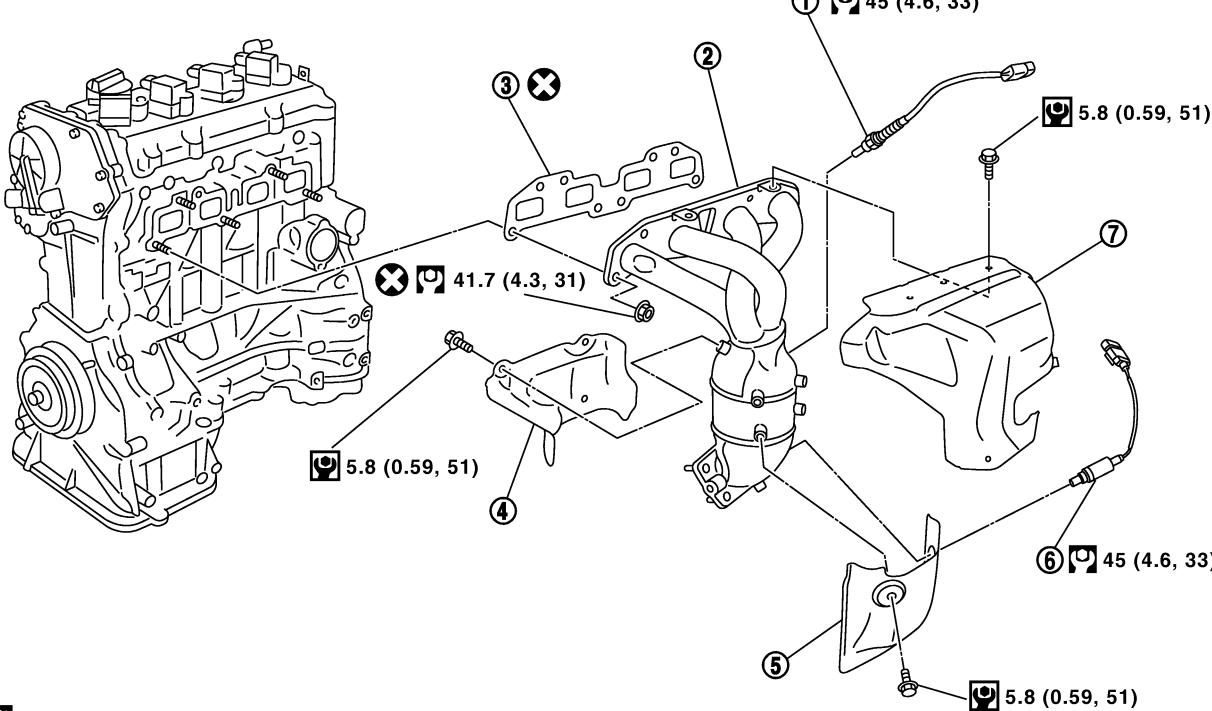
EXHAUST MANIFOLD AND THREE WAY CATALYST

PFP:14004

Removal and Installation

EBS00KND

SEC. 111•140•226



PBIC2176E

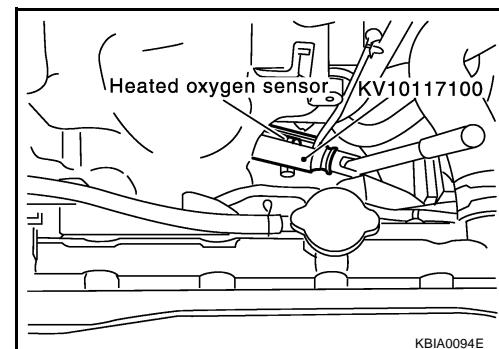
1. Heated oxygen sensor 1
2. Exhaust manifold and three way catalyst assembly
3. Gasket
4. Three way catalyst cover
5. Exhaust manifold cover (lower)
6. Heated oxygen sensor 2
7. Exhaust manifold cover (upper)

REMOVAL

1. Remove heated oxygen sensors with the following procedure:
 - a. Disconnect harness connector of each heated oxygen sensor, and harness from bracket and middle clamp.
 - b. Using heated oxygen sensor wrench (special service tool), remove heated oxygen sensors.

CAUTION:

- Be careful not to damage heated oxygen sensor.
- Discard any heated oxygen sensor 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 one.



KBIA0094E

2. Remove exhaust front tube. Refer to [EX-2, "EXHAUST SYSTEM"](#).
3. Remove alternator. Refer to [SC-12, "CHARGING SYSTEM"](#).
4. Remove exhaust manifold cover (upper).

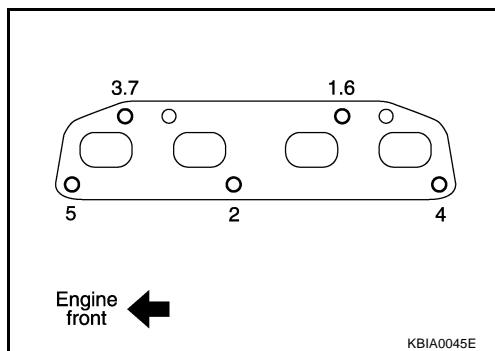
EXHAUST MANIFOLD AND THREE WAY CATALYST

[QR]

5. Loosen nuts in reverse order as shown in the figure to remove exhaust manifold and three way catalyst assembly.

NOTE:

Disregard No. 6 and 7 when loosening.



6. Remove gasket.

CAUTION:

Cover engine openings to avoid entry of foreign materials.

7. Remove exhaust manifold cover (lower) and three way catalyst cover from exhaust manifold and three way catalyst assembly.

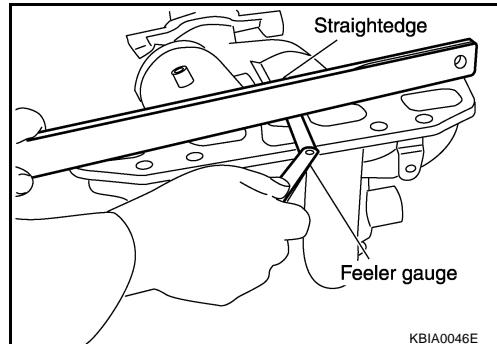
INSPECTION AFTER REMOVAL

Surface Distortion

- Using straightedge and feeler gauge, check the surface distortion of exhaust manifold and three way catalyst assembly mating surface.

Limit : 0.3 mm (0.012 in)

- If it exceeds the limit, replace exhaust manifold and three way catalyst assembly.



INSTALLATION

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

Exhaust Manifold

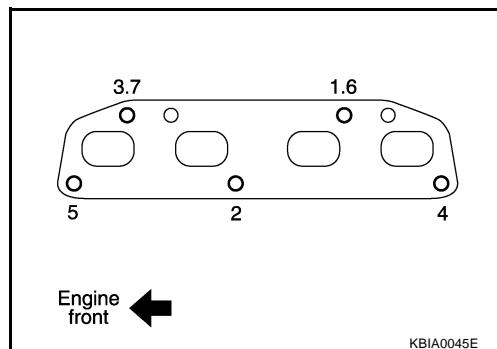
- If stud bolts were removed, install them and tighten to the specified torque below.

• : 14.7 N·m (1.5 kg·m, 11 ft-lb)

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

NOTE:

No. 6 and 7 mean double tightening of bolts No. 1 and 3.



Heated Oxygen Sensor

CAUTION:

- Before installing a new heated oxygen sensor, clean exhaust system threads using heated oxygen sensor thread cleaner and apply anti-seize lubricant (commercial service tool).
- Do not over torque the heated oxygen sensor. Doing so may cause damage to the heated oxygen sensor, resulting in the "MI" coming on.

OIL PAN AND OIL STRAINER

[QR]

OIL PAN AND OIL STRAINER

PFP:11110

Removal and Installation

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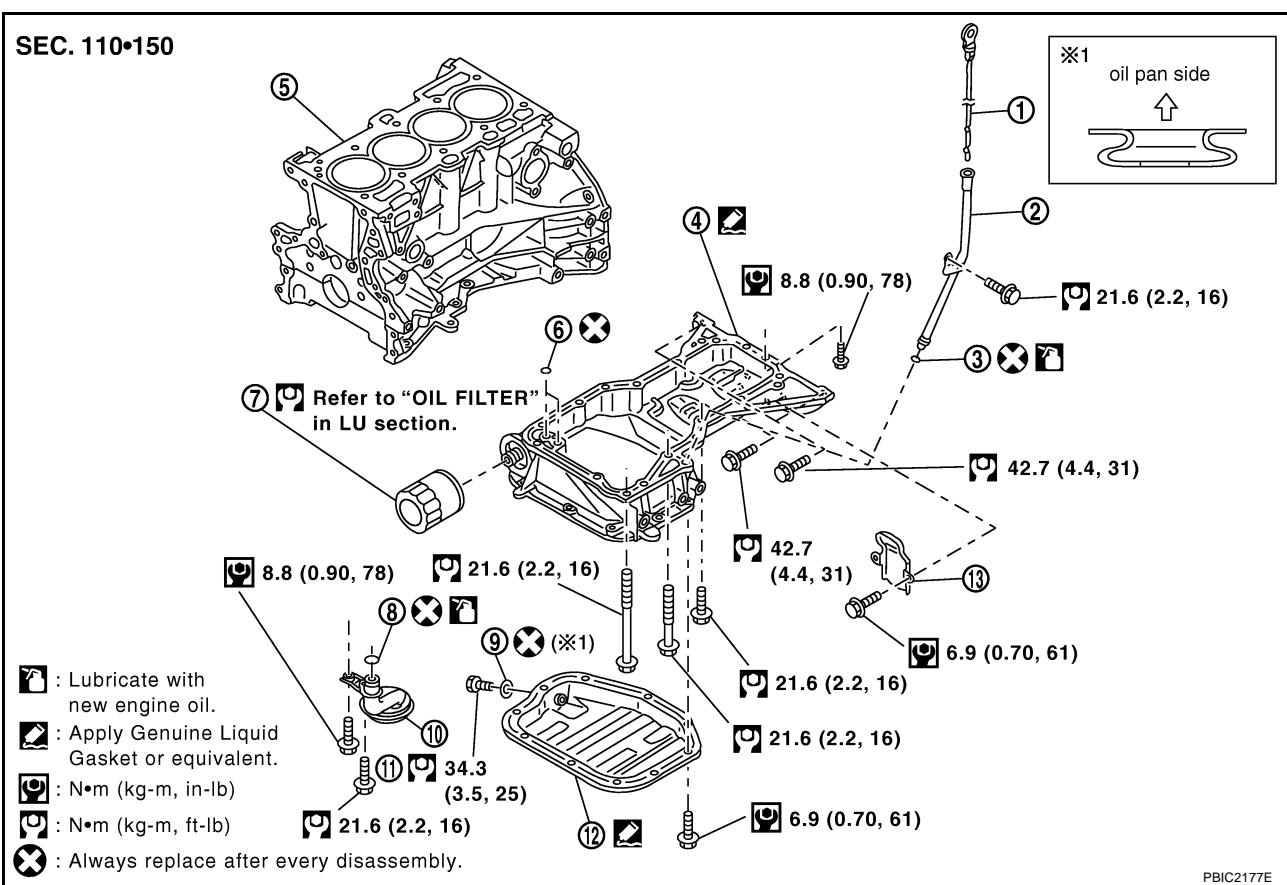
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PBIC2177E

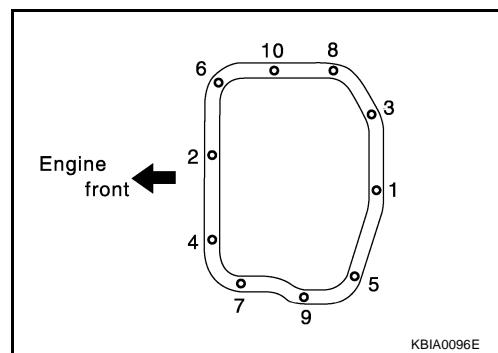
- | | | |
|----------------------|--------------------------|----------------------|
| 1. Oil level gauge | 2. Oil level gauge guide | 3. O-ring |
| 4. Oil pan (upper) | 5. Cylinder block | 6. O-ring |
| 7. Oil filter | 8. O-ring | 9. Drain plug washer |
| 10. Oil strainer | 11. Drain plug | 12. Oil pan (lower) |
| 13. Rear plate cover | | |

REMOVAL

WARNING:

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

1. Remove RH and LH undercovers.
2. Drain engine oil. Refer to [LU-8, "Changing Engine Oil"](#).
3. Remove oil pan (lower) with the following procedure:
 - a. Loosen mounting bolts in reverse order as shown in the figure.



KBIA0096E

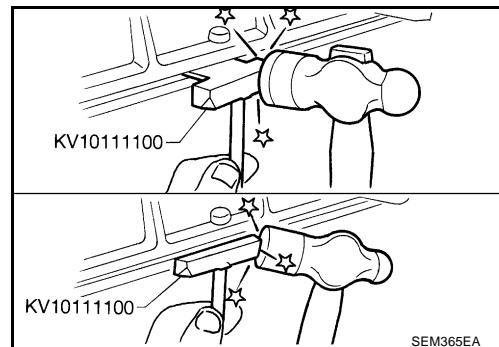
OIL PAN AND OIL STRAINER

[QR]

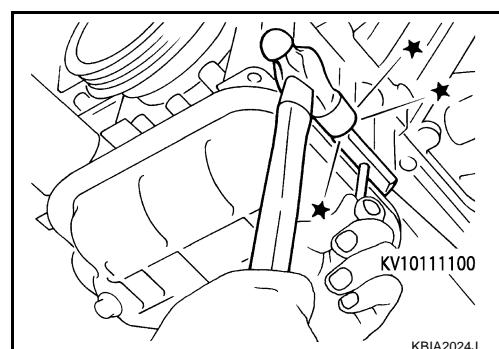
- b. Insert seal cutter (special service tool) between oil pan (upper) and oil pan (lower).

CAUTION:

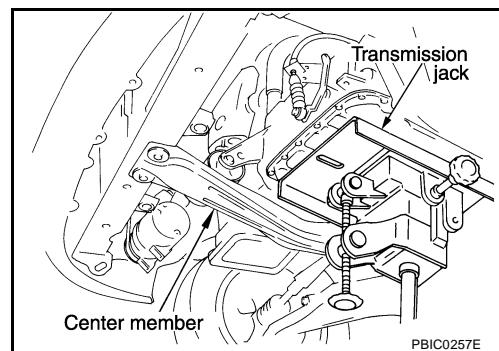
Be careful not to damage the mating surface.



- c. Slide seal cutter by tapping on the side of the tool with a hammer.



4. Remove oil strainer.
5. Remove oil pan (upper) with the following procedure:
 - a. Remove drive belt. Refer to [EM-13, "DRIVE BELTS"](#).
 - b. Remove A/C compressor with piping connected. And locate it aside temporarily with ropes or equivalent not to disturb the following work. Refer to [ATC-144, "Removal and Installation of Compressor"](#).
 - c. Remove oil level gauge guide.
 - d. Remove exhaust front tube and its support. Refer to [EX-2, "EXHAUST SYSTEM"](#).
 - e. Set a suitable transmission jack under transaxle and hoist engine with engine slinger, and then remove center member. Refer to [EM-78, "ENGINE ASSEMBLY"](#).

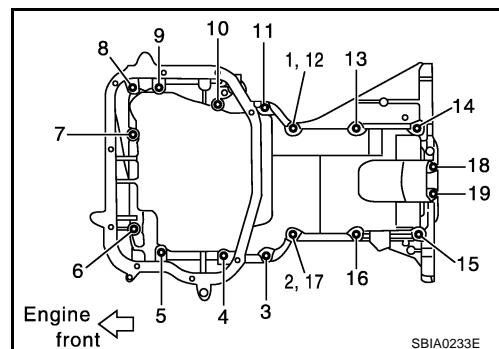


- f. Remove rear plate cover, and four transaxle joint bolts. Refer to [MT-17, "TRANSAXLE ASSEMBLY"](#) (M/T models) or [AT-413, "REMOVAL AND INSTALLATION"](#) (A/T models).

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

NOTE:

Disregard No.12 and 17 when loosening.



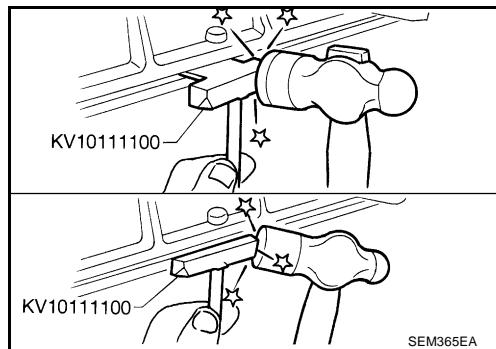
OIL PAN AND OIL STRAINER

[QR]

- h. Insert seal cutter (special service tool) between oil pan (upper) and cylinder block, and slide it by tapping on the side of the tool with a hammer.

CAUTION:

Be careful not to damage the mating surface.



6. Remove O-rings at front cover side.

INSPECTION AFTER REMOVAL

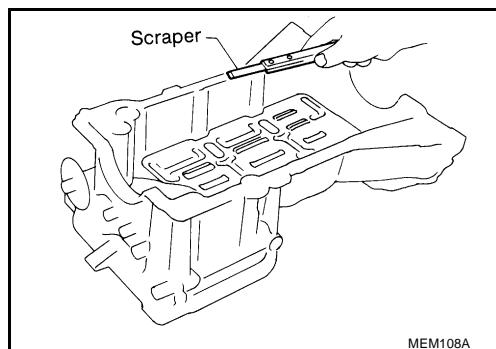
Clean oil strainer if any object attached.

INSTALLATION

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

CAUTION:

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

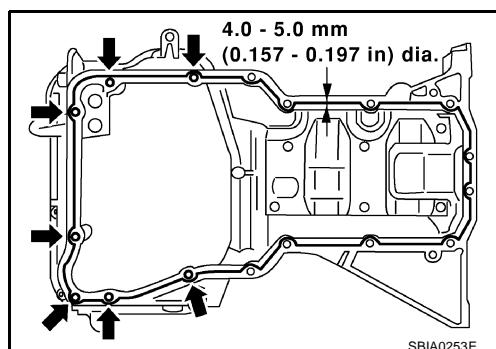


- b. Apply a continuous bead of liquid gasket with a tube presser (special service tool: WS39930000) as shown in the figure.

Use Genuine Liquid Gasket or equivalent.

CAUTION:

Apply liquid gasket to outside of bolt hole for the positions shown by arrows.



- c. Install new O-rings at front cover side.

- d. Tighten bolts in numerical order as shown in the figure.
No. 12 and 17 mean double tightening of bolts No. 1 and 2.

NOTE:

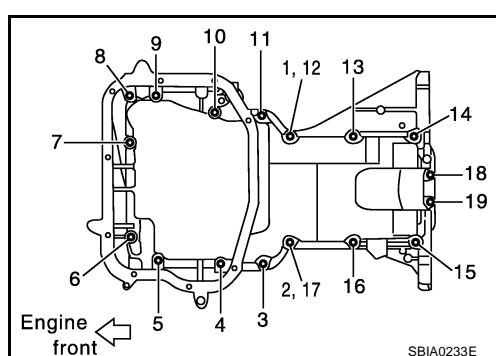
Refer to the following for locating bolts.

M6 × 20 mm (0.79 in) : No. 18, 19

M8 × 25 mm (0.98 in) : No. 1, 2, 3, 11

M8 × 45 mm (1.77 in) : No. 4, 10, 13, 14, 15, 16

M8 × 100 mm (3.97 in) : No. 5, 6, 7, 8, 9



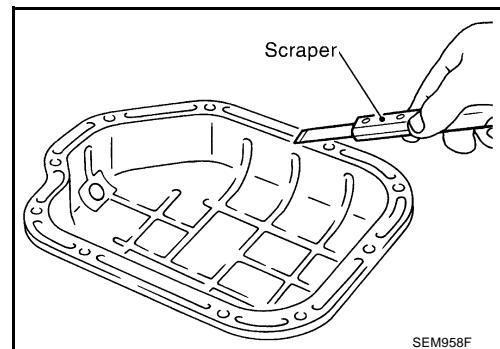
- e. Tighten transaxle joint bolts. Refer to [MT-17, "TRANSAXLE ASSEMBLY"](#) (M/T models) or [AT-413, "REMOVAL AND INSTALLATION"](#) (A/T models).

- f. Install rear plate cover.

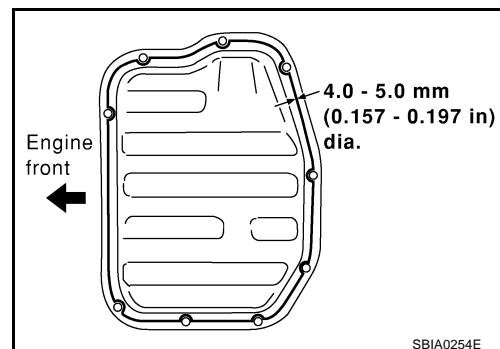
OIL PAN AND OIL STRAINER

[QR]

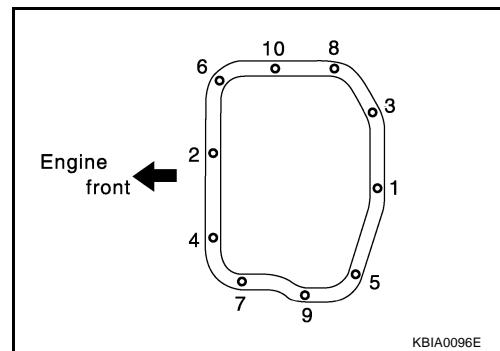
2. Install oil strainer.
3. Install oil pan (lower) with the following procedure:
 - a. Use a scraper to remove old liquid gasket from mating surfaces.
 - **Also remove old liquid gasket from mating surface of oil pan (upper).**



- b. Apply a continuous bead of liquid gasket with a tube presser (special service tool: WS39930000) as shown in the figure.
Use Genuine Liquid Gasket or equivalent.



- 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 washer. Refer to [EM-25, "Removal and Installation"](#).
5. Install in the reverse order of removal after this step.

NOTE:

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

INSPECTION AFTER INSTALLATION

1. Check engine oil level and add engine oil. Refer to [LU-7, "ENGINE OIL"](#).
2. Start engine, and make sure there is no leaks of engine oil.
3. Stop engine and wait for 10 minutes.
4. Check engine oil level again. Refer to [LU-7, "ENGINE OIL"](#).

IGNITION COIL

PFP:22448

Removal and Installation

EBS00KNF

A

EM

C

D

E

F

G

H

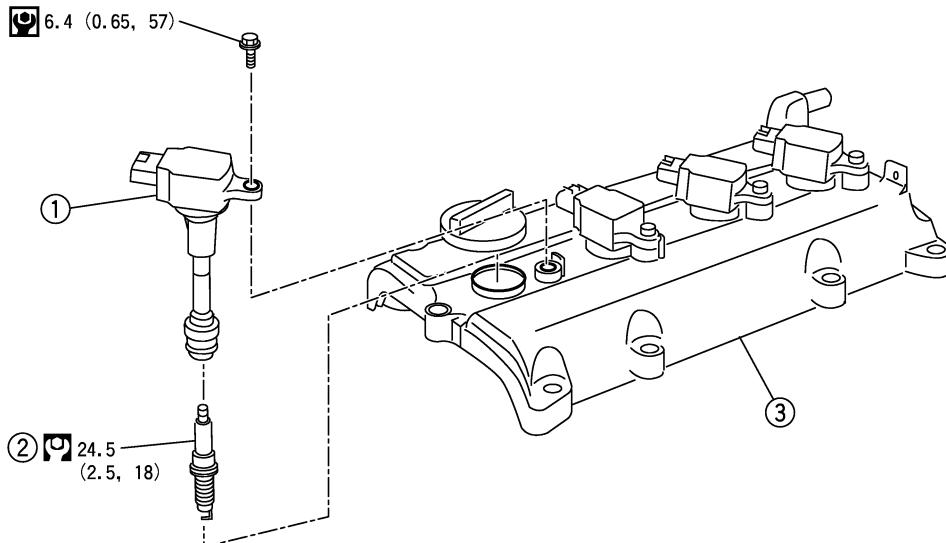
J

K

L

M

SEC. 111-220



KBIA1974J

1. Ignition coil

2. Spark plug

3. Rocker cover

REMOVAL

1. Disconnect harness connector from ignition coil.
2. Remove ignition coil.

CAUTION:**Do not drop or shock it.****INSTALLATION**

Install in the reverse order of removal.

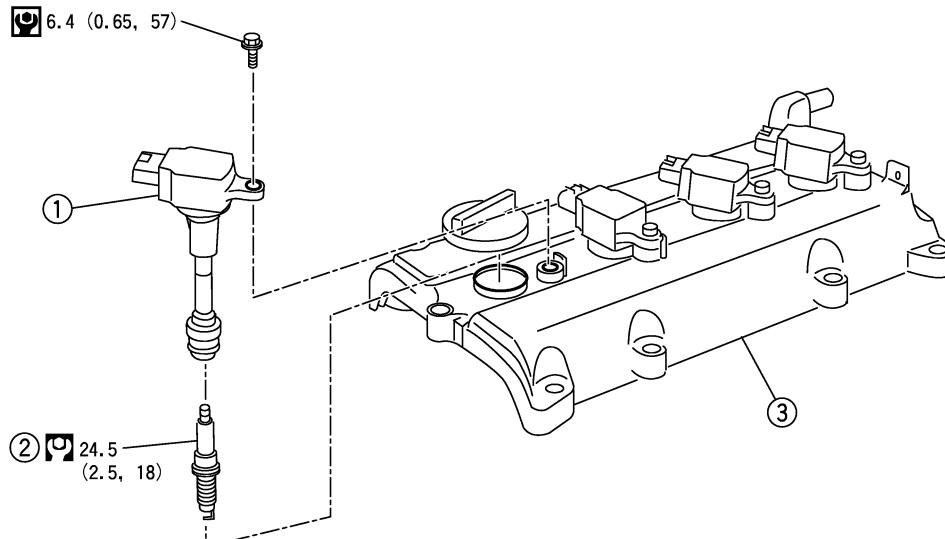
SPARK PLUG

PFP:22401

Removal and Installation

EBS00KNG

SEC. 111-220



KBIA1974J

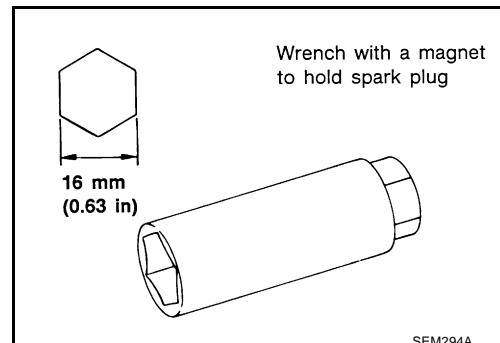
1. Ignition coil

2. Spark plug

3. Rocker cover

REMOVAL

1. Remove ignition coil. Refer to [EM-29, "IGNITION COIL"](#).
2. Remove spark plug with spark plug wrench (commercial service tool).

CAUTION:**Do not drop or shock it.**

SEM294A

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	LFR5A-11
Hot type	LFR4A-11
Cold type	LFR6A-11

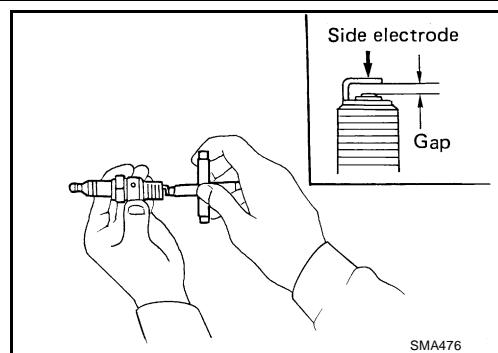
SPARK PLUG

[QR]

- Check plug gap of each spark plug.

Standard :1.0 - 1.1 mm (0.039 - 0.043 in)

- If out of standard, adjust or replace spark plug.
- Use a wire brush for cleaning, if necessary.



INSTALLATION

Install in the reverse order of removal.

A

EM

C

D

E

F

G

H

I

J

K

L

M

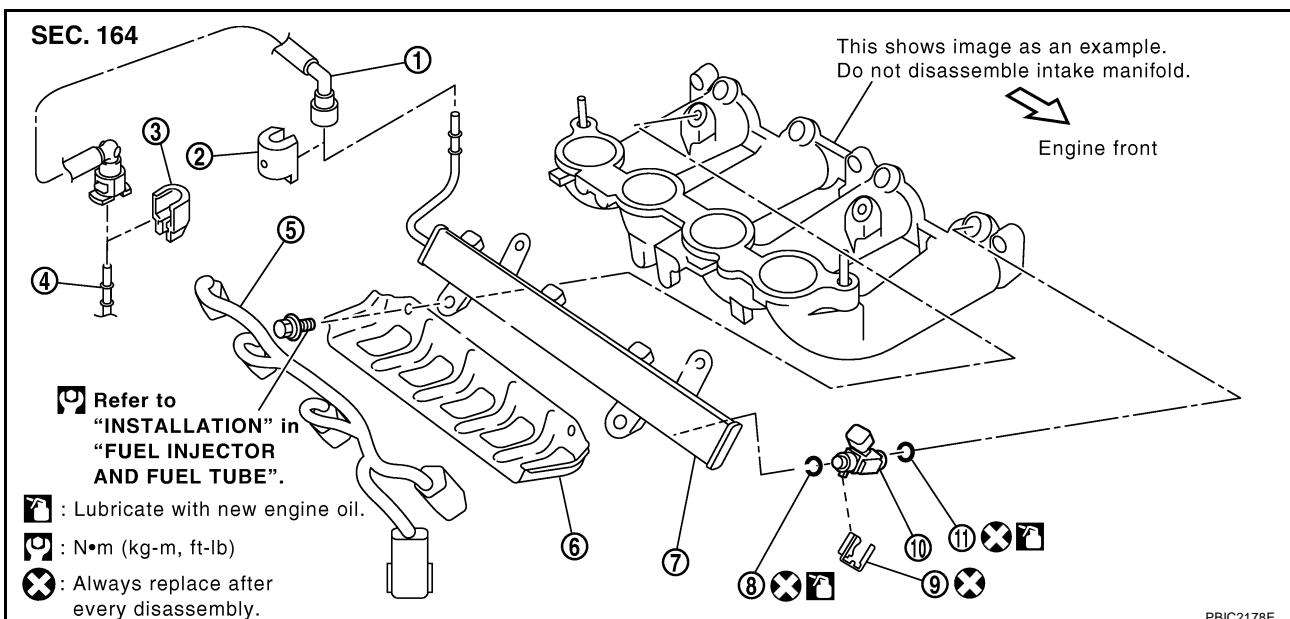
FUEL INJECTOR AND FUEL TUBE

[QR]

FUEL INJECTOR AND FUEL TUBE Removal and Installation (QR20DE)

PFP:16600

EBS00KNH



- | | | |
|-----------------------------------|--------------------------------------|---------------------------------------|
| 1. Fuel feed hose | 2. Quick connector cap (engine side) | 3. Quick connector cap (vehicle side) |
| 4. Centralized under-floor piping | 5. Sub-harness | 6. Fuel tube protector |
| 7. Fuel tube | 8. O-ring (black) | 9. Clip |
| 10. Fuel injector | 11. O-ring (green) | |

CAUTION:

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

REMOVAL

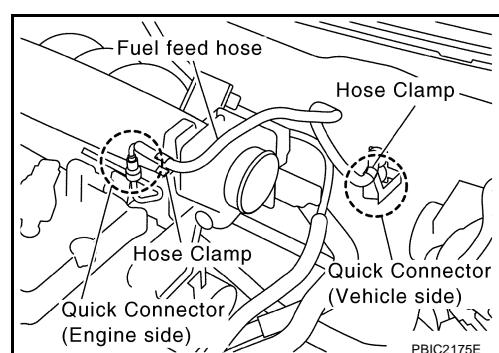
- Release fuel pressure. Refer to [EC-48, "FUEL PRESSURE RELEASE"](#) (WITH EURO-OBD) or [EC-510, "FUEL PRESSURE RELEASE"](#) (WITHOUT EURO-OBD).
- Remove air cleaner case upper, mass air flow sensor and air duct assembly. Refer to [EM-15, "AIR CLEANER AND AIR DUCT"](#).
- Disconnect quick connectors at engine side and vehicle side as follows, and remove fuel feed hose.

CAUTION:

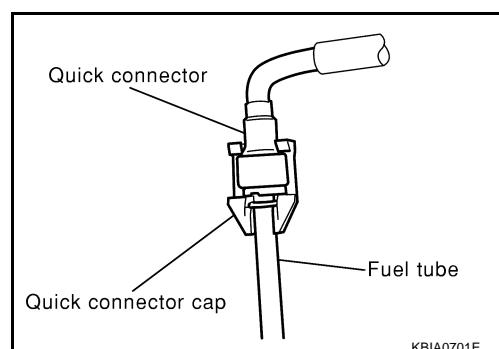
Disconnect quick connector by using quick connector release (special service tool), not by picking out retainer tabs.

NOTE:

There is quick connector for the engine side and for the vehicle side, and they have different shapes. But disconnection is same procedure. The following procedure shows the engine side.



- Remove quick connector cap (engine side).



FUEL INJECTOR AND FUEL TUBE

[QR]

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

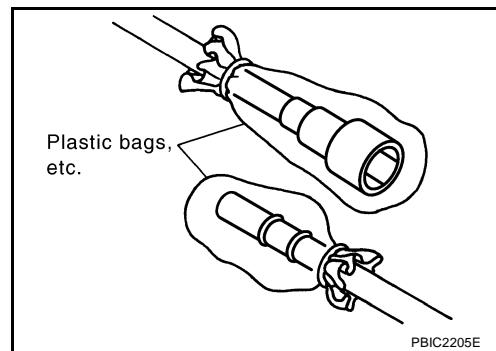
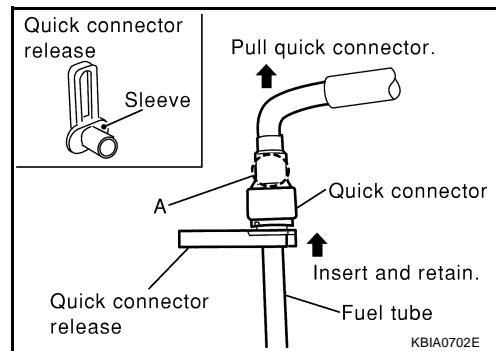
CAUTION:

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

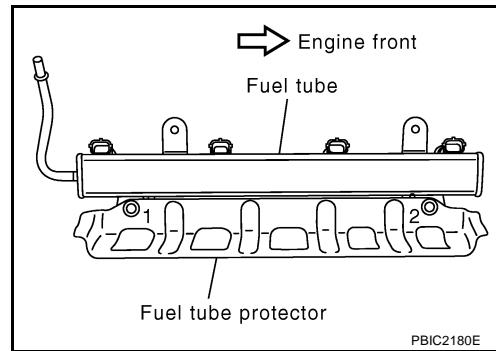
- d. Draw and pull out quick connector straight from fuel tube.

CAUTION:

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



4. Remove PCV hose. Refer to [EM-17, "Removal and Installation \(QR20DE\)"](#).
5. Disconnect harness connector from ignition coil.
6. Remove sub-harness for fuel injector.
7. Remove electric throttle control actuator and intake manifold support. Refer to [EM-17, "Removal and Installation \(QR20DE\)"](#).
8. Loosen mounting bolts in reverse order as shown in the figure.
9. Remove fuel tube protector.



10. Pull out fuel tube and fuel injector assembly rearward of engine.

CAUTION:

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

FUEL INJECTOR AND FUEL TUBE

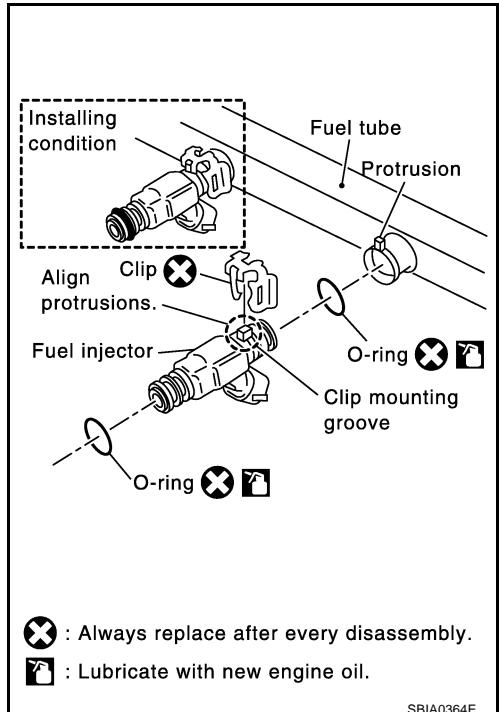
[QR]

11. Remove fuel injector from fuel tube with the following procedure:

- Open and remove clip.
- 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 fuel injector nozzle during removal.
- Do not bump or drop fuel injector.
- Do not disassemble fuel injector.



INSTALLATION

1. 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 : Black

Nozzle side : Green

- 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.

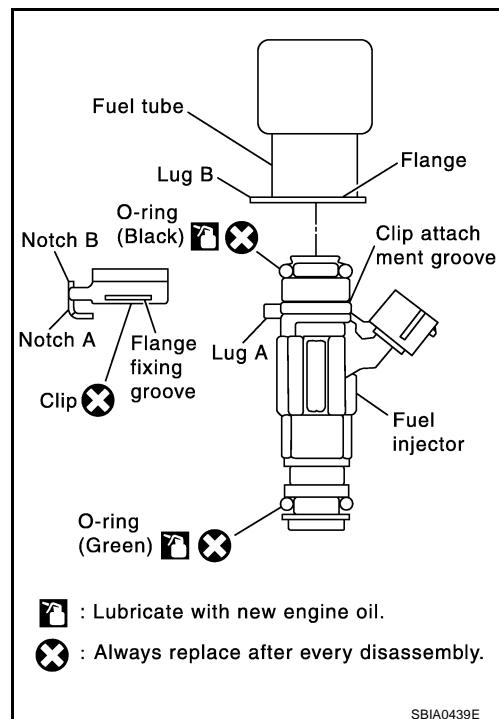
FUEL INJECTOR AND FUEL TUBE

[QR]

2. Install fuel injector to fuel tube with the following procedure:
 - 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 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.



3. From the engine rear side, set fuel tube and fuel injector assembly at its position for installation on intake manifold.

CAUTION:

For installation, be careful not to interfere with fuel injector nozzle.

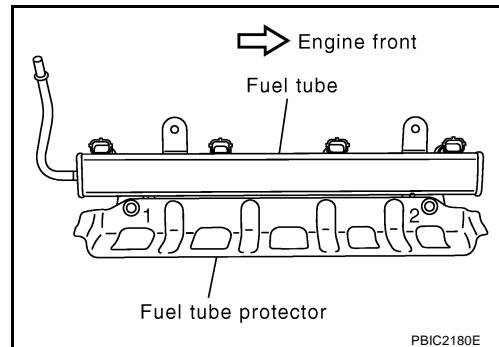
4. Set fuel tube protector onto fuel tube.
5. Tighten mounting bolts with the following procedure.
 - Tighten bolts evenly in two steps in numerical order as shown in the figure.

1st step

: 10.1 N·m (1.0 kg-m, 7 ft-lb)

2nd step

: 23.6 N·m (2.4 kg-m, 17 ft-lb)



6. Connect sub-harness for fuel injector.
7. Note the following, and connect quick connectors at engine side and vehicle side to install fuel feed hose.

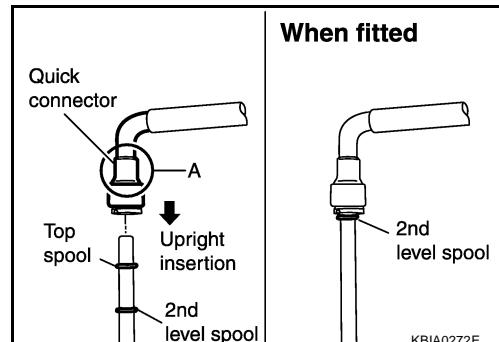
NOTE:

There is quick connector for the engine side and for the vehicle side, and they have different shapes. But connection is same procedure. The following procedure shows the engine side.

- a. Check the connection for foreign material and damage.
- b. Align center to insert quick connector straightly into fuel tube.
 - Insert fuel tube into quick connector until the top spool on fuel tube is inserted completely and the second level spool is positioned slightly below quick connector bottom end.

CAUTION:

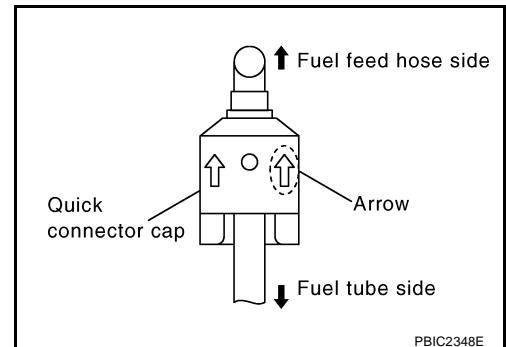
- Hold "A" position in the figure when inserting fuel tube into quick connector.
- Carefully align center to avoid inclined insertion to prevent damage to O-ring inside quick connector.



FUEL INJECTOR AND FUEL TUBE

[QR]

- Insert until you hear a “click” sound and actually feel the engagement.
 - To avoid misidentification of engagement with a similar sound, be sure to perform the next step.
- c. Before clamping fuel feed hose with hose clamps, pull quick connector hard by hand holding “A” position. Make sure it is completely engaged (connected) so that it does not come out from fuel tube.
- d. Install quick connector cap to quick connector connection. (On both the engine side and the vehicle side)
 - Install so that the arrow mark on the side faces up.
- CAUTION:**
 - Make sure that quick connector and fuel tube are securely fit into quick connector cap installation groove.
 - If quick connector cap cannot be installed smoothly, quick connector may have not been installed correctly. Check connection again.



NOTE:

There is quick connector cap for the engine side and for the vehicle side, and they have different shapes. The figure shows engine side as an example.

8. Install fuel feed hose to hose clamp.
9. Install in the reverse order of removal after this step.

INSPECTION AFTER INSTALLATION

Check on Fuel Leaks

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

NOTE:

Use mirrors for checking on invisible points.

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

CAUTION:

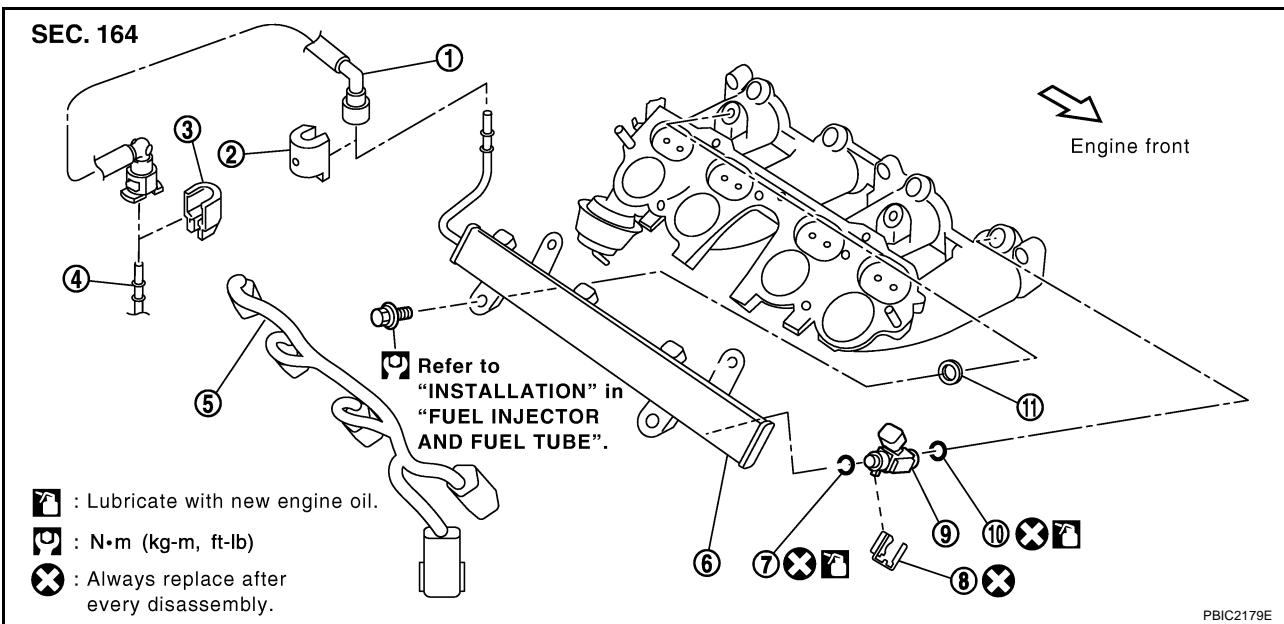
Do not touch engine immediately after stopped as engine becomes extremely hot.

FUEL INJECTOR AND FUEL TUBE

[QR]

Removal and Installation (QR25DE)

EBS011SY



1. Fuel feed hose
2. Quick connector cap (engine side)
3. Quick connector cap (vehicle side)
4. Centralized under-floor piping
5. Sub-harness
6. Fuel tube
7. O-ring (black)
8. Clip
9. Fuel injector
10. O-ring (green)
11. Insulator

CAUTION:

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

REMOVAL

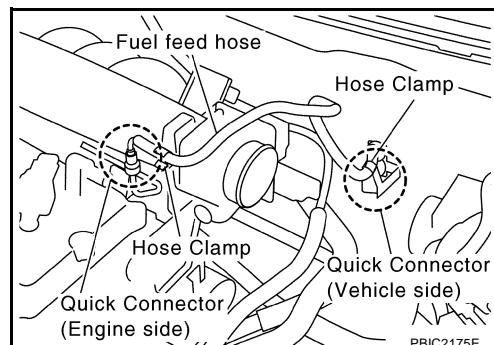
1. Release fuel pressure. Refer to [EC-48, "FUEL PRESSURE RELEASE" \(WITH EURO-OBD\)](#) or [EC-510, "FUEL PRESSURE CHECK" \(WITHOUT EURO-OBD\)](#).
2. Remove air cleaner case upper, mass air flow sensor and air duct assembly. Refer to [EM-15, "AIR CLEANER AND AIR DUCT"](#).
3. Disconnect quick connectors at engine side and vehicle side as follows, and remove fuel feed hose.

CAUTION:

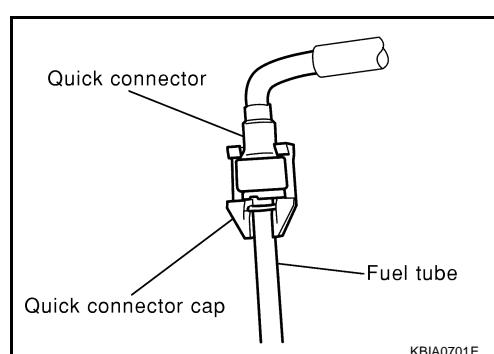
Disconnect quick connector by using quick connector release (special service tool), not by picking out retainer tabs.

NOTE:

There is quick connector for the engine side and for the vehicle side, and they have different shapes. But disconnection is same procedure. The following procedure shows the engine side.



- a. Remove quick connector cap (engine side).



FUEL INJECTOR AND FUEL TUBE

[QR]

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

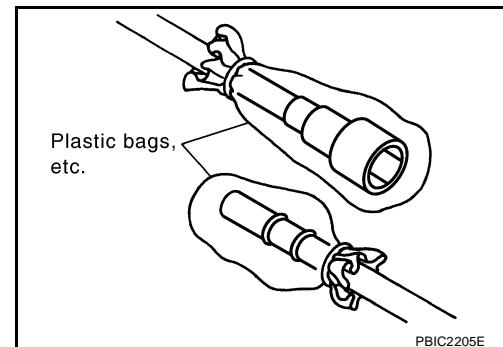
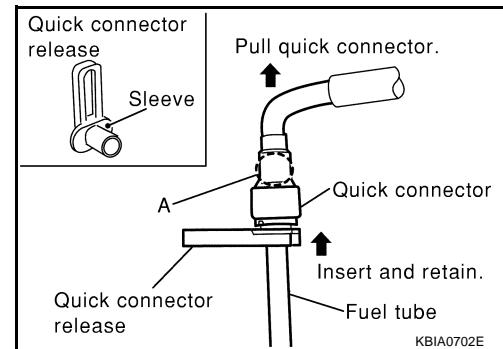
CAUTION:

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

- d. Draw and pull out quick connector straight from fuel tube.

CAUTION:

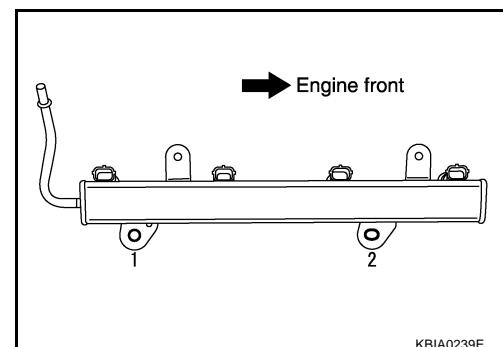
- Pull quick connector holding "A" position in the figure.
- Do not pull with lateral force applied. O-ring inside quick connector may be damaged.
- Prepare container and cloth beforehand as fuel will leak out.
- Avoid fire and sparks.
- Keep parts away from heat source. Especially, be careful when welding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



4. Remove intake manifold collector. Refer to [EM-20, "Removal and Installation \(QR25DE\)"](#).
5. Disconnect sub-harness for fuel injector.
6. Loosen mounting bolts in reverse order as shown in the figure.
7. Remove fuel tube and fuel injector assembly and insulators.

CAUTION:

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



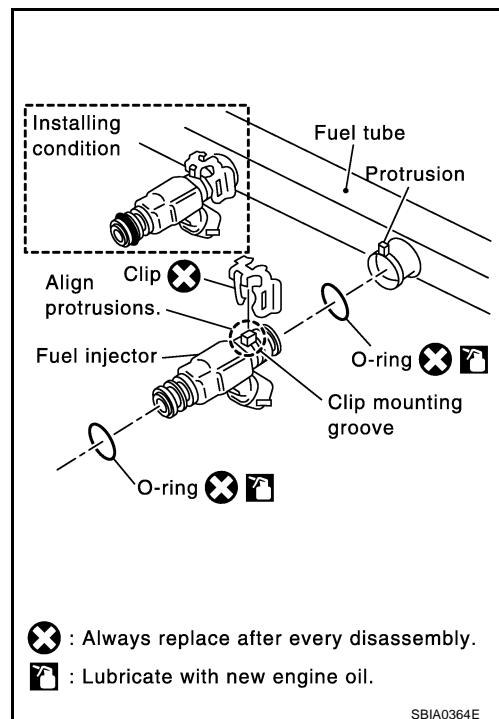
FUEL INJECTOR AND FUEL TUBE

[QR]

8. Remove fuel injector from fuel tube with the following procedure:
 - 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 fuel injector nozzle during removal.
- Do not bump or drop fuel injector.
- Do not disassemble fuel injector.



SBI0364E

INSTALLATION

1. 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 : Black

Nozzle side : Green

- 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.

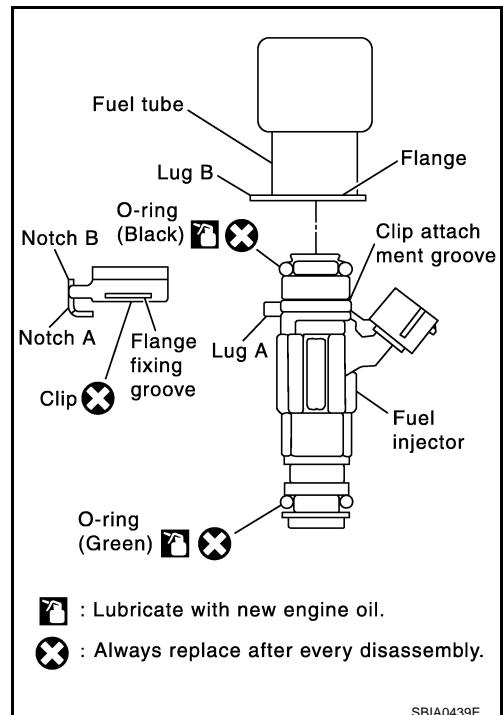
FUEL INJECTOR AND FUEL TUBE

[QR]

2. Install fuel injector to fuel tube with the following procedure:
 - 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 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.



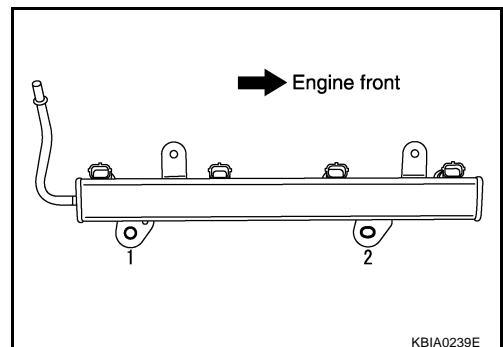
3. Install fuel tube and fuel injector assembly with the following procedure:
 - a. Insert the tip of each fuel injector into intake manifold.
 - b. Tighten mounting bolts evenly in two steps in numerical order as shown in the figure.

1st step

: 10.1 N·m (1.0 kg-m, 7 ft-lb)

2nd step

: 23.6 N·m (2.4 kg-m, 17 ft-lb)



4. Connect sub-harness for fuel injector.
5. Install intake manifold collector. Refer to [EM-20, "Removal and Installation \(QR25DE\)"](#).
6. Note the following, and connect quick connectors at engine side and vehicle side to install fuel feed hose.

NOTE:

There is quick connector for the engine side and for the vehicle side, and they have different shapes. But connection is same procedure. The following procedure shows the engine side.

- a. Check the connection for foreign material and damage.
- b. Align center to insert quick connector straightly into fuel tube.

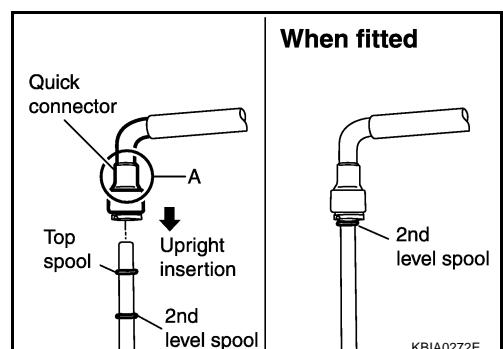
NOTE:

The figure shows engine side as an example.

- Insert fuel tube into quick connector until the top spool on fuel tube is inserted completely and the second level spool is positioned slightly below quick connector bottom end.

CAUTION:

- Hold "A" position in the figure when inserting fuel tube into quick connector.
- Carefully align center to avoid inclined insertion to prevent damage to O-ring inside quick connector.
- Insert until you hear a "click" sound and actually feel the engagement.



FUEL INJECTOR AND FUEL TUBE

[QR]

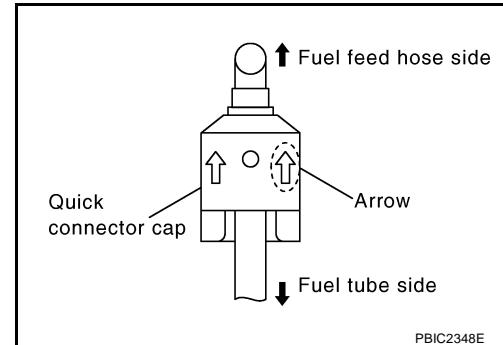
- To avoid misidentification of engagement with a similar sound, be sure to perform the next step.
- c. Before clamping fuel feed hose with hose clamps, pull quick connector hard by hand holding "A" position. Make sure it is completely engaged (connected) so that it does not come out from fuel feed tube.
- d. Install quick connector cap to quick connector connection. (On both the engine side and the vehicle side)
 - Install so that the arrow mark on the side faces up.

CAUTION:

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

NOTE:

There is quick connector cap for the engine side and for the vehicle side, and they have different shapes. The figure shows engine side as an example.



PBIC2348E

7. Install fuel feed hose to hose clamp.
8. Install in the reverse order of removal after this step.

INSPECTION AFTER INSTALLATION

Check on Fuel Leaks

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

NOTE:

Use mirrors for checking on invisible points.

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

CAUTION:

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

ROCKER COVER

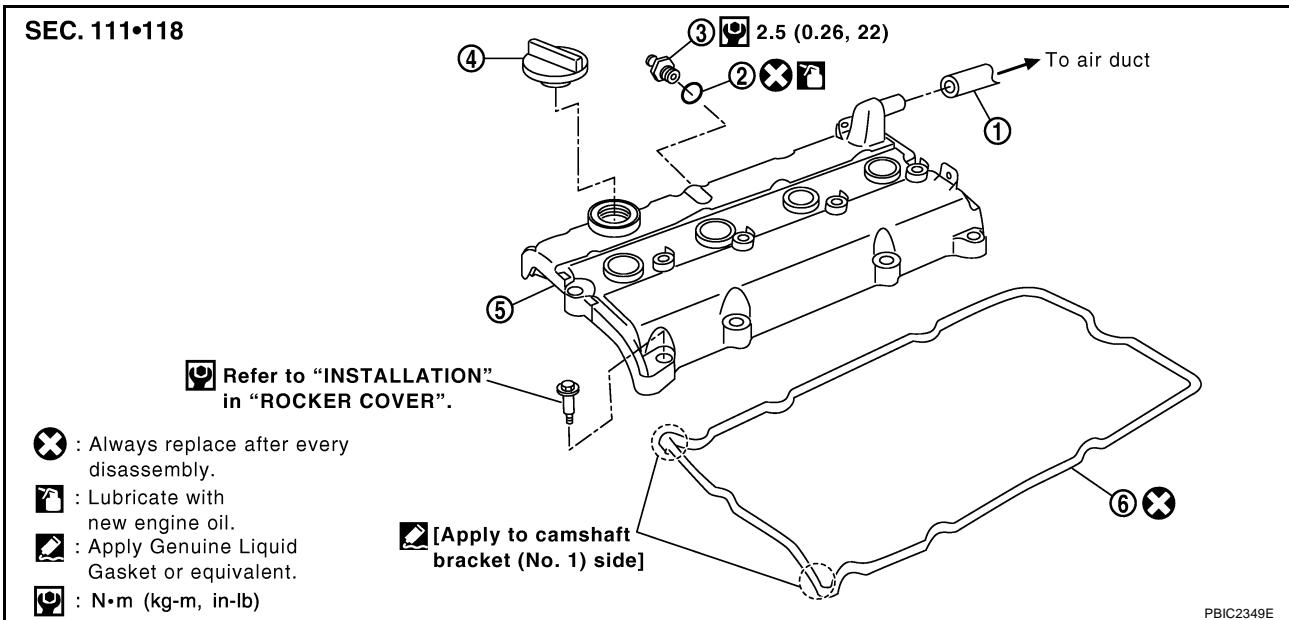
[QR]

ROCKER COVER

PFP:13264

Removal and Installation

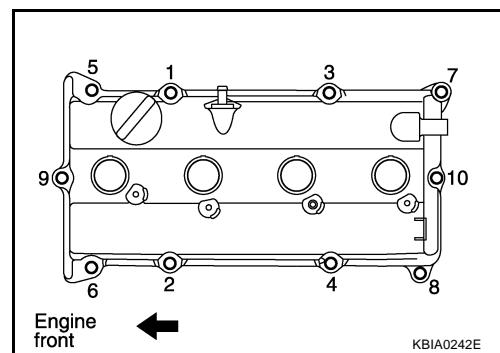
EBS00KNI



1. PCV hose
2. O-ring
3. PCV valve
4. Oil filler cap
5. Rocker cover
6. Rocker cover gasket

REMOVAL

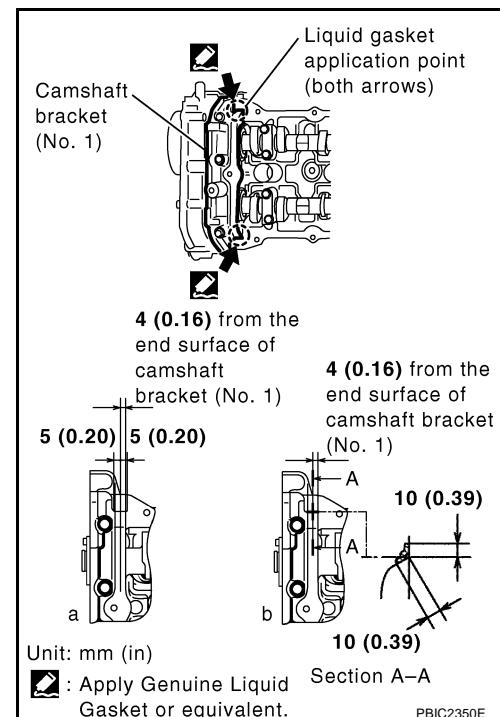
1. Disconnect PCV hose from rocker cover.
2. Remove ignition coil. Refer to [EM-29, "IGNITION COIL"](#).
3. Loosen bolts in reverse order shown in the figure.



INSTALLATION

1. Apply liquid gasket of 3.0 mm (0.12 in) diameter to the position shown in the figure with the following procedure:
 - a. Refer to figure "a" to apply liquid gasket to joint part of camshaft bracket (No. 1) and cylinder head.
 - b. Refer to figure "b" to apply liquid gasket in 90 degrees to figure "a".

Use Genuine Liquid Gasket or equivalent.



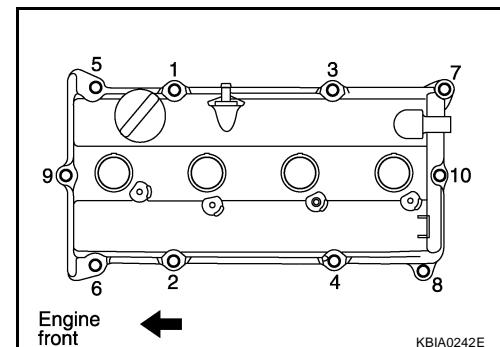
2. Install rocker cover.
 - Check if rocker cover gasket is not dropped from the installation groove of rocker cover.
3. Tighten bolts in two steps separately in numerical order as shown in the figure.

1st step

: 2.0 N·m (0.2 kg·m, 18 in-lb)

2nd step

: 8.3 N·m (0.85 kg·m, 73 in-lb)



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

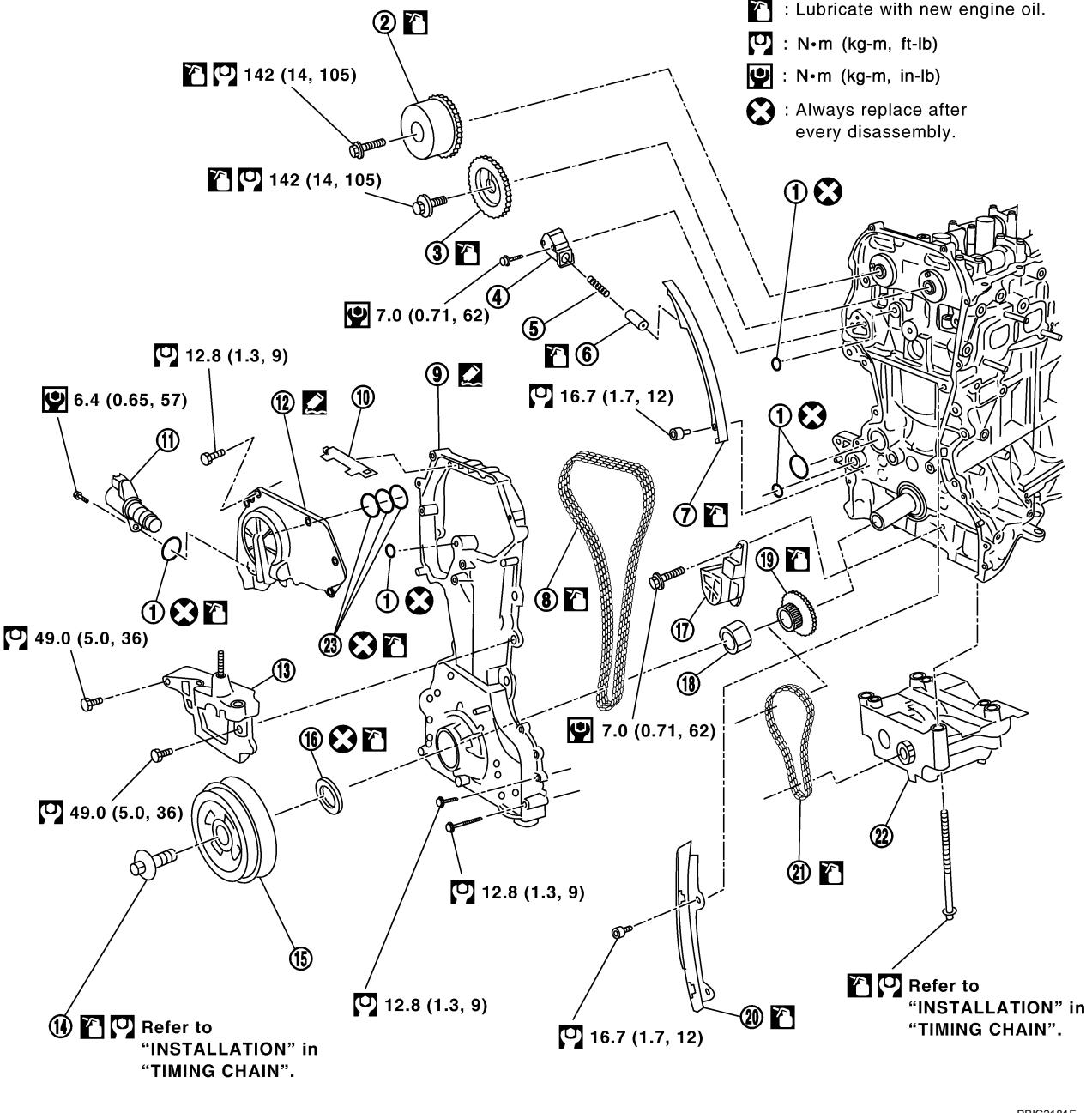
TIMING CHAIN

PFP:13028

Removal and Installation

EBS00KLN

SEC. 110•112•120•130•135



PBIC2181E

1. O-ring
2. Camshaft sprocket (INT)
3. Camshaft sprocket (EXH)
4. Chain tensioner
5. Spring
6. Chain tensioner plunger
7. Timing chain slack guide
8. Timing chain
9. Front cover
10. Chain guide
11. Intake valve timing control solenoid valve
12. Intake valve timing control cover
13. RH engine mounting bracket
14. Crankshaft pulley bolt
15. Crankshaft pulley
16. Front oil seal
17. Balancer unit timing chain tensioner
18. Oil pump drive spacer
19. Crankshaft sprocket
20. Timing chain tension guide
21. Balancer unit timing chain
22. Balancer unit
23. Oil ring

REMOVAL

1. Remove the following parts.

- Hood assembly; Refer to [BL-12, "HOOD"](#) .
 - RH and LH undercovers
 - PCV hose; Refer to [EM-17, "INTAKE MANIFOLD"](#) .
 - Ignition coil; Refer to [EM-29, "IGNITION COIL"](#) .
 - Rocker cover; Refer to [EM-42, "ROCKER COVER"](#) .
 - Engine coolant reservoir tank; Refer to [CO-12, "RADIATOR"](#) .
 - Drive belt; Refer to [EM-13, "REMOVAL"](#) .
 - Alternator; Refer to [SC-12, "CHARGING SYSTEM"](#) .
 - Drive belt auto-tensioner; Refer to [EM-14, "REMOVAL"](#) .
 - Exhaust front tube; Refer to [EX-2, "EXHAUST SYSTEM"](#) .
2. Remove A/C compressor from engine. Temporarily secure A/C compressor to vehicle side with a rope to avoid putting a load on them.
 3. Remove bracket mounting bolts for fixing A/C piping on right strut housing and exhaust manifold cover. Doing so simplifies moving.
 4. Remove power steering oil pump with piping connected, and secure it to vehicle side temporarily. Refer to [PS-34, "HYDRAULIC LINE"](#) .
 5. Remove power steering reservoir tank from bracket to move power steering piping. Refer to [PS-34, "HYDRAULIC LINE"](#) .

CAUTION:

To avoid power steering fluid leakage, temporarily fix power steering reservoir tank vertically.

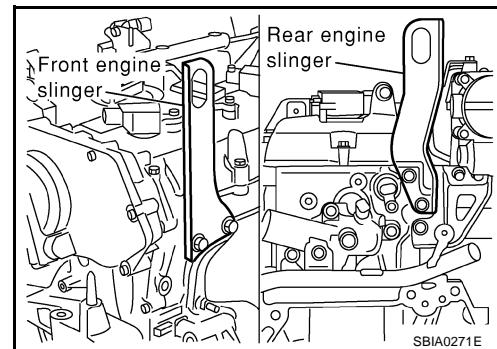
6. Install engine slingers into front left of cylinder head and rear right of cylinder head.
 - Use alternator bracket mounting bolt holes for the front side.

Slinger bolts:**Front**

: 57.9 N·m (5.9 kg-m, 43 ft-lb)

Rear

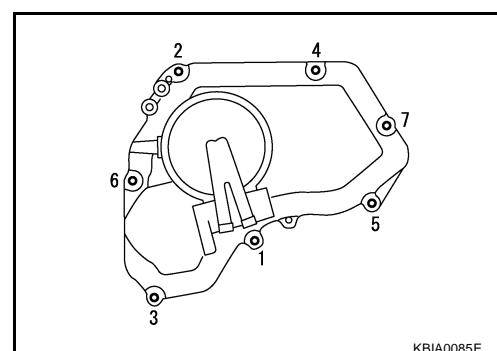
: 28.0 N·m (2.9 kg-m, 21 ft-lb)



7. Lift with hoist, and support the engine posture.
8. Remove RH engine mounting insulator and bracket. Refer to [EM-78, "ENGINE ASSEMBLY"](#) .
9. Remove center member and rear engine mounting bracket. Refer to [EM-78, "ENGINE ASSEMBLY"](#) .
10. Drain engine oil. Refer to [LU-8, "Changing Engine Oil"](#) .
11. Remove oil pan (upper and lower), and oil strainer. Refer to [EM-25, "OIL PAN AND OIL STRAINER"](#) .
12. Remove intake valve timing control cover.
 - Loosen bolts in reverse order as shown in the figure.
 - Use a seal cutter (special service tool: KV10111100) or equivalent tool to cut liquid gasket for removal.

CAUTION:

Be careful not to damage mounting surface.

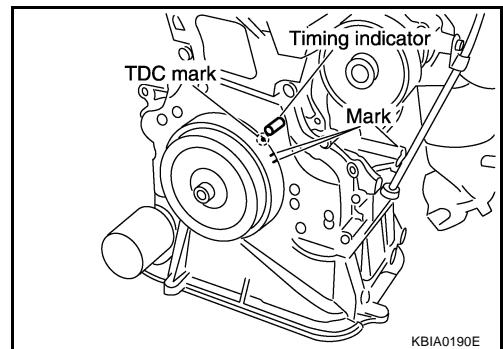


13. Pull chain guide between camshaft sprockets out through front cover.
14. Set No. 1 cylinder at TDC on its compression stroke with the following procedure:

TIMING CHAIN

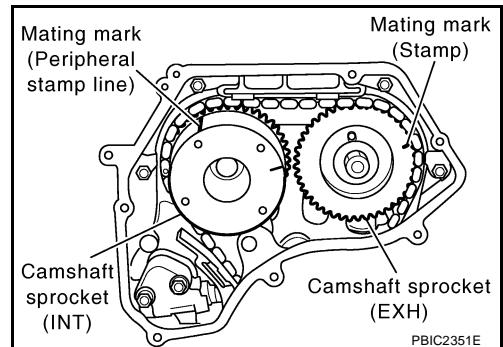
[QR]

- a. Rotate crankshaft pulley clockwise and align TDC mark to timing indicator on front cover.



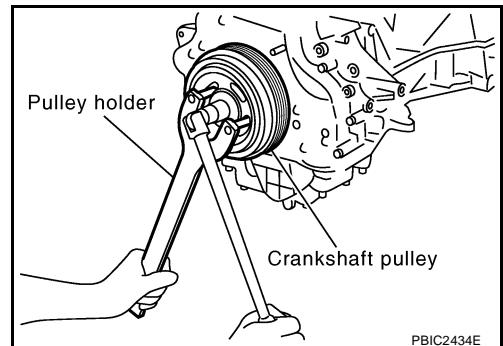
- b. At the same time, make sure that the mating marks on camshaft sprockets are located as shown in the figure.

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

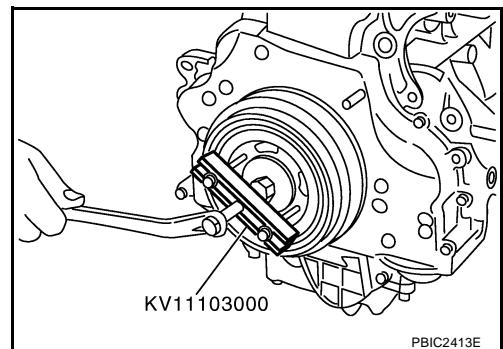


15. Remove crankshaft pulley with the following procedure:

- a. Fix crankshaft pulley with a pulley holder (commercial service tool), loosen crankshaft pulley bolt, and locate bolt seating surface at 10 mm (0.39 in) from its original position.



- b. Attach a pulley puller (special service tool) in the M 6 thread hole on crankshaft pulley, and remove crankshaft pulley.



16. Remove front cover with the following procedure:

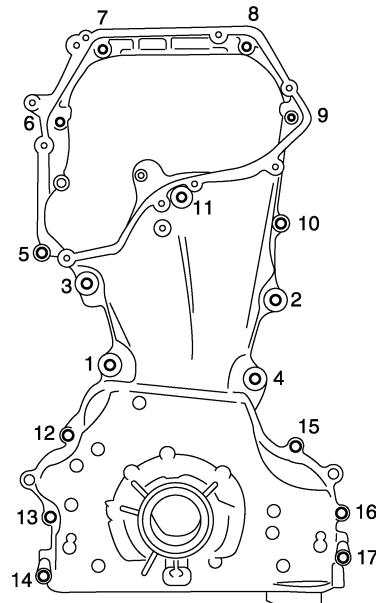
TIMING CHAIN

[QR]

- a. Loosen mounting bolts in reverse order as shown in the figure, and remove them.
- b. Use a seal cutter (special service tool: KV10111100) or equivalent tool to cut liquid gasket for removal.

CAUTION:

Be careful not to damage mounting surface.



KBIA0083E

17. If front oil seal needs to be replaced, lift it with a suitable tool, and remove it.

CAUTION:

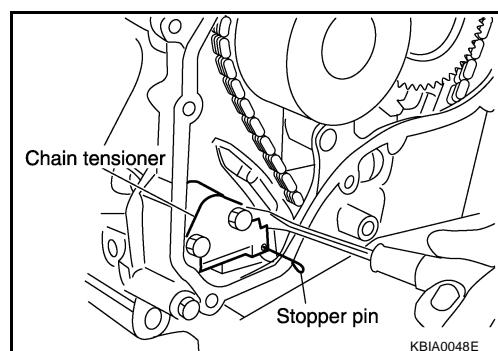
Be careful not to damage front cover.

18. Remove timing chain and camshaft sprockets with the following procedure:

- a. Push in chain tensioner plunger. Insert a stopper pin into hole on chain tensioner body to secure chain tensioner plunger and remove chain tensioner.

NOTE:

Use approx. 0.5 mm (0.02 in) dia. hard metal pin as a stopper pin.

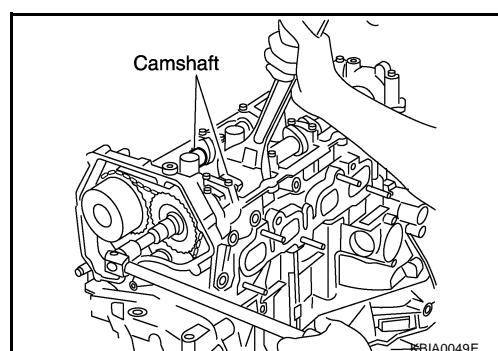


KBIA0048E

- b. Secure hexagonal part of camshaft with a wrench. Loosen camshaft sprocket mounting bolts and remove timing chain and camshaft sprockets.

CAUTION:

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



RBIA0049E

19. Remove timing chain slack guide, timing chain tension guide and oil pump drive spacer.

20. Remove balancer unit timing chain tensioner with the following procedure:

TIMING CHAIN

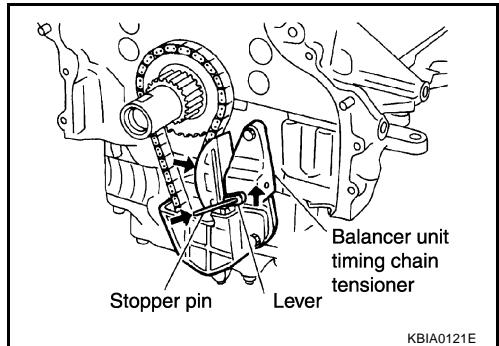
[QR]

- a. Lift lever up, and release ratchet claw for return proof.
- b. Push tensioner sleeve in, and hold it.
- c. Matching the hole on lever with the one on body, insert a stopper pin to secure tensioner sleeve.

NOTE:

Use approximately 1 mm (0.04 in) dia. hard metal pin as a stopper pin.

- d. Remove balancer unit timing chain tensioner.



21. Remove balancer unit timing chain and crankshaft sprocket.

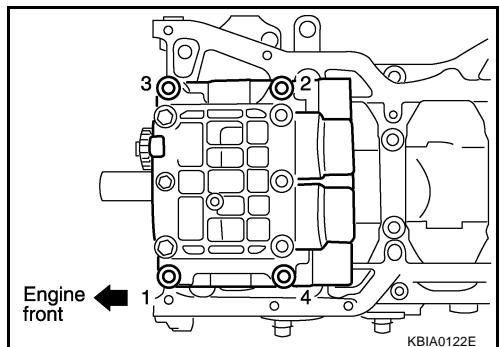
22. Loosen mounting bolts in reverse order as shown in the figure, and remove balancer unit.

CAUTION:

Do not disassemble balancer unit.

NOTE:

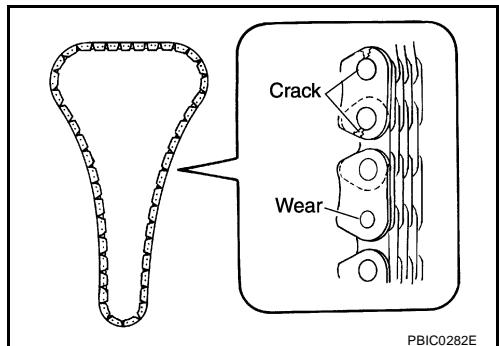
Use TORX socket (size E14).



INSPECTION AFTER REMOVAL

Timing Chain

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

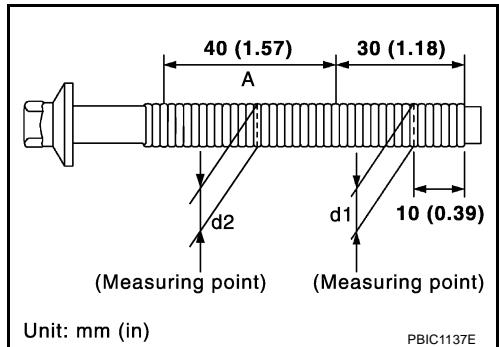


Balancer Unit Mounting Bolt Outer Diameter

- 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") : 0.15 mm (0.0059 in)

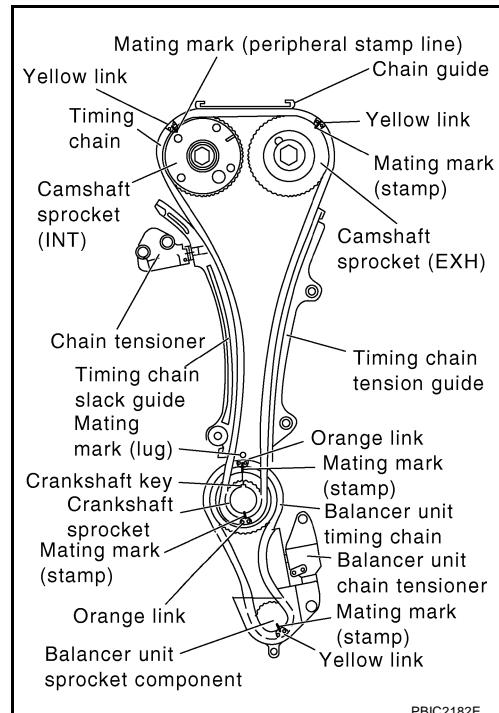
- If it exceeds the limit (large difference in dimensions), replace it with a new one.



INSTALLATION**NOTE:**

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

1. Make sure that crankshaft key points straight up.



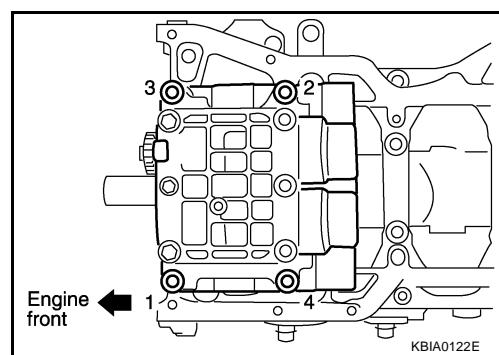
2. Tighten mounting bolts in numerical order as shown in figure with the following procedure, and install balancer unit.

CAUTION:

If mounting bolts are re-used, check their outer diameter before installation. Refer to [EM-48, "INSPECTION AFTER REMOVAL"](#).

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

: 48.1 N·m (4.9 kg-m, 35 ft-lb)



- c. Turn all bolts 90 degrees clockwise (angle tightening).
- d. Completely loosen.

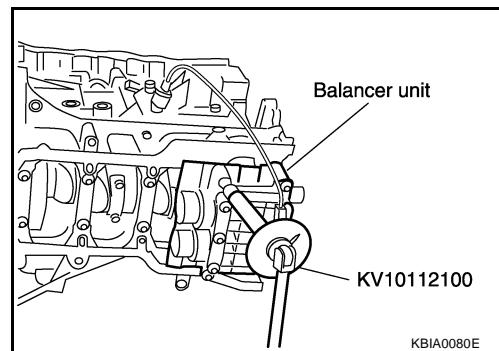
: 0 N·m (0 kg-m, 0 ft-lb)

CAUTION:

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

- e. Tighten all bolts.

: 48.1 N·m (4.9 kg-m, 35 ft-lb)



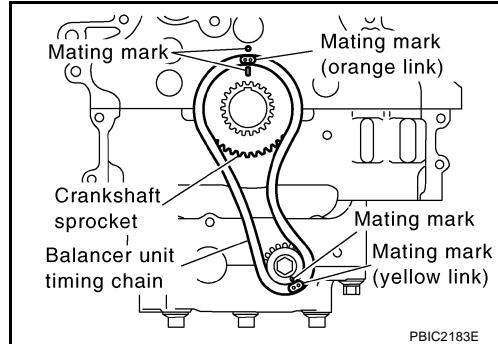
- f. Turn them another 90 degrees clockwise (angle tightening).

CAUTION:

Check tightening angle with an angle wrench (special service tool) or a protractor. Do not make judgment by visual check alone.

3. Install crankshaft sprocket and balancer unit timing chain.

- Make sure that crankshaft sprocket is positioned with mating marks on cylinder block and crankshaft sprocket meeting at the top.
- Install it by aligning mating marks on each sprocket and balancer unit timing chain.

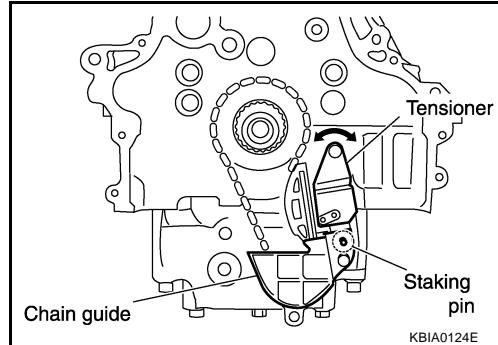


4. Install balancer unit timing chain tensioner.

NOTE:

Chain guide and tensioner move freely with the staking pin as the axle. Therefore, bolt hole position of the three points could be changed during removal. If points change, temporarily fix the two mounting bolts on chain guide, and move tensioner to mate the bolt holes.

- Be careful not to let mating marks of each sprocket and timing chain slip.
- After installation, make sure the mating marks have not slipped, then remove stopper pin and release tensioner sleeve.



5. Install timing chain and related parts.

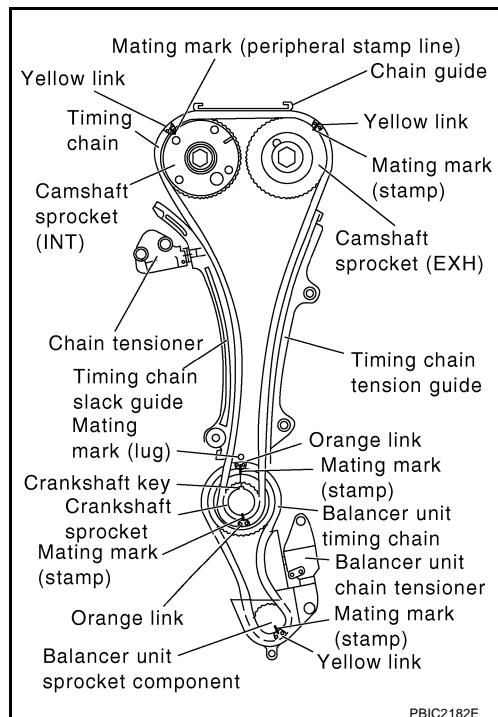
- Install by aligning mating marks on each sprocket and timing chain.
- Before and after installing chain tensioner, check again to make sure that mating marks have not slipped.
- After installing chain tensioner, remove stopper pin, and make sure that tensioner moves freely.

CAUTION:

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

NOTE:

Before installing chain tensioner, it is possible to change the position of mating mark on timing chain for that on each sprocket for alignment.



6. Install front oil seal to front cover. Refer to [EM-64, "Removal and Installation of Front Oil Seal"](#).

7. Install front cover with the following procedure:

- a. Install O-rings to cylinder head and cylinder block.

- b. Apply a continuous bead of liquid gasket with a tube presser (special service tool: WS39930000) to front cover as shown in the figure.

Use Genuine Liquid Gasket or equivalent.

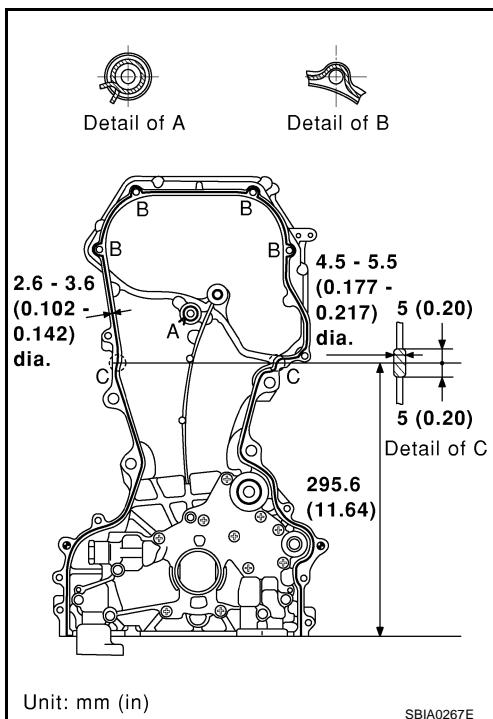
NOTE:

Application instruction differs depending on the position.

Detail of A : Cross over the start of the application and the end.

Detail of B : Apply liquid gasket outside of bolt holes. (For all bolt holes other than B, apply to the inside.)

Detail of C : Between here only, apply 4.5 - 5.5 mm (0.177 - 0.217 in) dia.



Unit: mm (in)

SBIA0267E

- c. Make sure that mating marks of timing chain and each sprocket are still aligned. Then install front cover.

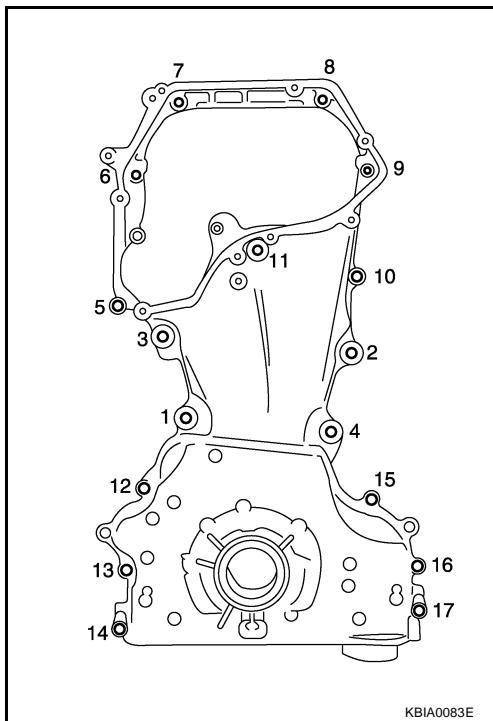
CAUTION:

- Do not let A/C and power steering pipings interfere with upper part of front cover.
- Be careful not to damage front oil seal by interference with front end of crankshaft.

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

CAUTION:

Be sure to wipe off any excessive liquid gasket leaking to surface for fitting oil pan.



KBIA0083E

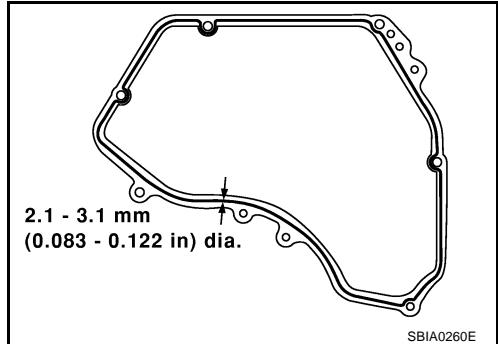
8. Install chain guide between camshaft sprockets.
9. Install intake valve timing control cover with the following procedure:
 - a. Install intake valve timing control solenoid valves to intake valve timing control cover if removed.
 - b. Install oil rings to the camshaft sprocket (INT) insertion points on backside of intake valve timing control cover.
 - c. Install O-ring to front cover.

TIMING CHAIN

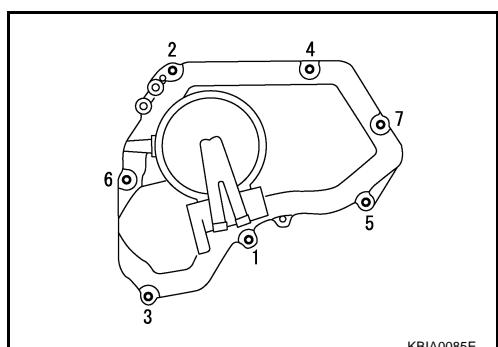
[QR]

- d. Apply a continuous bead of liquid gasket with a tube presser (special service tool: WS39930000) to intake valve timing control cover as shown in the figure.

Use Genuine Liquid Gasket or equivalent.



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



10. Insert crankshaft pulley by aligning with crankshaft key.

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

CAUTION:

Install protecting front oil seal lip section from any damage.

11. Tighten crankshaft pulley bolt.

- Secure crankshaft pulley with a pulley holder (commercial service tool), and tighten crankshaft pulley bolt.
- Perform angle tightening with the following procedure:

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

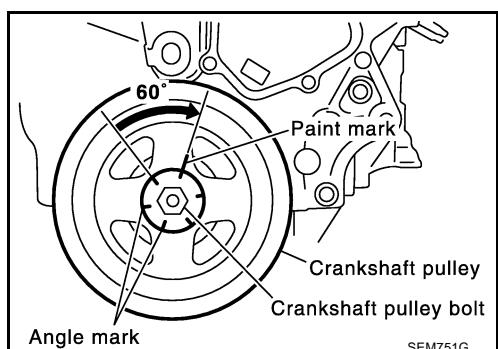
- b. Tighten crankshaft pulley bolt.

: 42.1 N·m (4.3 kg·m, 31 ft-lb)

- c. Put a paint mark on crankshaft pulley, mating with any one of six easy to recognize angle marks on bolt flange.

- d. Turn another 60 degrees clockwise (angle tightening).

- Check the tightening angle with movement of one angle mark.



12. Install all removed parts in the reverse order of removal.

CAMSHAFT

PFP:13001

Removal and Installation

EBS00LS2

A

EM

C

D

E

F

G

H

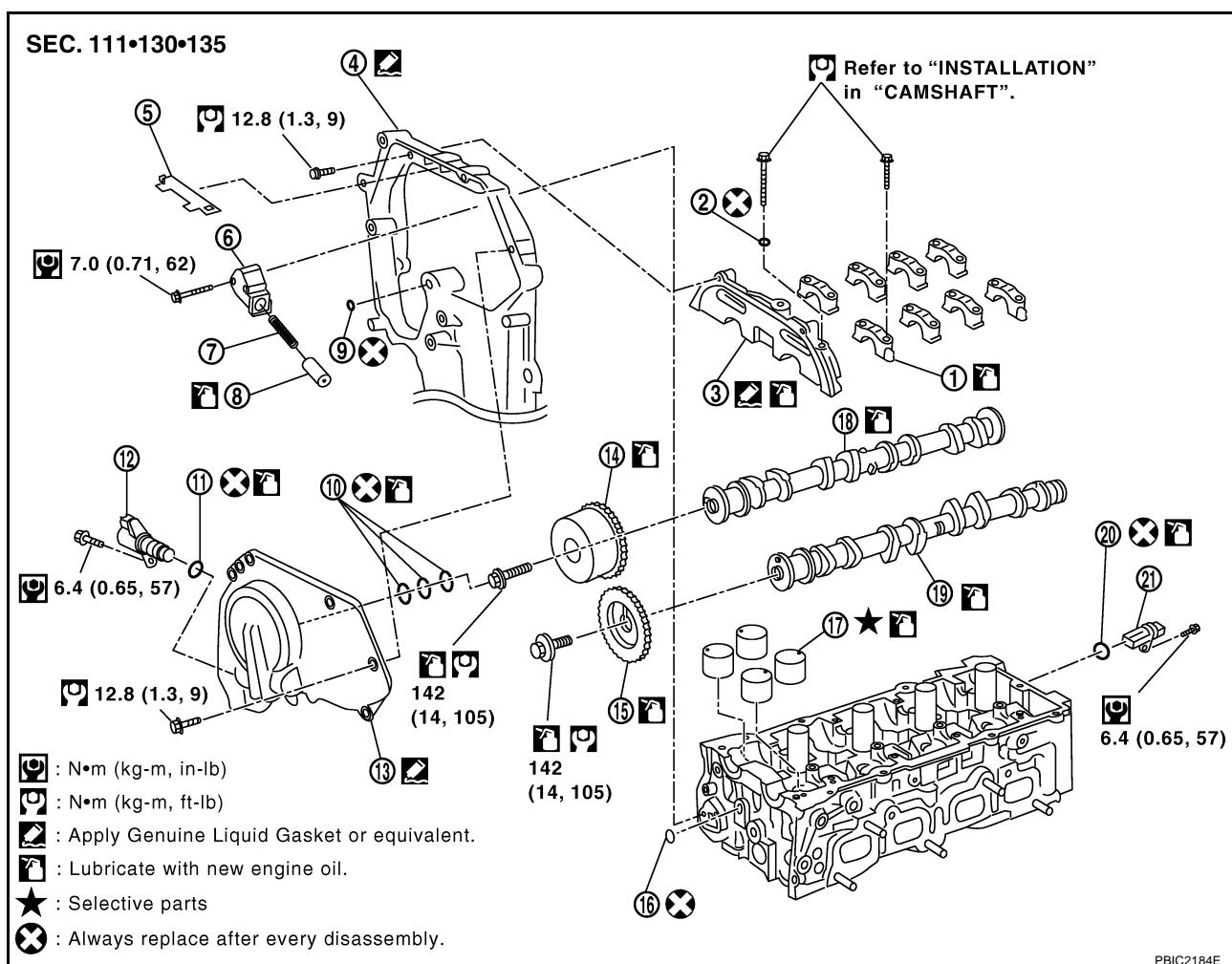
I

J

K

L

M



PBIC2184E

- | | | |
|---------------------------------------|-----------------------------|--|
| 1. Camshaft bracket (No. 2 to 5) | 2. Seal washer | 3. Camshaft bracket (No. 1) |
| 4. Front cover | 5. Chain guide | 6. Chain tensioner |
| 7. Spring | 8. Chain tensioner plunger | 9. O-ring |
| 10. Oil ring | 11. O-ring | 12. Intake valve timing control solenoid valve |
| 13. Intake valve timing control cover | 14. Camshaft sprocket (INT) | 15. Camshaft sprocket (EXH) |
| 16. O-ring | 17. Valve lifter | 18. Camshaft (INT) |
| 19. Camshaft (EXH) | 20. O-ring | 21. Camshaft position sensor (PHASE) |

NOTE:

This section describes removal/installation procedure of camshaft without removing front cover. If front cover is removed or installed, removal of camshaft bracket (No. 1) is easier before step 8 and installation is easier after step 3. Regarding removal and installation of front cover, refer to [EM-44, "TIMING CHAIN"](#).

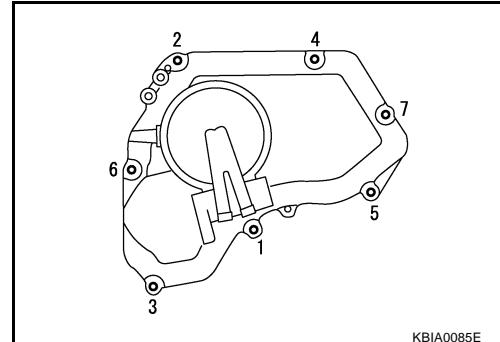
REMOVAL

- Release fuel pressure. Refer to [EC-48, "FUEL PRESSURE RELEASE"](#) (WITH EURO-OBD) or [EC-510, "FUEL PRESSURE RELEASE"](#) (WITHOUT EURO-OBD).
- Remove the following parts.
 - Ignition coil; Refer to [EM-29, "IGNITION COIL"](#).
 - Rocker cover; Refer to [EM-42, "ROCKER COVER"](#).
- Remove power steering reservoir tank from bracket to move power steering piping. Refer to [PS-34, "HYDRAULIC LINE"](#).

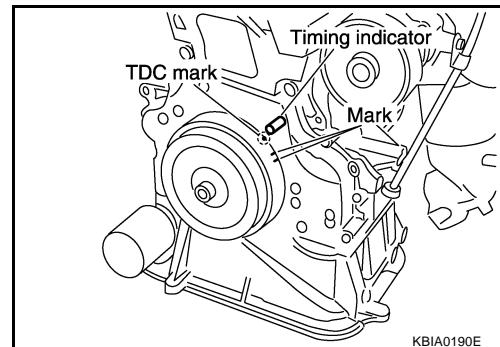
CAUTION:

To avoid power steering fluid leakage, temporarily fix power steering reservoir tank vertically.

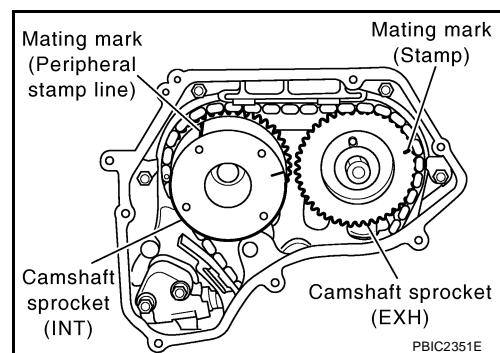
4. Remove intake valve timing control cover with the following procedure:
 - a. Disconnect intake valve timing control solenoid valve harness connector.
 - b. Remove intake valve timing control solenoid valve, if necessary.
 - c. Disconnect ground cables.
 - d. Loosen bolts in reverse order as shown in the figure.
 - e. Use a seal cutter (special service tool: KV10111100) or equivalent tool to cut liquid gasket for removal.



5. Pull chain guide between camshaft sprockets out through front cover.
6. Set No. 1 cylinder at TDC on its compression stroke with the following procedure:
 - a. Open splash guard on RH undercover.
 - b. Rotate crankshaft pulley clockwise and align TDC mark to timing indicator on front cover.



- c. At the same time, make sure that the mating marks on camshaft sprockets are located as shown in the figure.
 - If not, rotate crankshaft pulley one more turn to align mating marks to the positions in the figure.

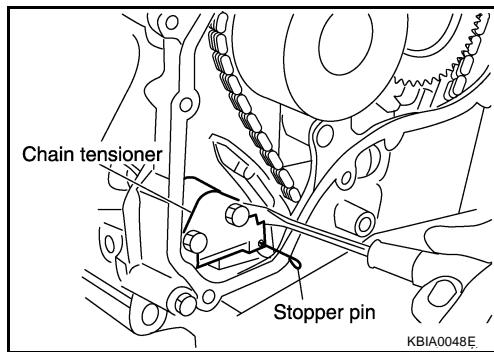


7. Remove camshaft sprockets with the following procedure:
 - a. Line up the mating marks on camshaft sprockets, and paint indelible mating marks on timing chain link plate.

- b. Push in chain tensioner plunger. Insert a stopper pin into hole on chain tensioner body to secure chain tensioner plunger and remove chain tensioner.

NOTE:

Use approximately 0.5 mm (0.02 in) dia. hard metal pin as a stopper pin.



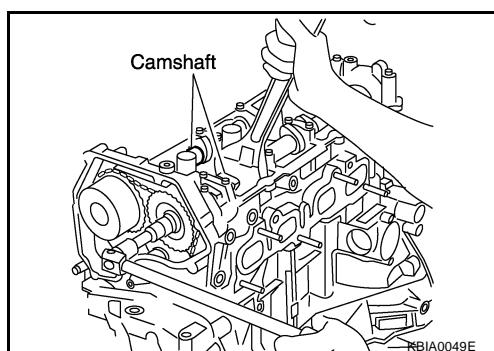
- c. Secure hexagonal part of camshaft with a wrench. Loosen camshaft sprocket mounting bolts and remove camshaft sprockets.

CAUTION:

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

NOTE:

Chain tension holding work is not necessary. Crankshaft sprocket and timing chain do not disconnect structurally while front cover is attached.



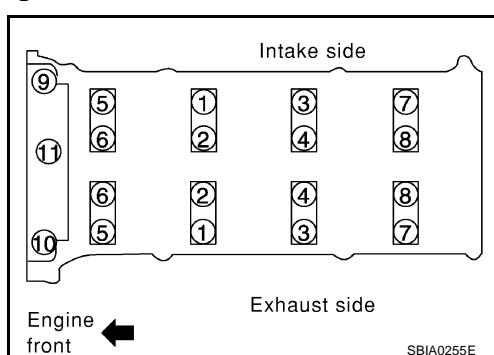
8. Remove camshaft position sensor (PHASE) from cylinder head back side.

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 sensor in a location where it is exposed to magnetism.

9. Loosen mounting bolts in reverse order as shown in the figure, and remove camshaft brackets and camshafts.

- Remove camshaft bracket (No. 1) by slightly tapping it with a plastic hammer.



10. Remove valve lifters.

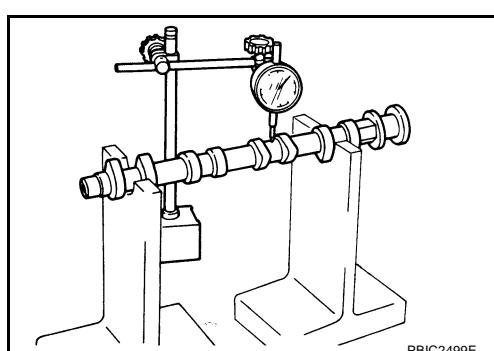
- Identify installation positions, and store them without mixing them up.

INSPECTION AFTER REMOVAL**Camshaft Runout**

1. Put V-block on a precise flat table, and support No. 2 and 5 journal of camshaft.
2. Set dial gauge vertically to No. 3 journal.
3. Turn camshaft to one direction with hands, and measure the camshaft runout on dial gauge. (Total indicator reading)

Standard: Less than 0.02 mm (0.0008 in).

4. If out of the standard, replace camshaft.



Camshaft Cam Height

- Measure the camshaft cam height with a micrometer.

Standard:**Intake**

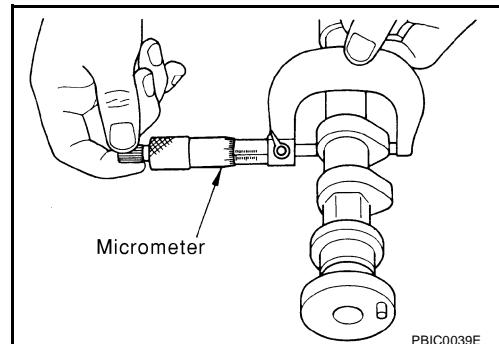
QR20DE : 45.015 - 45.205 mm (1.7722 - 1.7797 in)

QR25DE : 45.665 - 45.855 mm (1.7978 - 1.8053 in)

Exhaust

QR20DE : 42.825 - 43.015 mm (1.6860 - 1.6935 in)

QR25DE : 43.975 - 44.165 mm (1.7313 - 1.7388 in)



- If out of the standard, replace camshaft.

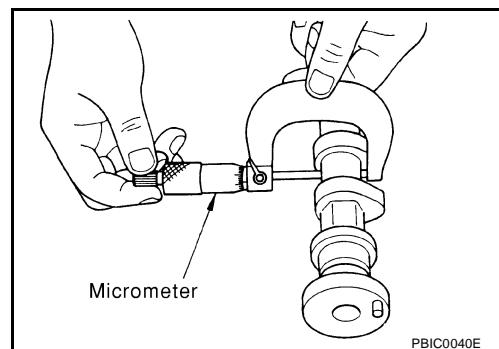
Camshaft Journal Oil Clearance**CAMSHAFT JOURNAL DIAMETER**

Measure the outer diameter of camshaft journal with a micrometer.

Standard:

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

No. 2, 3, 4, 5 : 23.435 - 23.455 mm (0.9226 - 0.9234 in)

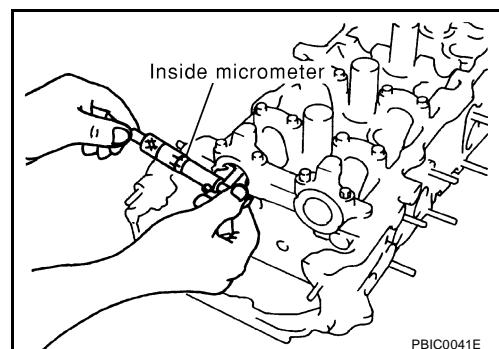
**CAMSHAFT BRACKET INNER DIAMETER**

- Tighten camshaft bracket bolts with specified torque. Refer to [EM-58, "INSTALLATION"](#) for the tightening procedure.
- Measure the inner diameter of camshaft bracket with an inside micrometer.

Standard:

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

No. 2, 3, 4, 5 : 23.500 - 23.521 mm (0.9252 - 0.9260 in)

**CAMSHAFT JOURNAL OIL CLEARANCE**

- (Oil clearance) = (Camshaft bracket inner diameter) - (Cam-shaft journal diameter)

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

- If out of the standard, replace either or both camshaft and cylinder head.

NOTE:

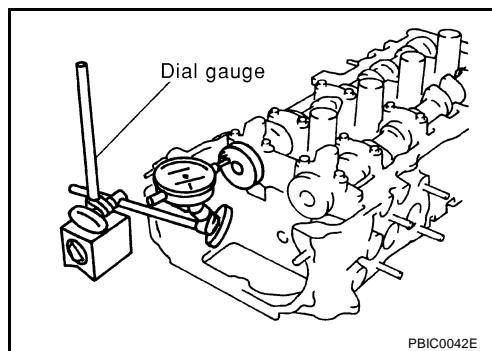
Camshaft bracket cannot be replaced as a single part, because it is machined together with cylinder head. Replace whole cylinder head assembly.

Camshaft End Play

- Install camshaft in cylinder head. Refer to [EM-58, "INSTALLATION"](#) for tightening procedure.

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

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



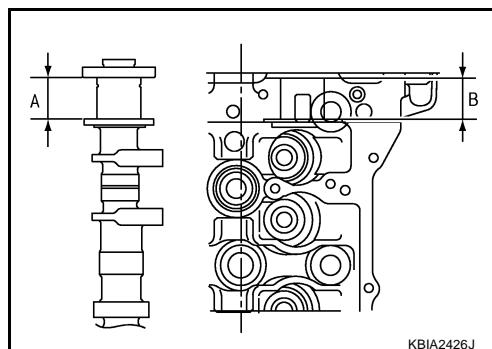
- Measure the following parts if out of the standard.
 - Dimension "A" for camshaft No. 1 journal

Standard : 25.800 - 25.848 mm (1.0157 - 1.0176 in)

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

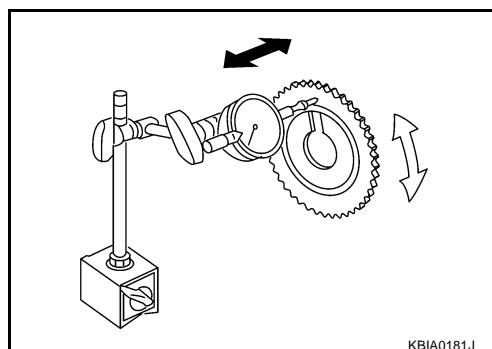
Standard : 25.660 - 25.685 mm (1.0102 - 1.0112 in)

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



Camshaft Sprocket Runout

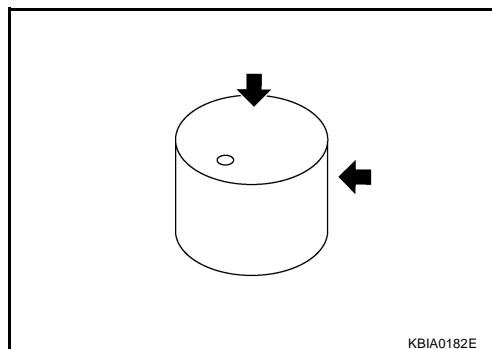
1. Install camshaft in cylinder head. Refer to [EM-58, "INSTALLATION"](#) for tightening procedure.
2. Install camshaft sprocket to camshaft. Refer to [EM-53, "Removal and Installation"](#).
3. Measure the camshaft sprocket runout with a dial gauge. (Total indicator reading)
 - Limit : 0.15 mm (0.0059 in)**
 - If it exceeds the limit, replace camshaft sprocket.



Valve Lifter

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

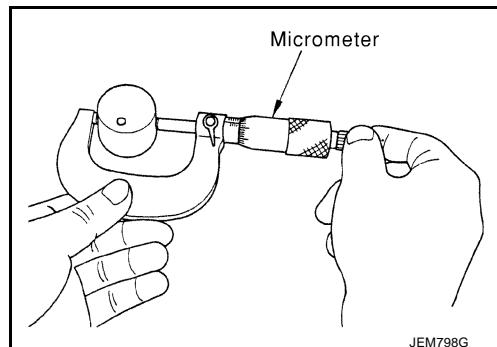
- If anything above is found, replace valve lifter. Refer to [EM-61, "Valve Clearance"](#).



Valve Lifter Clearance**VALVE LIFTER OUTER DIAMETER**

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

Standard: 33.965 - 33.980 mm (1.3372 - 1.3378 in)

**VALVE LIFTER HOLE DIAMETER**

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

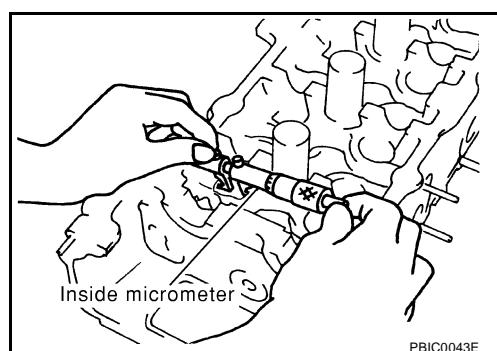
Standard: 34.000 - 34.021 mm (1.3386 - 1.3394 in)

VALVE LIFTER CLEARANCE

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

Standard: 0.020 - 0.056 mm (0.0008 - 0.0022 in)

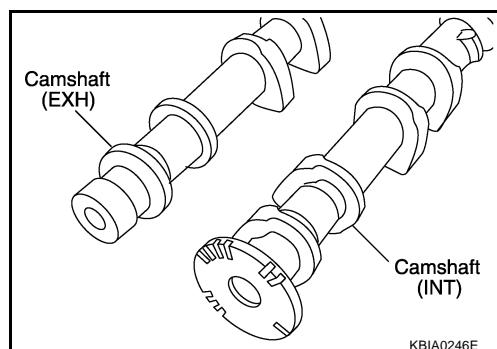
- If out of the standard, referring to the each standard of valve lifter outer diameter and valve lifter hole diameter, replace either or both valve lifter and cylinder head.

**INSTALLATION**

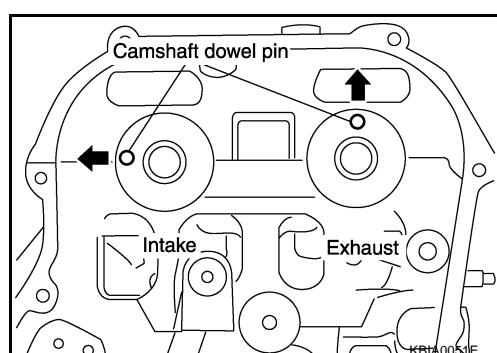
- Install valve lifters.
 - Install them in the original positions.
- Install camshafts.
 - Distinction between intake and exhaust camshafts is performed with the different shapes of rear end.

Intake : Signal plate shape for camshaft position sensor (PHASE)

Exhaust : Cone end shape



- Install camshafts so that camshaft dowel pins on the front side are positioned as shown in the figure.



- Install camshaft brackets with the following procedure:

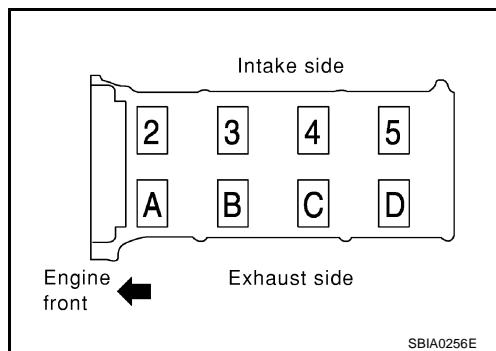
CAMSHAFT

[QR]

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

NOTE:

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



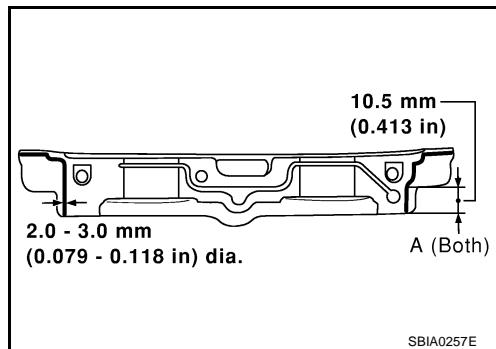
- b. Install camshaft bracket (No. 1) with the following procedure:

- i. Apply liquid gasket to camshaft bracket (No. 1) as shown in the figure.

Use Genuine Liquid Gasket or equivalent.

CAUTION:

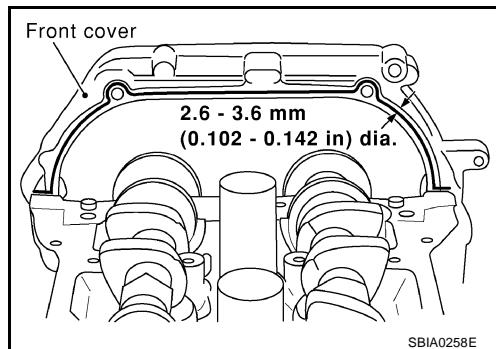
After installation, be sure to wipe off any excessive liquid gasket leaking from part "A" (both on right and left sides).



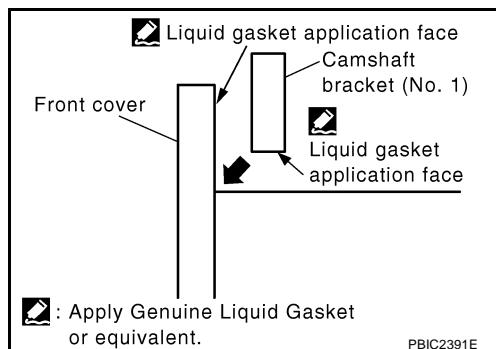
- ii. Apply liquid gasket to camshaft bracket (No. 1) contact surface on the front cover backside.

Use Genuine Liquid Gasket or equivalent.

- Apply liquid gasket to the outside of bolt hole on front cover.



- iii. For camshaft bracket (No. 1) near installation position, and install it without disturbing the liquid gasket applied to the surfaces.



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

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

: 2.0 N·m (0.2 kg-m, 1 ft-lb)

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

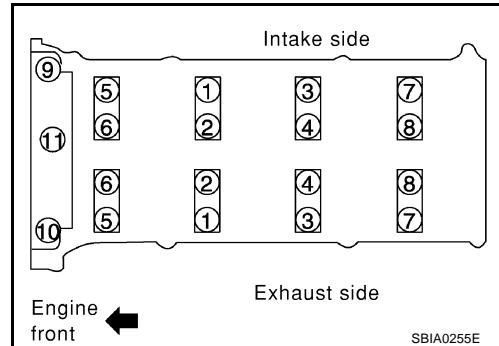
: 2.0 N·m (0.2 kg-m, 1 ft-lb)

- c. Tighten all bolts in numerical order.

: 5.9 N·m (0.6 kg-m, 4 ft-lb)

- d. Tighten all bolts in numerical order.

: 10.4 N·m (1.1 kg-m, 8 ft-lb)



SBIA0255E

CAUTION:

After tightening mounting bolts of camshaft brackets, be sure to wipe off excessive liquid gasket from the parts listed below.

- Mating surface of rocker cover.
- Mating surface of front cover. (When installed without front cover)

5. Install camshaft position sensor (PHASE).

6. Install camshaft sprockets.

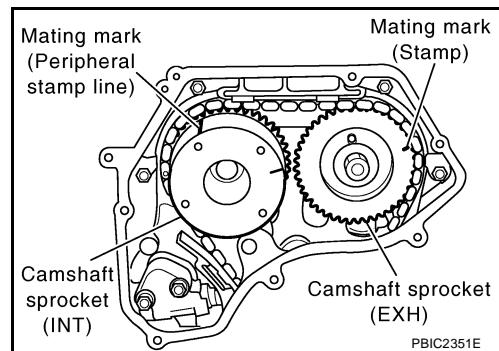
- Install them by aligning the mating marks on each camshaft sprocket with the ones painted on timing chain link plate during removal.

CAUTION:

- Aligned mating marks could slip. Therefore, after matching them, hold the timing chain in place by hand.
- Before and after installing chain tensioner, make sure again that mating marks have not slipped.

NOTE:

Before installation of chain tensioner, it is possible to re-match the marks on timing chain with the ones on each sprocket.



PBIC2351E

7. Install chain tensioner.

CAUTION:

After installation, pull the stopper pin off completely, and make sure that chain tensioner plunger is released.

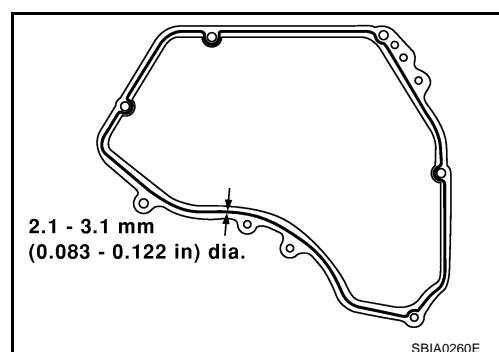
8. Install chain guide.

9. Install intake valve timing control cover with the following procedure:

- a. Install intake valve timing control solenoid valve to intake valve timing control cover if removed.
- b. Install oil rings to the intake camshaft sprocket insertion points on backside of intake valve timing control cover.
- c. Install O-ring to front cover.

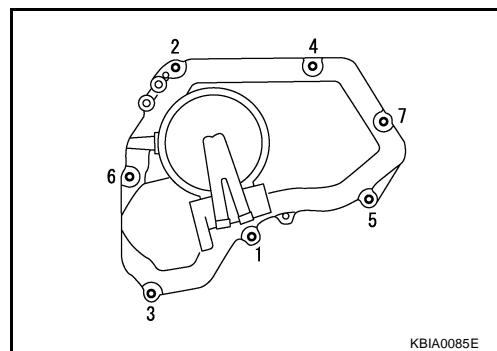
- d. Apply liquid gasket with a tube presser (special service tool: WS39930000) to intake valve timing control cover as shown in the figure.

Use Genuine Liquid Gasket or equivalent.



SBIA0260E

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



10. Inspect and adjust valve clearance. Refer to [EM-61, "Valve Clearance"](#).

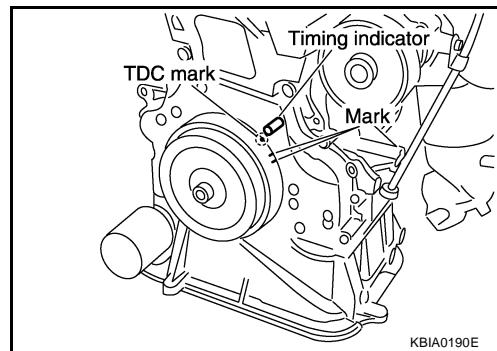
11. Install in the reverse order of removal after this step.

Valve Clearance INSPECTION

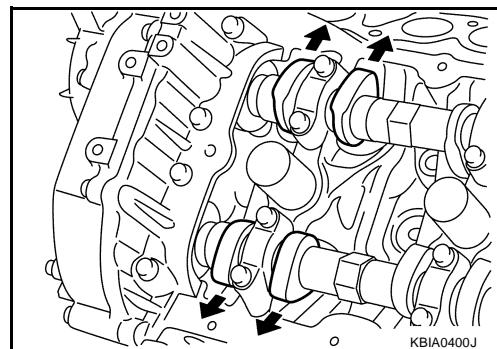
EBS00LS3

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

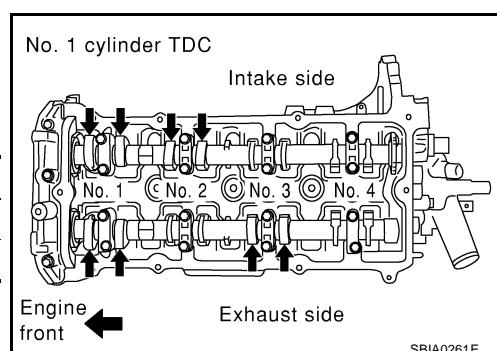
1. Warm up engine. Then stop it.
2. Open splash guard on RH undercover.
3. Remove rocker cover. Refer to [EM-42, "ROCKER COVER"](#).
4. Rotate crankshaft pulley clockwise and align TDC mark to timing indicator on front cover.



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



6. By referring to the figure, measure the valve clearances at locations marked "X" as shown in the table below (locations indicated with black arrow in figure) with a feeler gauge.
- No. 1 cylinder compression TDC.



Measuring position		No. 1 CYL.	No. 2 CYL.	No. 3 CYL.	No. 4 CYL.
No. 1 cylinder at TDC	INT	X	X		
	EXH	X		X	

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

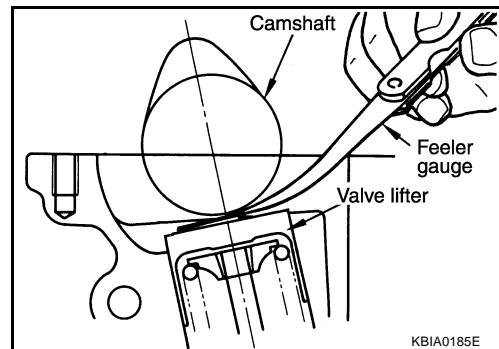
Valve clearance standard:

Hot	Intake	: 0.32 - 0.40 mm (0.013 - 0.016 in)
	Exhaust	: 0.33 - 0.41 mm (0.013 - 0.016 in)
Cold*	Intake	: 0.24 - 0.32 mm (0.009 - 0.013 in)
	Exhaust	: 0.26 - 0.34 mm (0.010 - 0.013 in)

*: Reference data at approximately 20°C (68°F)

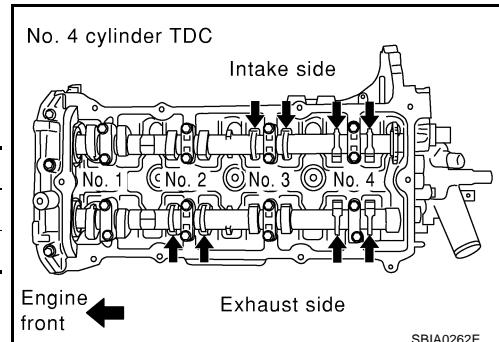
CAUTION:

If inspection was performed with cold engine, make sure that values with fully warmed up engine are still within specifications.



7. Rotate crankshaft one revolution (360 degrees) and align TDC mark to timing indicator on front cover.
8. By referring to the figure, measure the valve clearance at locations marked "X" as shown in the table below (locations indicated with black arrow in figure).
 - No. 4 cylinder compression TDC.

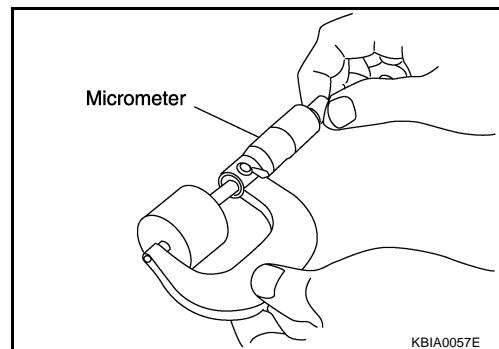
Measuring position		No. 1 CYL.	No. 2 CYL.	No. 3 CYL.	No. 4 CYL.
No. 4 cylinder at TDC	INT			X	X
	EXH		X		X



9. If out of standard, perform adjustment. Refer to [EM-62, "ADJUSTMENT"](#).

ADJUSTMENT

- Perform adjustment depending on selected head thickness of valve lifter.
 - The specified valve lifter thickness is the dimension at normal temperature. Ignore dimensional differences caused by temperature. Therefore, use the specifications for hot engine condition to adjust.
1. Remove camshaft. Refer to [EM-53, "REMOVAL"](#).
 2. Remove valve lifters at the locations that are out of the standard.
 3. Measure the center thickness of the removed valve lifters with a micrometer.



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

$$\text{Valve lifter thickness calculation: } t = t_1 + (C_1 - C_2)$$

t = Valve lifter thickness to be replaced

t₁ = Removed valve lifter thickness

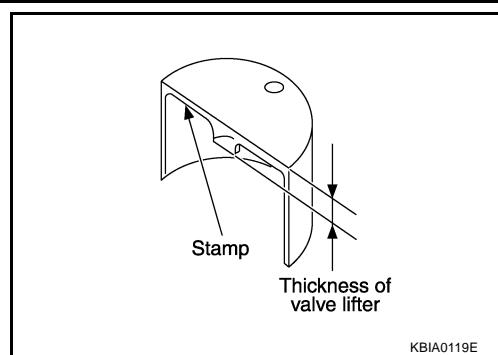
C₁ = Measured valve clearance

C₂ = Standard valve clearance in cold condition [approximately 20°C (68°F)]:

Intake : 0.36 mm (0.0142 in)

Exhaust : 0.37 mm (0.0146 in)

- Thickness of new valve lifter can be identified by stamp mark on the reverse side (inside the cylinder).
Stamp mark "696" indicates 6.96 mm (0.2740 in) in thickness.

**NOTE:**

Available thickness of valve lifter: 26 sizes range 6.96 to 7.46 mm (0.2740 to 0.2937 in) in steps of 0.02 mm (0.0008 in) (when manufactured at factory). Refer to [EM-111, "Available Valve Lifter"](#).

- Install the selected valve lifter.
- Install camshaft. Refer to [EM-58, "INSTALLATION"](#).
- Manually rotate crankshaft pulley a few rotations.
- Make sure that valve clearances for cold engine are within specifications by referring to the specified values.
- After completing the repair, check valve clearances again with the specifications for warmed engine. Make sure the values are within specifications.

Valve clearance:

Unit: mm (in)

	Hot	Cold * (reference data)
Intake	0.32 - 0.40 (0.013 - 0.016)	0.24 - 0.32 (0.009 - 0.013)
Exhaust	0.33 - 0.41 (0.013 - 0.016)	0.26 - 0.34 (0.010 - 0.013)

*: Reference data at approximately 20°C (68°F)

OIL SEAL

PFP:12279

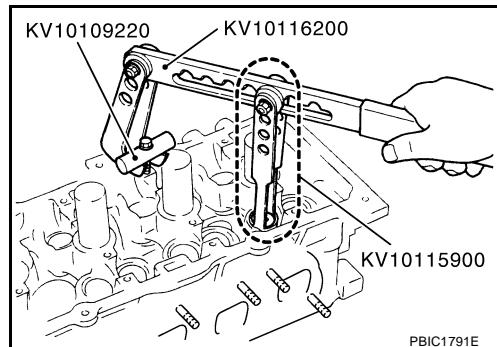
**Removal and Installation of Valve Oil Seal
REMOVAL**

EBS00KNM

1. Remove camshafts. Refer to [EM-53, "CAMSHAFT"](#) .
2. Remove valve lifters. Refer to [EM-53, "CAMSHAFT"](#) .
3. Rotate crankshaft, and set piston whose valve oil seal is to be removed to TDC. This will prevent valve from dropping into cylinder.

CAUTION:**When rotating crankshaft, be careful to avoid scarring front cover with timing chain.**

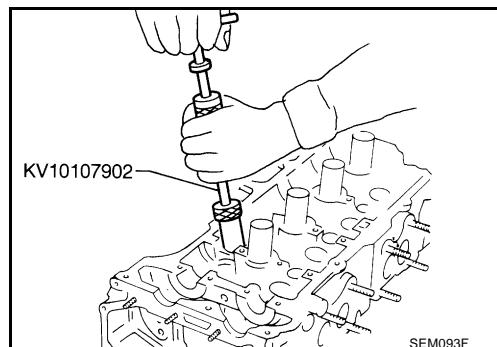
4. Remove valve collet.
 - Compress valve spring with valve spring compressor, attachment and adapter (special service tool). Remove valve collet with a magnet hand.

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

5. Remove valve spring retainer and valve spring.

CAUTION:**Do not remove valve spring seat from valve spring.**

6. Remove valve oil seal with a valve oil seal puller (special service tool).

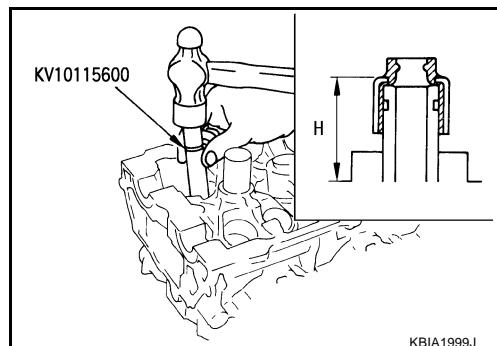
**INSTALLATION**

1. Apply new engine oil to valve oil seal joint surface and seal lip.
2. Press in valve oil seal to the height "H" shown in the figure with a valve oil seal drift (special service tool).

NOTE:

Dimension "H" is height that measured before installing valve spring (with valve spring seat).

Height "H" : 11.8 - 12.4 mm (0.465 - 0.488 in)



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

**Removal and Installation of Front Oil Seal
REMOVAL**

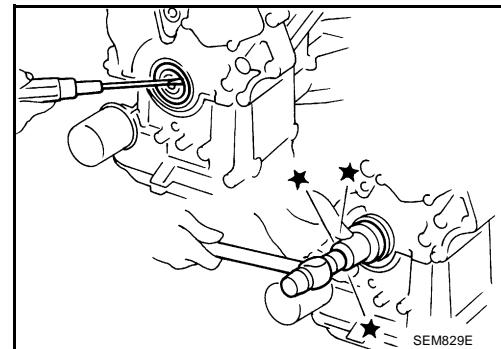
EBS00KNM

1. Remove the following parts.
 - RH undercover

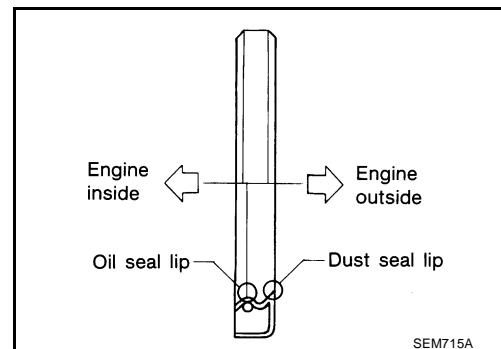
- Drive belt; Refer to [EM-13, "DRIVE BELTS"](#) .
 - Crankshaft pulley; Refer to [EM-44, "TIMING CHAIN"](#) .
2. Remove front oil seal with a suitable tool.

CAUTION:

Be careful not to damage front cover and crankshaft.

**INSTALLATION**

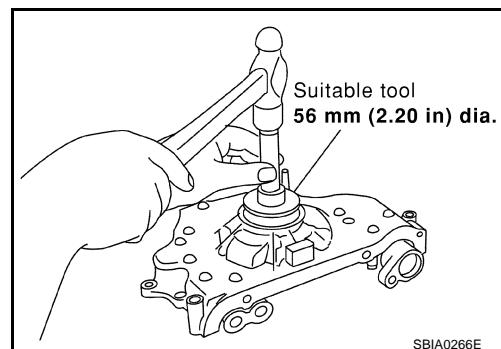
1. Apply new engine oil to new front oil seal joint surface and seal lip.
2. Install front oil seal so that each seal lip is oriented as shown in the figure.



- Press-fit front oil seal until it is flush with front end surface of front cover with a suitable tool.

CAUTION:

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



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

Removal and Installation of Rear Oil Seal**REMOVAL**

1. Remove transaxle assembly. Refer to [MT-17, "TRANSAXLE ASSEMBLY"](#) (M/T models) or [AT-413, "REMOVAL AND INSTALLATION"](#) (A/T models).
2. Remove drive plate (A/T models) or flywheel (M/T models). Refer to [EM-82, "CYLINDER BLOCK"](#) .
3. Remove rear oil seal with a suitable tool.

CAUTION:

Be careful not to damage crankshaft and cylinder block.

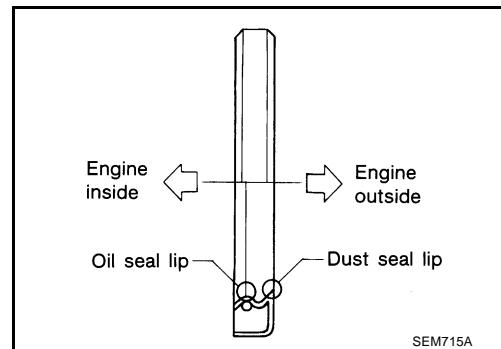
INSTALLATION

1. Apply new engine oil to new rear oil seal joint surface and seal lip.

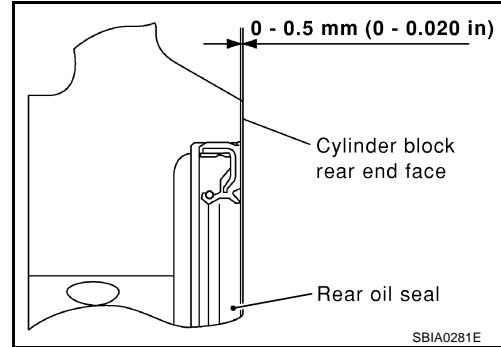
OIL SEAL

[QR]

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



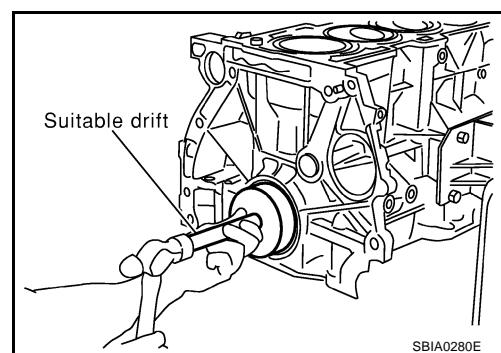
- Press in rear oil seal to the position as shown in the figure.



- Press-fit rear oil seal with a suitable drift [outside diameter 102 mm (4.02 in), inside diameter 86 mm (3.39 in)].

CAUTION:

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



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

CYLINDER HEAD

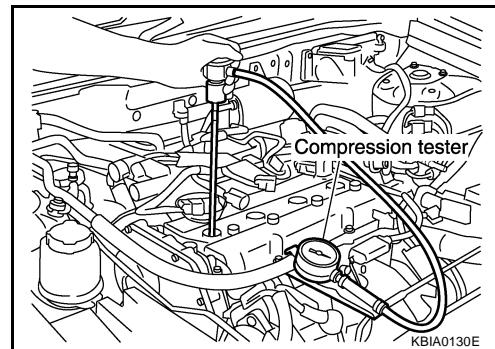
PFP:11041

On-Vehicle Service

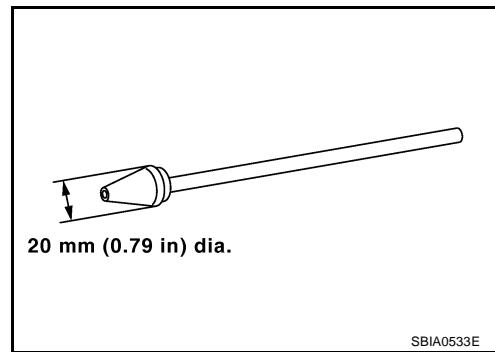
EBS00KNP

CHECKING COMPRESSION PRESSURE

1. Warm up engine thoroughly. Then, stop it.
2. Release fuel pressure by "Without CONSULT-II". Refer to [EC-48, "FUEL PRESSURE RELEASE" \(WITH EURO-OBD\)](#) or [EC-510, "FUEL PRESSURE RELEASE" \(WITHOUT EURO-OBD\)](#).
 - Leave fuel pump fuse disconnecting to avoid fuel injection during measurement.
3. Remove ignition coil and spark plug from each cylinder. Refer to [EM-29, "IGNITION COIL"](#) and [EM-30, "SPARK PLUG"](#).
4. Connect engine tachometer (not required in use of CONSULT-II).
5. 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.



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

Compression pressure:Unit: kPa (bar, kg/cm², psi) / rpm

Engine type	Standard	Minimum	Differential limit between cylinders
QR20DE	1,190 (11.9, 12.1, 173) / 250	990 (9.9, 10.1, 144) / 250	100 (1.0, 1.0, 14) / 250
QR25DE	1,250 (12.5, 12.8, 181) / 250	1,060 (10.6, 10.8, 154) / 250	

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

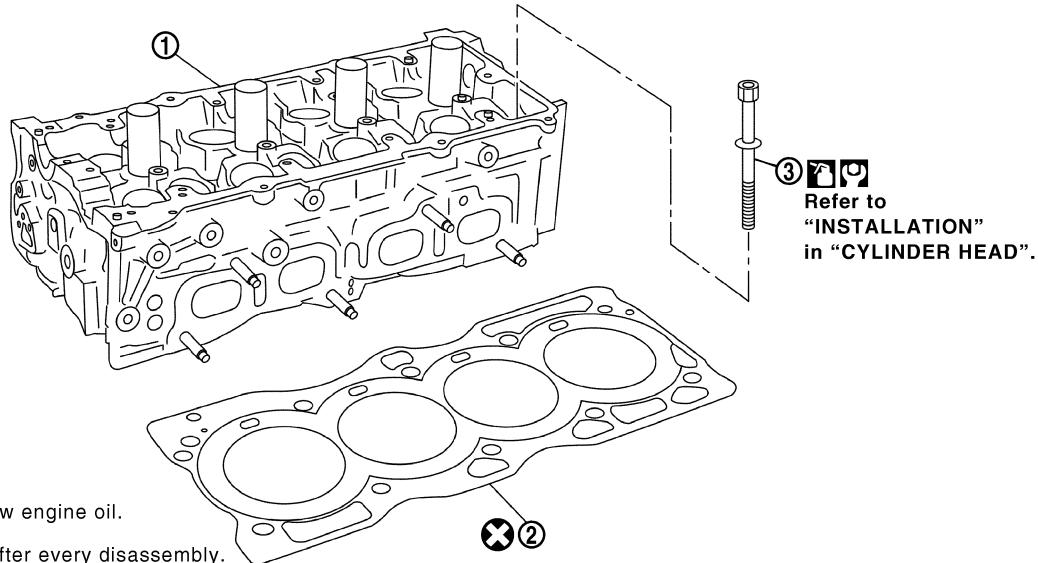
- If the engine speed is out of specified range, check battery liquid for proper gravity. Check engine speed again with normal battery gravity.
- If compression pressure is below minimum value, check valve clearances and parts associated with combustion chamber (Valve, valve seat, piston, piston ring, cylinder bore, cylinder head, cylinder head gasket). After the checking, measure 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.
7. After inspection is completed, install removed parts.
 8. Start engine, and confirm that engine runs smoothly.
 9. Perform trouble diagnosis. If DTC appears, erase it. Refer to [EC-73, "TROUBLE DIAGNOSIS"](#) (WITH EURO-OBD) or [EC-520, "TROUBLE DIAGNOSIS"](#) (WITHOUT EURO-OBD).

Removal and Installation

EBS00KNQ

SEC. 111



PBIC2185E

1. Cylinder head assembly

2. Cylinder head gasket

3. Cylinder head bolt

REMOVAL

1. Release fuel pressure. Refer to [EC-48, "FUEL PRESSURE RELEASE"](#) (WITH EURO-OBD) or [EC-510, "FUEL PRESSURE RELEASE"](#) (WITHOUT EURO-OBD).
2. Drain engine coolant and engine oil. Refer to [CO-9, "Changing Engine Coolant"](#) and [LU-8, "Changing Engine Oil"](#).
3. Remove the following components and related parts.
 - Exhaust manifold and three way catalyst assembly; Refer to [EM-23, "EXHAUST MANIFOLD AND THREE WAY CATALYST"](#).
 - Intake manifold and fuel tube assembly (QR20DE); Refer to [EM-17, "Removal and Installation \(QR20DE\)"](#).
 - Intake manifold collector, intake manifold and fuel tube assembly (QR25DE); Refer to [EM-20, "Removal and Installation \(QR25DE\)"](#).
 - Water control valve and housing (water outlet); Refer to [CO-22, "THERMOSTAT AND WATER CONTROL VALVE"](#).

NOTE:

Can be removed and installed even when assembled with cylinder head.

4. Remove front cover and timing chain. Refer to [EM-44, "TIMING CHAIN"](#).
5. Remove camshafts. Refer to [EM-53, "CAMSHAFT"](#).
6. Securely support bottom of cylinder block with a jack or equivalent tool, and release the hoist that was supporting it.

CYLINDER HEAD

[QR]

7. Remove cylinder head loosening bolts in reverse order as shown in the figure.
- Using the following tool, loosen cylinder head bolts.

Bolt with washer

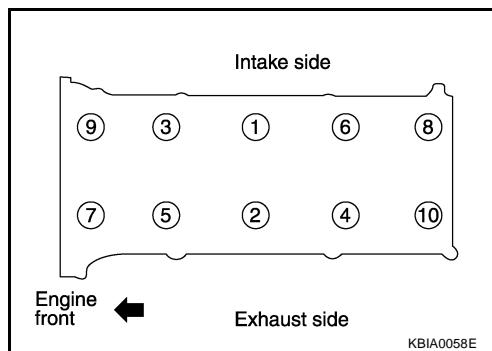
:Hexagonal wrench [size 10 mm (0.39 in)]

Flange bolt

:TORX socket (size E20)

NOTE:

There are two types of cylinder head bolt because of parallel manufacture.



8. Remove cylinder head gasket.

INSPECTION AFTER REMOVAL

Cylinder Head Bolts Outer Diameter

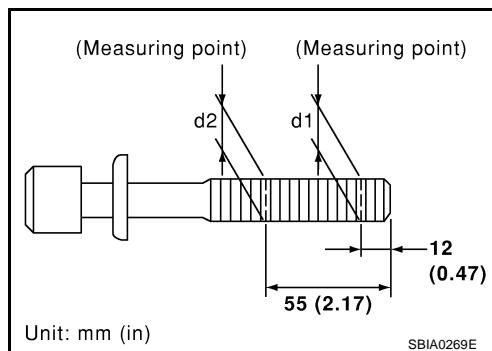
- Cylinder head bolts are tightened by plastic zone tightening method. Whenever the size difference between "d1" and "d2" exceeds the limit, replace them with a new one.

Limit ("d1" – "d2"): 0.23 mm (0.0091 in)

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

NOTE:

When replacing any cylinder head bolts, it is possible to use them with mixing flange bolt and bolt with washer.



Cylinder Head Distortion

NOTE:

When performing this inspection, cylinder block distortion should be also checking. Refer to [EM-102, "CYLINDER BLOCK DISTORTION"](#).

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

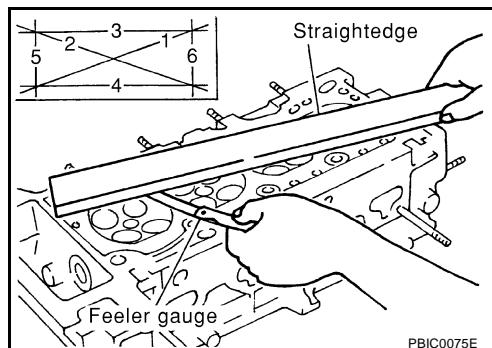
CAUTION:

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

- 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.

CYLINDER HEAD

[QR]

2. Tighten cylinder head bolts in numerical order as shown in figure with the following procedure, and install cylinder head.

CAUTION:

If cylinder head bolts are re-used, check their outer diameters before installation. Refer to [EM-69, "Cylinder Head Bolts Outer Diameter"](#).

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

 : 5.0 N·m (0.51 kg·m, 4 ft-lb)

- c. Turn all bolts 60 degrees clockwise (angle tightening).
- d. Completely loosen.

 : 0 N·m (0 kg·m, 0 ft-lb)

CAUTION:

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

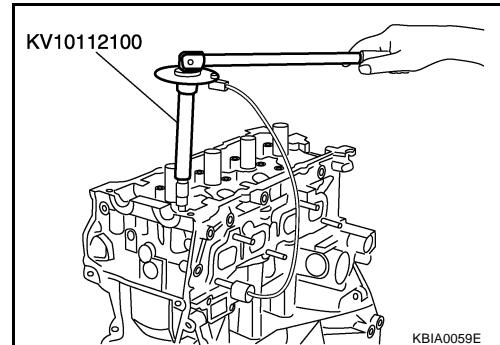
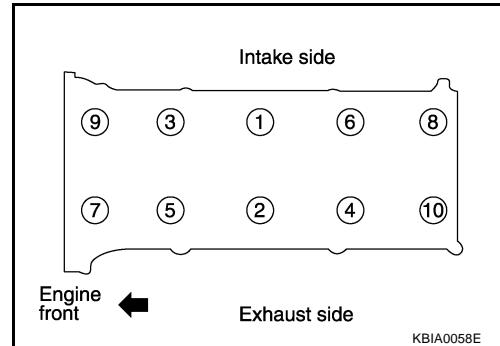
- e. Tighten all bolts.

 : 39.2 N·m (4.0 kg·m, 29 ft-lb)

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

CAUTION:

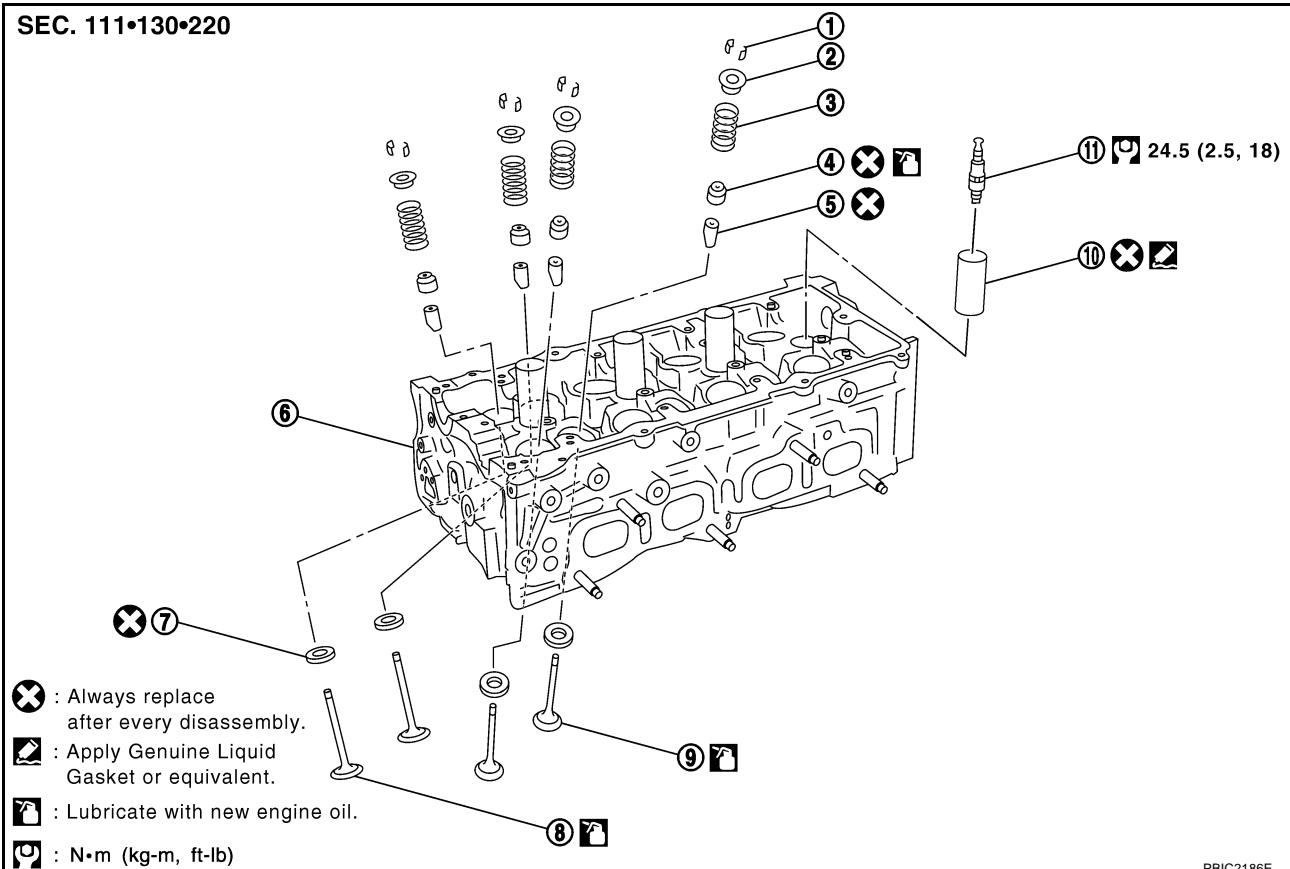
Check and confirm the tightening angle by using an angle wrench (special service tool) or protractor. Avoid judgment by visual inspection without the tool.



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

Disassembly and Assembly

EBS00KNR



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

DISASSEMBLY

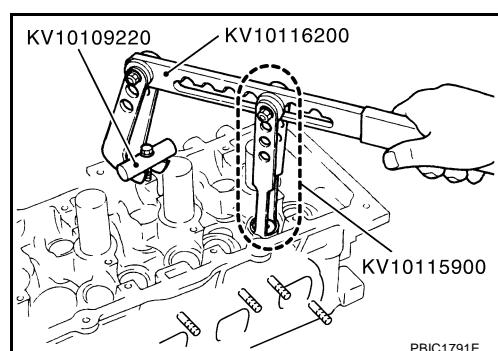
1. Remove spark plug with spark plug wrench (commercial service tool).
2. Remove spark plug tube, if necessary.
 - Using pliers, remove it from cylinder head.

CAUTION:

 - Be careful not to damage cylinder head.
 - Do not remove spark plug tube if not necessary. Once removed, spark plug tube cannot be reused because of deformation.
3. Remove valve lifter.
 - Identify installation positions, and store them without mixing them up.
4. Remove valve collet.
 - Compress valve spring with valve spring compressor, attachment and adapter (special service tool). Remove valve collet with a magnet hand.

CAUTION:

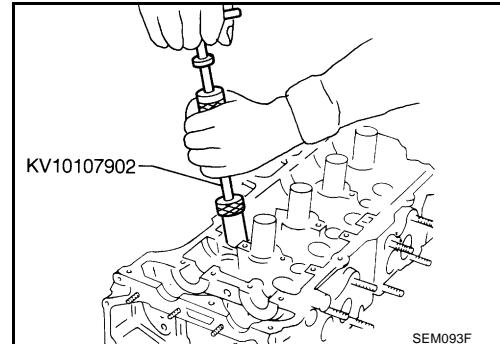
When working, be careful not to damage valve lifter holes.



- Remove valve spring retainer and valve spring (with valve spring seat).

CAUTION:**Do not remove valve spring seat from valve spring.**

- Push valve stem to combustion chamber side, and remove valve.
 - Identify installation positions, and store them without mixing them up.
- Remove valve oil seal with a valve oil seal puller (special service tool).



- When valve seat must be replaced, refer to [EM-75, "VALVE SEAT REPLACEMENT"](#) to removal.
- When valve guide must be replaced, refer to [EM-74, "VALVE GUIDE REPLACEMENT"](#) to removal.

ASSEMBLY

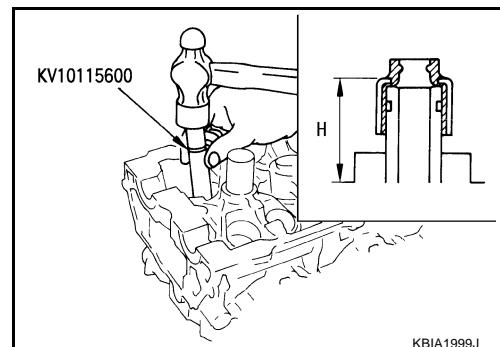
- Install valve guide if removed. Refer to [EM-74, "VALVE GUIDE REPLACEMENT"](#).
- Install valve seat if removed. Refer to [EM-75, "VALVE SEAT REPLACEMENT"](#).
- Install valve oil seal.

- Install with a valve oil seal drift (special service tool) to match dimension in the figure.

NOTE:

Dimension "H" is height that measured before installing valve spring (with valve spring seat).

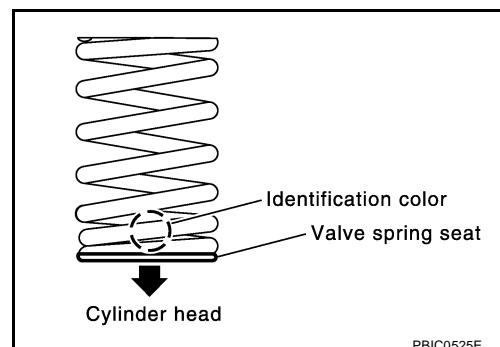
Height "H" : 11.8 - 12.4 mm (0.465 - 0.488 in)



- Install valve.
 - Install larger diameter to intake side.
- Install valve spring (with valve spring seat).
 - Install smaller pitch (valve spring seat side) to cylinder head side.
 - Confirm identification color of valve spring.

Intake : Blue

Exhaust : Yellow



- Install valve spring retainer.
- Install valve collet.

CYLINDER HEAD

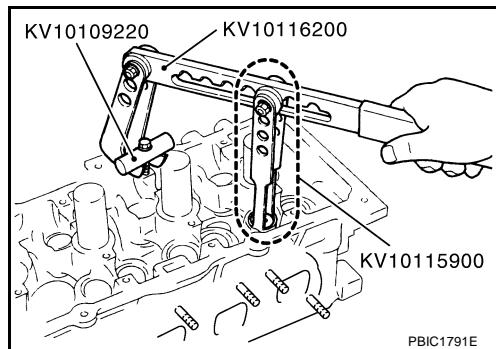
[QR]

- Compress valve spring with a valve spring compressor, attachment and adapter (special service tool). Install valve collet with a magnet hand.

CAUTION:

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

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



PBIC1791E

8. Install valve lifter.

9. Install spark plug tube if removed.

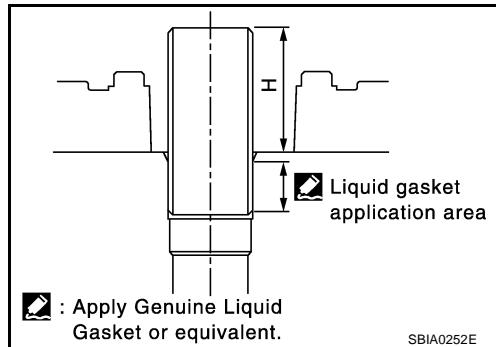
- Press-fit it into cylinder head with the following procedure:

a. Remove old liquid gasket from cylinder head side installation hole.

b. Apply liquid gasket all round on spark plug tube within approximately 12 mm (0.47 in) width from edge of spark plug tube on the press-fit side.

Use Genuine Liquid Gasket or equivalent.

c. Using a drift, press-fit spark plug tube so that height is as same as "H" shown in figure.



SBIA0252E

Standard press-fit height "H":

41.2 - 42.2 mm (1.622 - 1.661 in)

CAUTION:

- When press-fitting, be careful not to deform spark plug tube.

- After press-fitting, wipe off any protruding liquid gasket on top surface of cylinder head.

10. Install spark plug with spark plug wrench (commercial service tool).

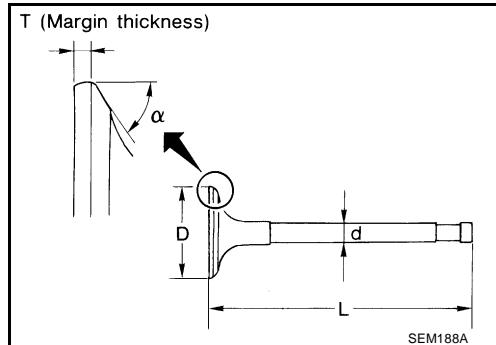
Inspection After Disassembly

EBS00KNS

VALVE DIMENSIONS

K

- Check dimensions of each valve. For dimensions, refer to [EM-110, "Valve Dimensions"](#).
- If dimensions are out of the standard, replace valve.



SEM188A

VALVE GUIDE CLEARANCE

M

Valve Stem Diameter

K

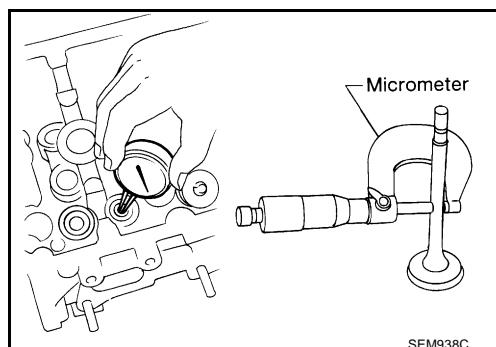
Measure the diameter of valve stem with a micrometer.

L

Standard

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

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



SEM938C

Valve Guide Inner Diameter

Measure the inner diameter of valve guide with a 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)

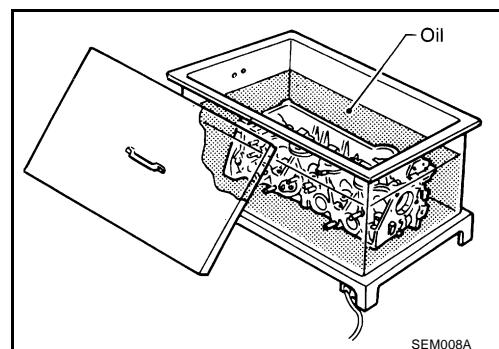
Exhaust : 0.09 mm (0.004 in)

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

VALVE GUIDE REPLACEMENT

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

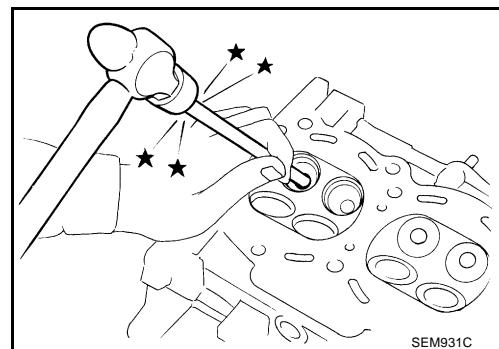
1. To remove valve guide, heat cylinder head to 110 to 130°C (230 to 266°F) by soaking in heated oil.



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

CAUTION:

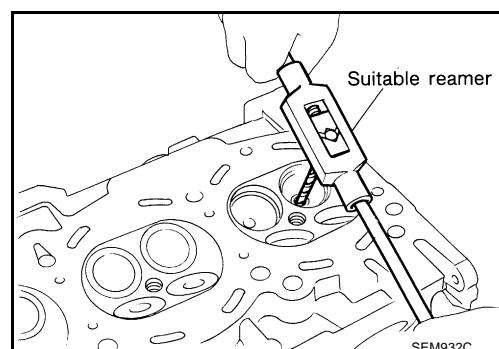
Cylinder head contains heat, when working, wear protective equipment to avoid getting burned.



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

Valve guide hole diameter (for service parts):**Intake and exhaust**

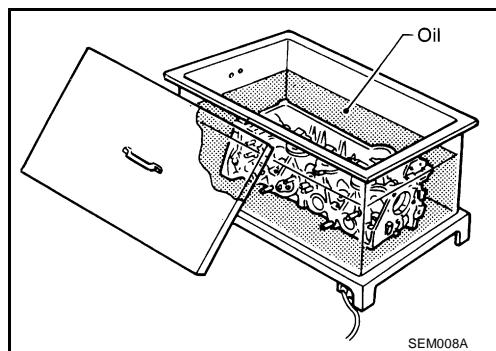
: 10.175 - 10.196 mm (0.4006 - 0.4014 in)



CYLINDER HEAD

[QR]

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



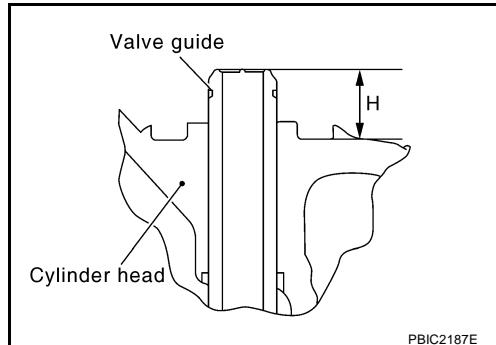
5. Press valve guide from camshaft side to dimensions as shown in the figure.

Projection "H":

Intake	: 10.1 - 10.3 mm (0.398 - 0.406 in)
Exhaust	: 10.0 - 10.4 mm (0.394 - 0.409 in)

CAUTION:

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

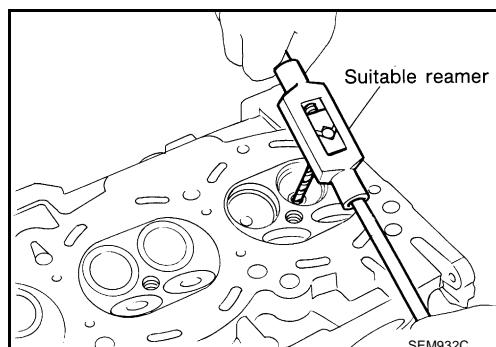


6. Apply reamer finish to valve guide with a valve guide reamer (commercial service tool).

Standard

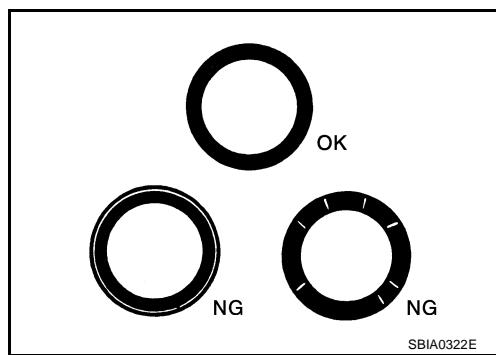
Intake and exhaust:

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. Refer to [EM-113, "Valve Seat"](#).

CYLINDER HEAD

[QR]

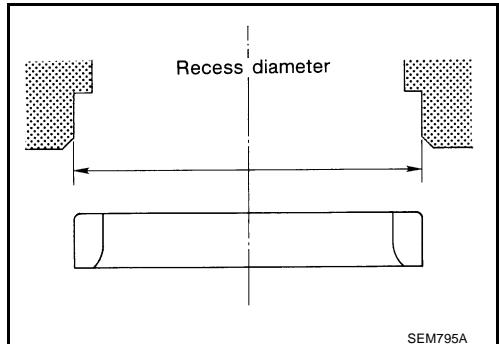
- Ream cylinder head recess diameter for service valve seat.

Oversize [0.5 mm (0.020 in)]

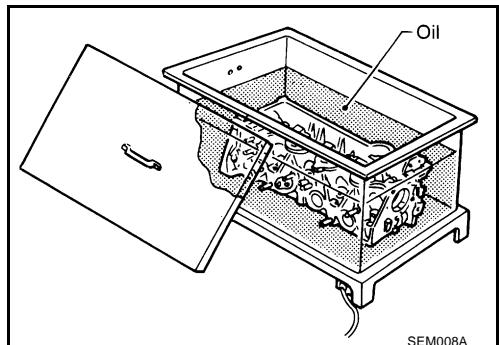
Intake : 37.000 - 37.016 mm (1.4567 - 1.4573 in)

Exhaust : 32.000 - 32.016 mm (1.2598 - 1.2605 in)

- Be sure to ream in circles concentric to the valve guide center.
This will enable valve seat 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. Press-fit valve seat into cylinder head.

CAUTION:

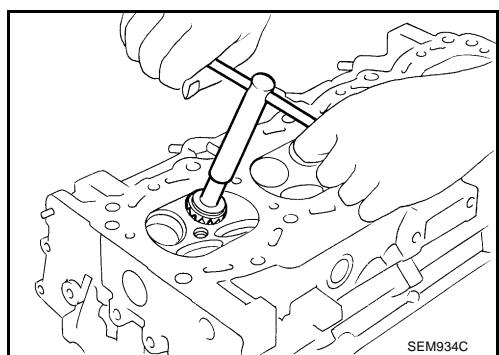
- Avoid directly touching cold valve seats.

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

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

CAUTION:

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



- Grind to obtain the dimensions indicated in the figure.

Standard

D1 dia. : 33.5 mm (1.319 in)^{*1}

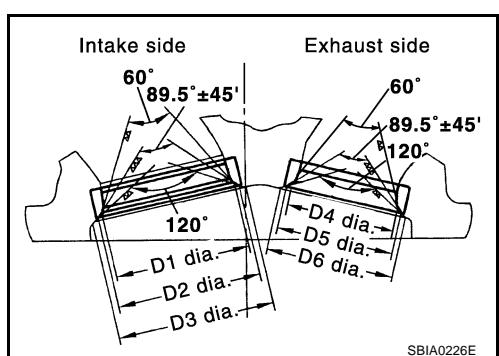
D2 dia. : 35.1 - 35.3 mm (1.382 - 1.390 in)^{*2}

D3 dia. : 39.0 - 39.2 mm (1.535 - 1.543 in)^{*3}

D4 dia. : 28.0 mm (1.102 in)^{*1}

D5 dia. : 29.9 - 30.1 mm (1.177 - 1.185 in)^{*2}

D6 dia. : 33.5 - 33.7mm (1.319 - 1.327 in)^{*3}



***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**

***3 : 120 degrees cutter diameter**

- Using compound, grind to adjust valve fitting.

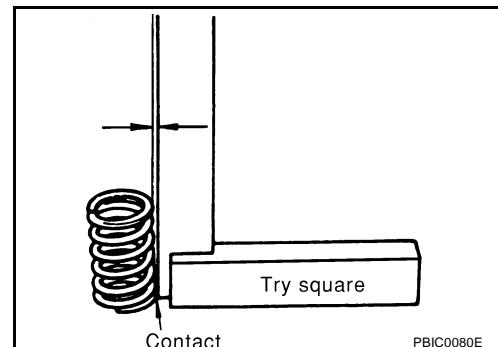
7. Check again for normal contact. Refer to [EM-75, "VALVE SEAT CONTACT"](#).

VALVE SPRING SQUARENESS

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

Limit : 1.9 mm (0.075 in)

- If it exceeds the limit, replace valve spring.

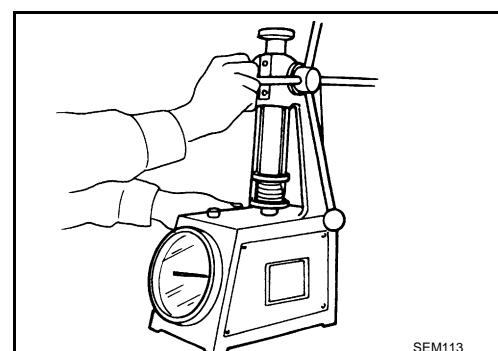


VALVE SPRING DIMENSIONS AND VALVE SPRING PRESSURE LOAD

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

CAUTION:

Do not remove valve spring seat from valve spring.



Standard:

Items	INTAKE	EXHAUST
Free height	44.84 - 45.34 mm (1.7654 - 1.7850 in)	45.28 - 45.78 mm (1.7827 - 1.8024 in)
Installation height	35.30 mm (1.390 in)	35.30 mm (1.390 in)
Installation load	151 - 175 N (15.4 - 17.8 kg, 34 - 39 lb)	151 - 175 N (15.4 - 17.8 kg, 34 - 39 lb)
Height during valve open	24.94 mm (0.9819 in)	26.39 mm (1.0390 in)
Load with valve open	358 - 408 N (36.5 - 41.6 kg, 80 - 92 lb)	325 - 371 N (33.1 - 37.8 kg, 73 - 83 lb)
Identification color	Blue	Yellow

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

ENGINE ASSEMBLY

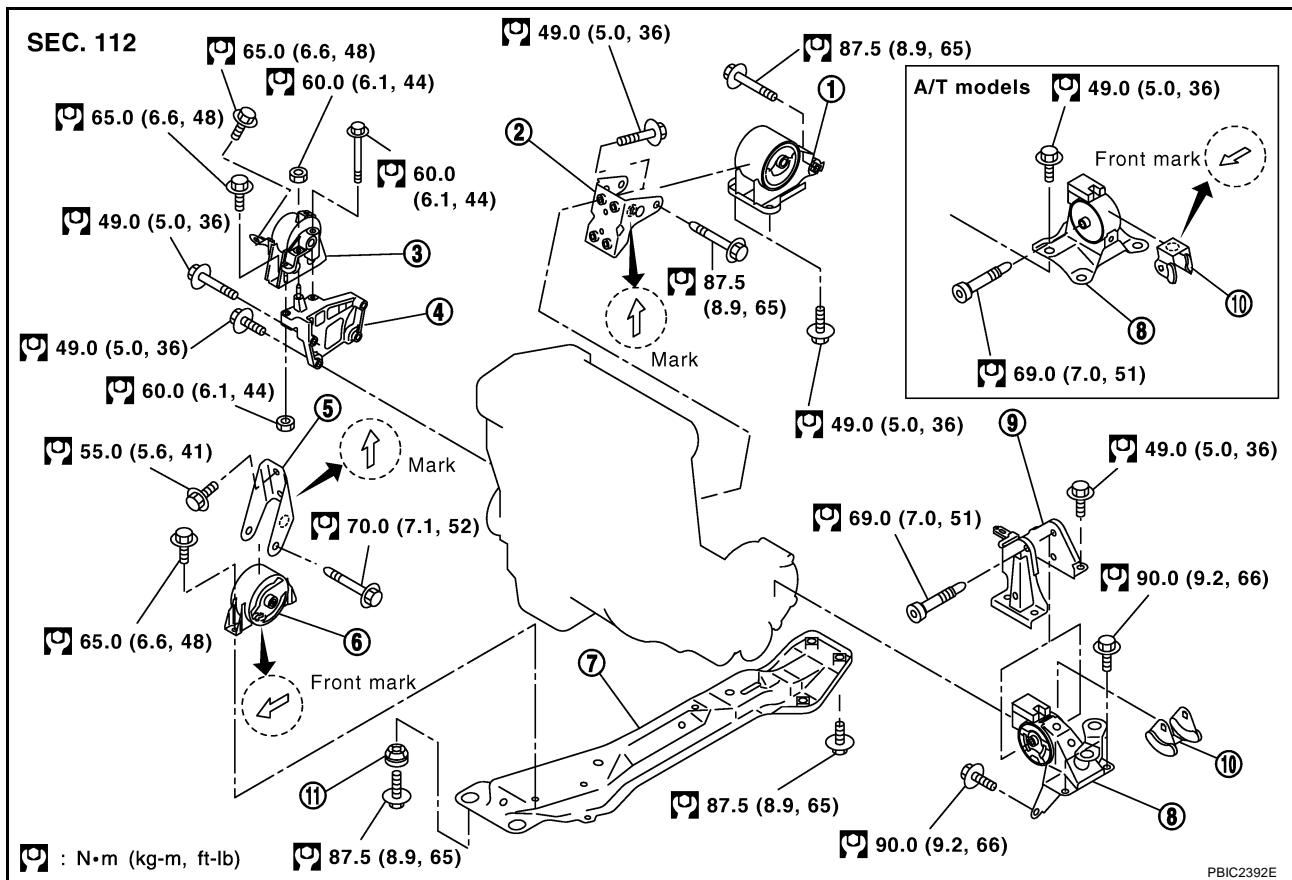
[QR]

ENGINE ASSEMBLY

PFP:10001

Removal and Installation

EBS00KNT



1. Rear engine mounting insulator
2. Rear engine mounting bracket
3. RH engine mounting insulator
4. RH engine mounting bracket
5. Front engine mounting bracket
6. Front engine mounting insulator
7. Center member
8. LH engine mounting insulator
9. LH engine mounting bracket
10. Stopper
11. Grommet

WARNING:

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

CAUTION:

- Always be careful to work safely, avoid forceful or uninstructed operations.
- Do not start working until exhaust system and engine coolant are cool enough.
- If items or work required are not covered by the engine section, refer to the applicable sections.
- Always use the support point specified for lifting.
- Use either 2-pole lift type or separate type lift as best you can. If board-on type is used for unavoidable reasons, support at the rear axle jacking point with transmission jack or similar tool before starting work, in preparation for the backward shift of center of gravity.
- For supporting points for lifting and jacking point at rear axle, refer to [GI-36, "Garage Jack and Safety Stand"](#).

REMOVAL

Outline

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

Preparation

1. Remove hood assembly. Refer to [BL-12, "HOOD"](#) .
2. Release fuel pressure. Refer to [EC-48, "FUEL PRESSURE RELEASE"](#) (WITH EURO-OBD) or [EC-510, "FUEL PRESSURE RELEASE"](#) (WITHOUT EURO-OBD).
3. Disconnect both battery terminals. Refer to [SC-3, "BATTERY"](#) .
4. Drain engine coolant from radiator. Refer to [CO-9, "DRAINING ENGINE COOLANT"](#) .
5. Remove the following parts.
 - LH and RH undercovers
 - Front road wheels and tyres
 - Battery; Refer to [SC-3, "BATTERY"](#) .
 - Drive belt; Refer to [EM-13, "DRIVE BELTS"](#) .
 - Air duct and air cleaner case assembly; Refer to [EM-15, "AIR CLEANER AND AIR DUCT"](#) .
 - Alternator; Refer to [SC-12, "CHARGING SYSTEM"](#) .
 - Radiator and radiator cooling fan assembly; Refer to [CO-12, "RADIATOR"](#) .
6. Disconnect engine room harness from the engine side and set it aside for easier work.
7. Disconnect all vacuum hoses and air hoses connected to vehicle side at engine side.

Engine Room LH

1. Disconnect fuel feed hose, and plug it to prevent fuel from draining. Refer to [EM-32, "FUEL INJECTOR AND FUEL TUBE"](#) .
2. Disconnect heater hose, and install plug it to prevent engine coolant from draining.
3. Disconnect control cable from transaxle (A/T models). Refer to [AT-404, "ON-VEHICLE SERVICE"](#) .
4. Disconnect clutch operating cylinder from transaxle, and move it aside (M/T models). Refer to [CL-10, "OPERATING CYLINDER"](#) .
5. Disconnect shift and select cable from transaxle (M/T models). Refer to [MT-14, "CONTROL LINKAGE"](#) .

Engine Room RH

1. Remove engine coolant reservoir tank. Refer to [CO-12, "RADIATOR"](#) .
2. Remove A/C compressor with piping connected from engine. Temporarily secure it on vehicle side with a rope to avoid putting load on it. Refer to [ATC-144, "Removal and Installation of Compressor"](#) .

Vehicle Underbody

1. Remove exhaust front tube. Refer to [EX-2, "EXHAUST SYSTEM"](#) .
2. Remove propeller shaft. Refer to [PR-3, "REAR PROPELLER SHAFT"](#) .
3. Remove steering lower joint from steering gear. Refer to [PS-10, "STEERING COLUMN"](#) .
4. Disconnect power steering fluid piping at a point between vehicle and engine. Refer to [PS-34, "HYDRAULIC LINE"](#) .
5. Remove rear plate cover from oil pan (upper). Then remove bolts fixing drive plate to torque converter (A/T models). Refer to [EM-25, "OIL PAN AND OIL STRAINER"](#) and [AT-413, "REMOVAL AND INSTALLATION"](#) .
6. Remove transaxle joint bolts which pierce at oil pan (upper) lower rear side. Refer to [MT-17, "TRANSAXLE ASSEMBLY"](#) (M/T models) or [AT-413, "REMOVAL AND INSTALLATION"](#) (A/T models).
7. Remove front wheel sensor (LH and RH) for ABS from steering knuckle. Refer to [BRC-45, "WHEEL SENSORS"](#) (ABS) or [BRC-116, "WHEEL SENSORS"](#) (ESP/TCS/ABS).
8. Remove brake caliper assembly with piping connected from steering knuckle. Temporarily secure it on vehicle side with a rope to avoid load on it. Refer to [BR-27, "FRONT DISC BRAKE"](#) .
9. Remove lower ends of left and right strut from steering knuckle. Refer to [FSU-5, "FRONT SUSPENSION ASSEMBLY"](#) .

Removal

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

ENGINE ASSEMBLY

[QR]

- Use alternator bracket mounting bolt holes for the front side.

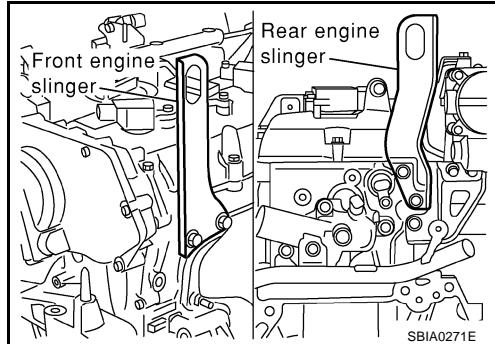
Slinger bolts:

Front

: 57.9 N·m (5.9 kg-m, 43 ft-lb)

Rear

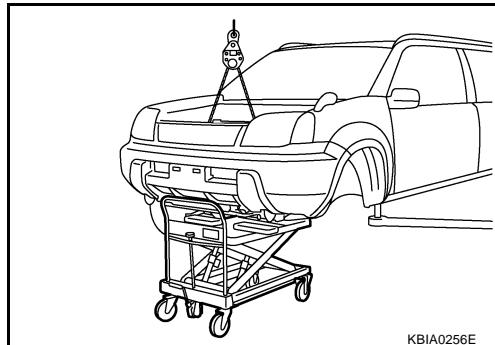
: 28.0 N·m (2.9 kg-m, 21 ft-lb)



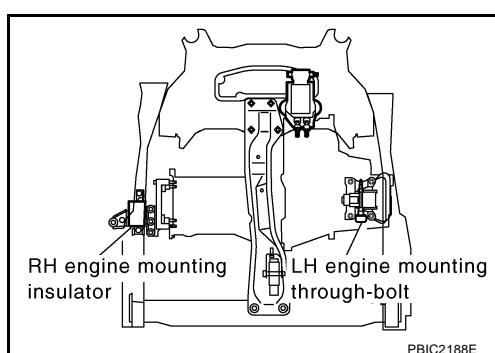
2. Lift with hoist and secure engine in position.
3. Use a manual lift table caddy (commercial service tool) or equivalently rigid tool such as a transmission jack. Securely support bottom of engine and transaxle, and simultaneously adjust hoist tension.

CAUTION:

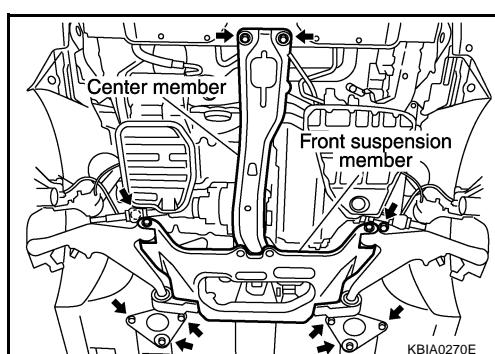
Put a piece of wood or something similar as the supporting surface, secure a completely stable condition.



4. Remove RH engine mounting insulator.
5. Pull LH engine mounting through-bolt out.



6. Remove mounting bolts at front end of center member.
7. Remove front suspension member mounting bolts and nuts. Refer to [FSU-5, "FRONT SUSPENSION ASSEMBLY"](#).



8. Remove engine, transaxle and transfer assembly with front suspension member and center member from vehicle downward by carefully operating supporting tools.

CAUTION:

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

9. Remove power steering oil pump with piping connected from engine. Move it aside on front suspension member. Refer to [PS-34, "HYDRAULIC LINE"](#).
10. Remove front engine mounting and rear engine mounting through-bolts to remove front suspension member and center member.
11. Remove starter motor. Refer to [SC-21, "STARTING SYSTEM"](#).
12. Separate engine and transaxle. Refer to [MT-17, "TRANSAXLE ASSEMBLY"](#) (M/T models) or [AT-413, "REMOVAL AND INSTALLATION"](#) (A/T models).

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INSTALLATION

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

- Do not allow engine oil to get on mounting insulator. Be careful not to damage mounting insulator.
- When installation directions are specified, install parts according to the direction marks on them referring to figure of components. Refer to [EM-78, "Removal and Installation"](#).
- Make sure that each mounting insulator is seated properly, and tighten mounting bolts and nuts.

INSPECTION AFTER INSTALLATION

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

CYLINDER BLOCK

[QR]

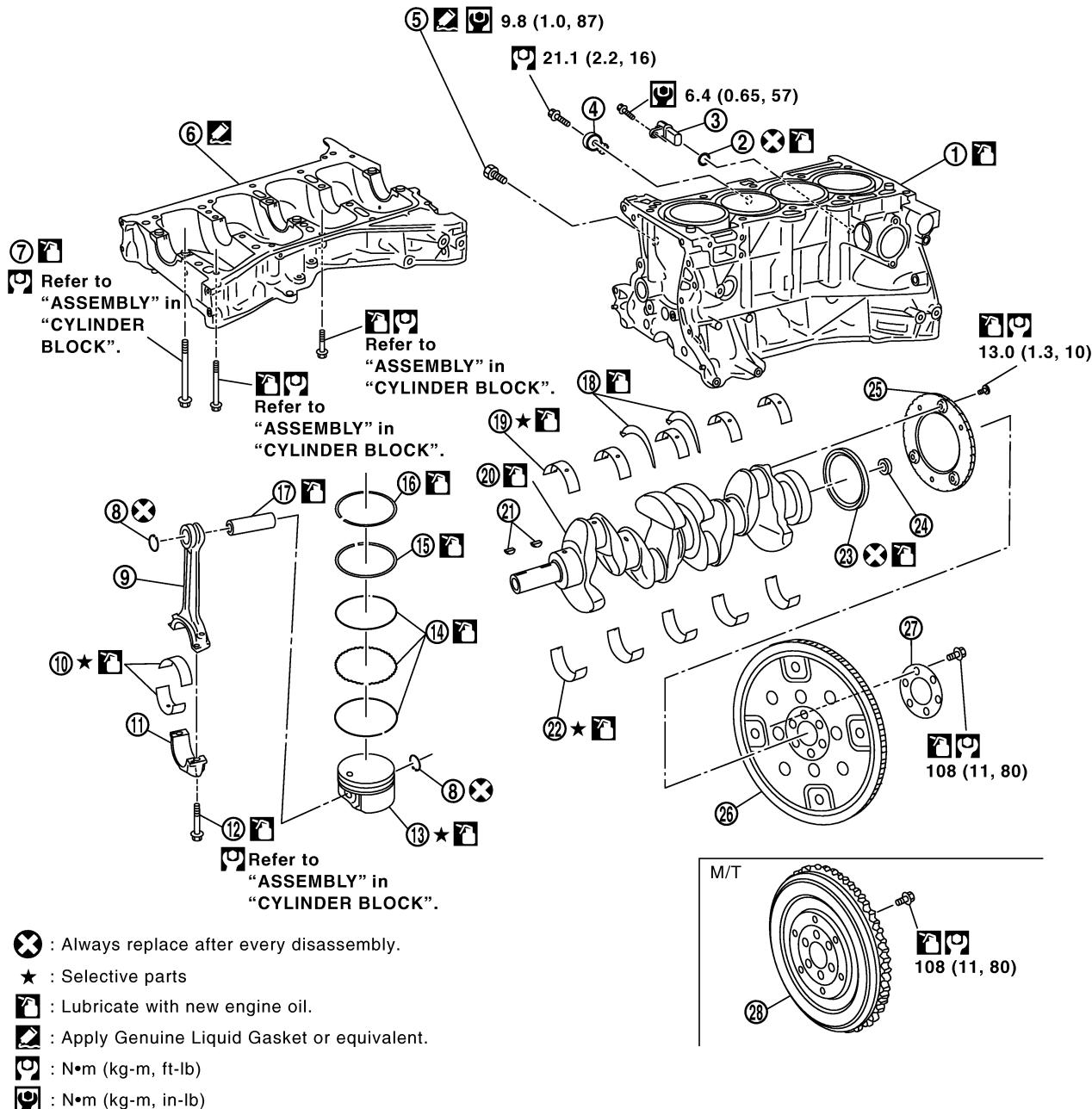
CYLINDER BLOCK

PFP:11010

Disassembly and Assembly

EBS00KNU

SEC. 110•120•221•226

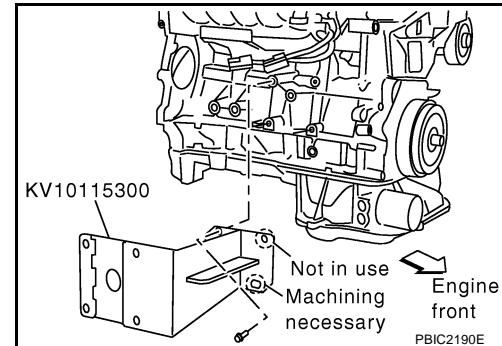


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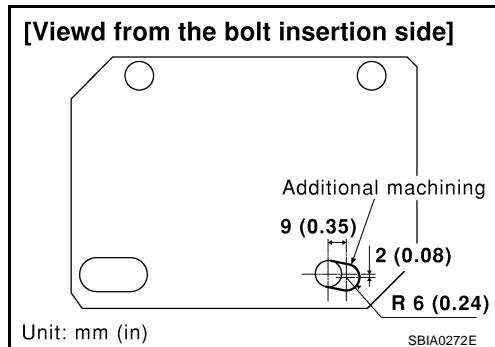
- | | | |
|---------------------------------------|--------------------------------|-------------------------------------|
| 1. Cylinder block | 2. O-ring | 3. Crankshaft position sensor (POS) |
| 4. Knock sensor | 5. Water drain plug | 6. Lower cylinder block |
| 7. Lower cylinder block mounting bolt | 8. Snap ring | 9. Connecting rod |
| 10. Connecting rod bearing | 11. Connecting rod bearing cap | 12. Connecting rod bolt |
| 13. Piston | 14. Oil ring | 15. Second ring |
| 16. Top ring | 17. Piston pin | 18. Thrust bearing |
| 19. Main bearing upper | 20. Crankshaft | 21. Crankshaft key |
| 22. Main bearing lower | 23. Rear oil seal | 24. Pilot convertor (A/T models) |
| 25. Signal plate | 26. Drive plate (A/T models) | 27. Reinforce plate (A/T models) |
| 28. Flywheel (M/T models) | | |

DISASSEMBLY

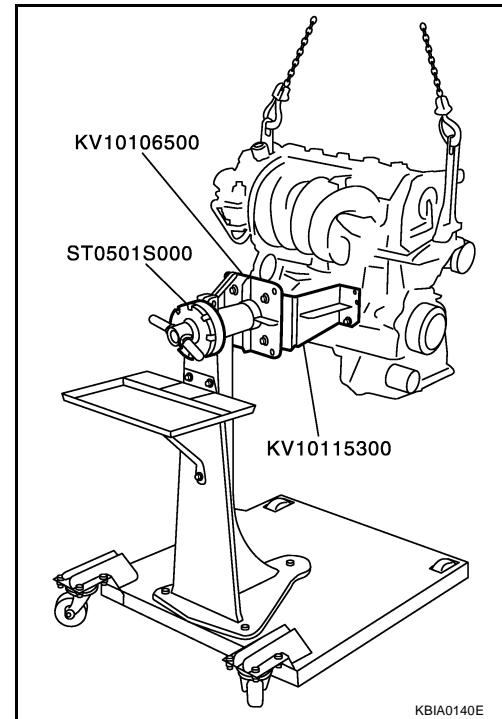
1. Remove engine, transaxle and transfer assembly from vehicle, and separate transaxle and transfer assembly from engine. Refer to [EM-78, "ENGINE ASSEMBLY"](#).
2. Mount engine on an engine stand with the following procedure:
 - a. Remove oil cooler with oil cooler bracket on right side of cylinder block. Refer to [LU-11, "OIL COOLER"](#).
 - b. Install engine sub-attachment (special service tool) to right side of cylinder block.
 - Do not use bolt hole at the upper right looking from bolt insertion side as shown in the figure.



- Machine a bolt hole at the lower right of the engine sub-attachment looking from bolt insertion side as shown in the figure.



- c. Lift engine, and mount it onto the engine stand (special service tool).



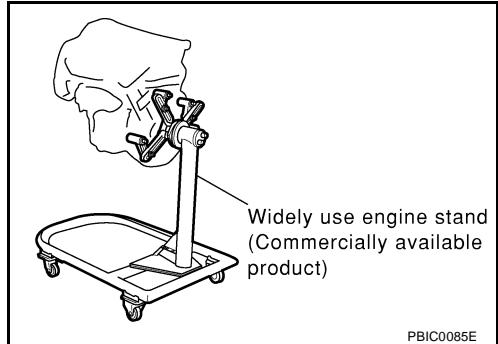
CYLINDER BLOCK

[QR]

- A widely use engine stand can be used.

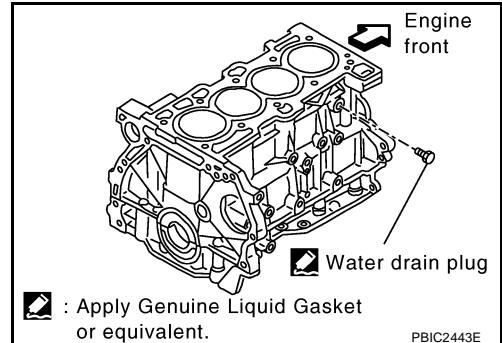
NOTE:

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



PBIC0085E

3. Drain engine oil. Refer to [LU-8, "Changing Engine Oil"](#).
4. Drain engine coolant by removing water drain plug from inside of engine.



5. Remove cylinder head. Refer to [EM-67, "CYLINDER HEAD"](#).
6. Remove knock sensor.

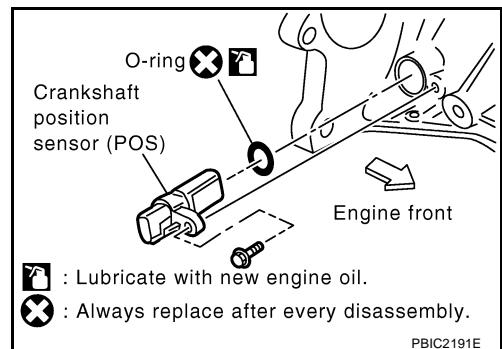
CAUTION:

Carefully handle knock sensor avoiding shocks.

7. Remove crankshaft position sensor (POS).

CAUTION:

- Avoid impacts such as a dropping.
- Do not disassemble.
- Keep it away from metal particles.
- Do not place sensor in a location where it is exposed to magnetism.



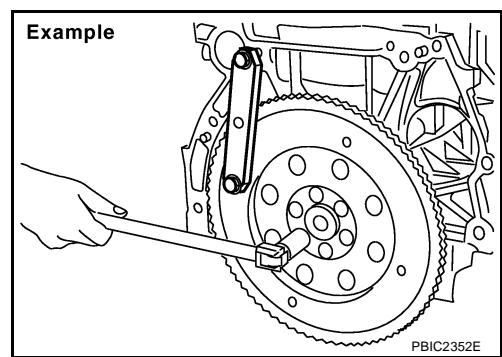
8. Remove clutch cover and clutch disc (M/T models). Refer to [CL-14, "CLUTCH DISC, CLUTCH COVER AND FLYWHEEL"](#).
9. Remove flywheel (M/T models) or drive plate (A/T models).
 - Secure crankshaft with a stopper plate, and remove mounting bolts.
 - Using the following TORX socket, loosen mounting bolts.

Flywheel (M/T models)

: size T55 (commercial service tool)

Drive plate (A/T models)

: size E20



CAUTION:

Be careful not to damage contact surface for clutch disc of flywheel (M/T models).

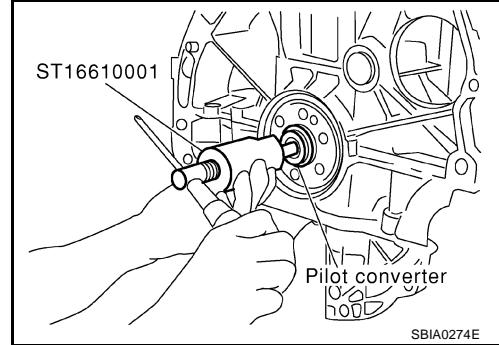
NOTE:

The flywheel, two block construction, allows movement in response to transaxle side pressure, or when twisted in its rotational direction. Therefore, some amount of noise is normal.

10. Remove pilot converter using pilot bushing puller (special service tool) or suitable tool. (A/T models)

NOTE:

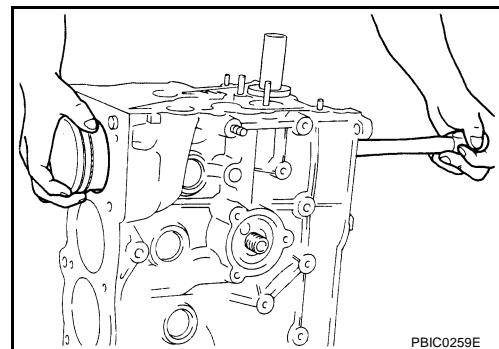
M/T models have no pilot bushing.



11. Remove piston and connecting rod assembly with the following procedure:

- Before removing piston and connecting rod assembly, check the connecting rod side clearance. Refer to [EM-99, "CONNECTING ROD SIDE CLEARANCE"](#).

 - a. Position crankshaft pin corresponding to connecting rod to be removed onto the bottom dead center.
 - b. Remove connecting rod cap.
 - c. Using a hammer handle or similar tool, push piston and connecting rod assembly out to the cylinder head side.



12. Remove connecting rod bearings.

CAUTION:

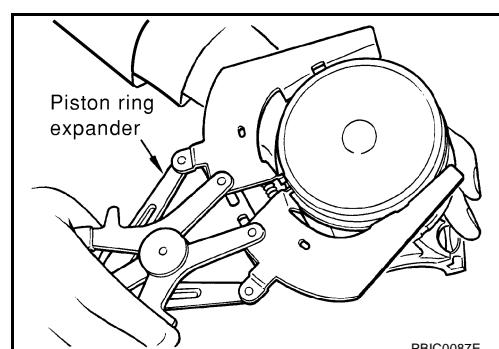
When removing them, note the installation position. Keep them in the correct order.

13. Remove piston rings form piston.

- Use a piston ring expander (commercial service tool).

CAUTION:

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

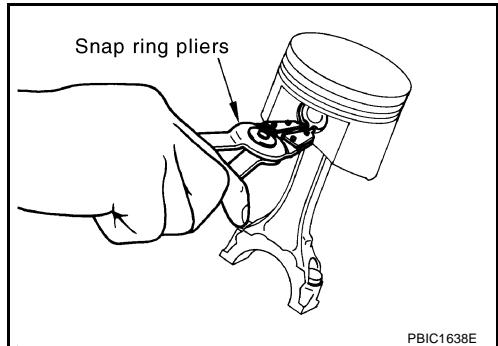


14. Remove piston from connecting rod with the following procedure:

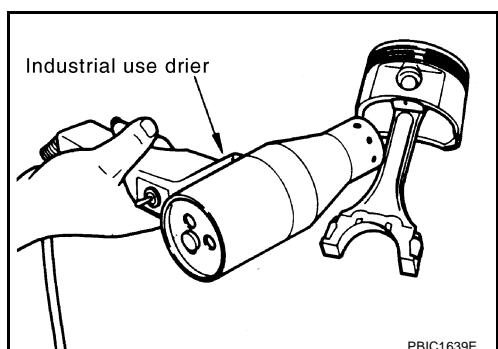
CYLINDER BLOCK

[QR]

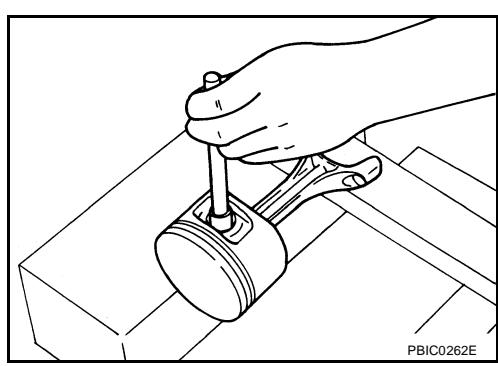
- a. Using snap ring pliers, remove snap ring.



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

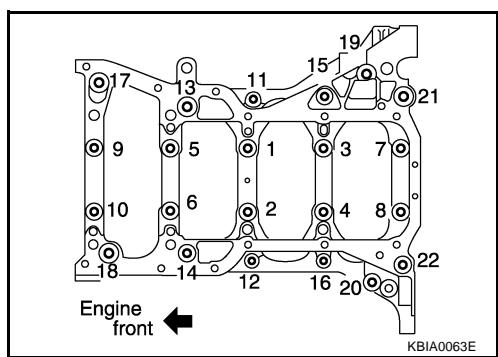


- c. Push out piston pin with stick of outer diameter approximately 19 mm (0.75 in).



15. Remove lower cylinder block mounting bolts.

- Loosen them in reverse order as shown in the figure, and remove them.
- Use TORX socket (size E14) for bolts No. 1 to 10.
- Before loosening lower cylinder block mounting bolts, measure crankshaft end play. Refer to [EM-99, "CRANKSHAFT END PLAY"](#).



16. Remove lower cylinder block.

- Use a seal cutter (special service tool: KV10111100) or equivalent tool to cut liquid gasket for removal.

CAUTION:

Be careful not to damage the mounting surface.

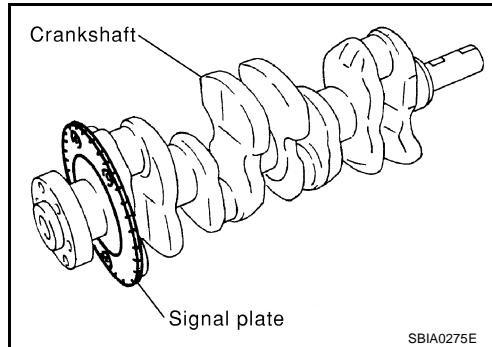
17. Remove crankshaft.

CAUTION:

- Be careful not damage or deform signal plate mounted on crankshaft.
- When setting crankshaft on a flat floor surface, use a block of wood to avoid interference between signal plate and the floor surface.
- Do not remove signal plate unless it is necessary to do so.

NOTE:

When removing or installing signal plate, use TORX socket (size T30).



18. Pull rear oil seal out from rear end of crankshaft.

NOTE:

When replacing rear oil seal without removing lower cylinder block, use a screwdriver to pull it out from between crankshaft and cylinder block.

CAUTION:

Be careful not to damage crankshaft and cylinder block.

19. Remove main bearings and thrust bearings from cylinder block and lower cylinder block.

CAUTION:

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

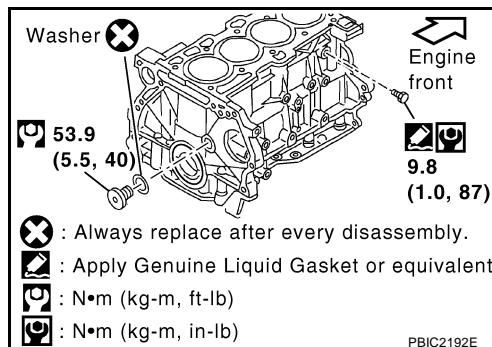
ASSEMBLY

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

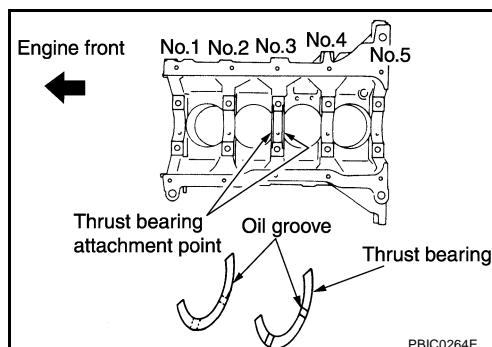
CAUTION:

Use a goggles to protect your eye.

2. Install each plug to cylinder block.
 - Apply liquid gasket.
Use Genuine Liquid Gasket or equivalent.



3. Install main bearings and thrust bearings with the following procedure:
 - a. Remove dust, dirt, and engine oil on the bearing mating surfaces of cylinder block and lower cylinder block.
 - b. Install thrust bearings to the both sides of the No. 3 journal housing on cylinder block.
 - Install thrust bearings with the oil groove facing crankshaft arm (outside).

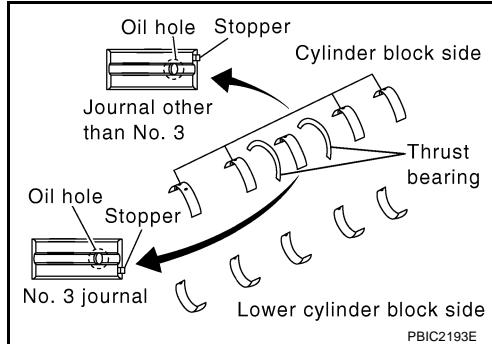


- c. Install the main bearings paying attention to the direction.

CYLINDER BLOCK

[QR]

- Main bearing with an oil hole and groove goes on cylinder block. The one without them goes on lower cylinder block.
- Only main bearing (on cylinder block) for No. 3 journal has different specifications.
- Before installing main bearings, apply new engine oil to the bearing surface (inside). Do not apply new engine oil to the back surface, but thoroughly clean it.
- When installing, align main bearing stopper to the notch.
- Ensure the oil holes on cylinder block and those on the corresponding bearing are aligned.



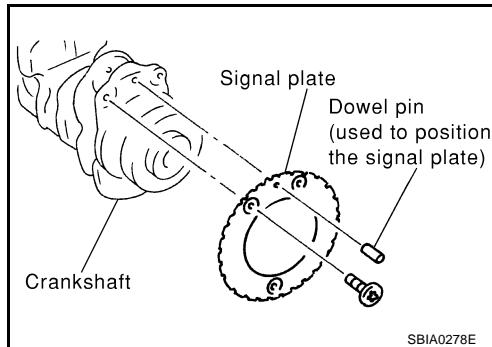
4. Install signal plate to crankshaft if removed.
- a. Position crankshaft and signal plate using a dowel pin, and tighten mounting bolts.
- b. Remove dowel pin.

CAUTION:

Be sure to remove dowel pin.

NOTE:

Dowel pin of crankshaft and signal plate is provided as a set for each. If dowel pin is not available (when reusing crankshaft and signal), use M6 bolt [length 10 mm (0.39 in) or more] as a substitute.



5. Install crankshaft to cylinder block.
- While turning crankshaft by hand, make sure that it turns smoothly.
6. Install lower cylinder block with the following procedure:

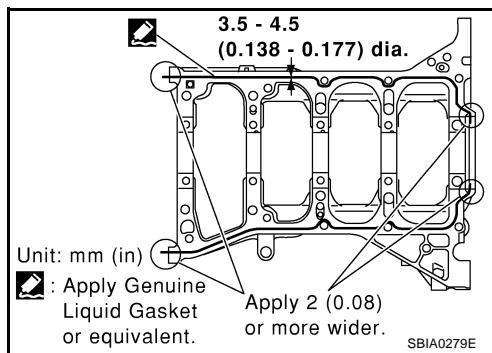
- a. Apply liquid gasket with a tube presser (special service tool: WS39930000) to lower cylinder block as shown in the figure.
Use Genuine Liquid Gasket or equivalent.

CAUTION:

After liquid gasket is applied, rear oil seal installation must be finished within 5 minutes. Therefore, the following procedure must be performed quickly.

NOTE:

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

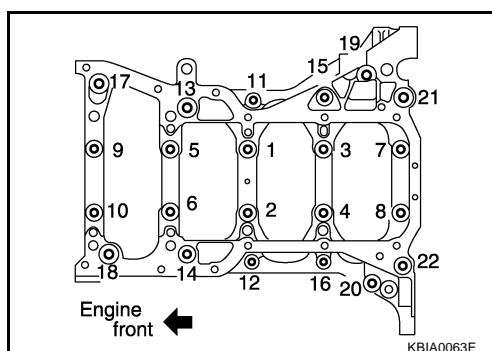


- b. Tighten lower cylinder block mounting bolts with the following procedure:
 - i. Apply new engine oil to threads and seat surfaces of mounting bolts.
 - ii. Tighten M8 bolts in numerical order from No. 11 to 22 in the figure.

: **25.1 N·m (2.6 kg·m, 19 ft·lb)**

NOTE:

There are more processes to complete the tightening of mounting bolts. However stop procedure here to install rear oil seal.



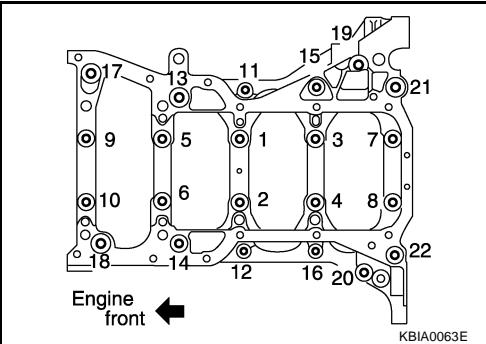
- c. Install rear oil seal. Refer to [EM-65, "Removal and Installation of Rear Oil Seal"](#).
- d. Restart tightening of lower cylinder block mounting bolts with the following procedure:

CYLINDER BLOCK

[QR]

- i. Tighten M10 bolts in numerical order from No. 1 to 10.

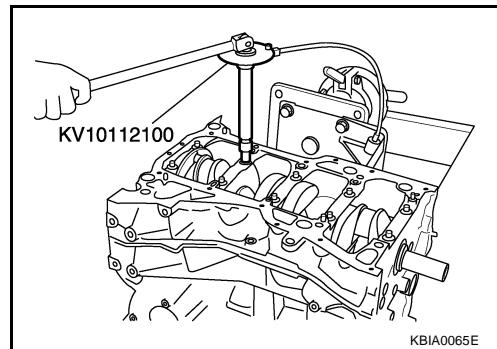
 : 39.2 N·m (4.0 kg·m, 29 ft-lb)



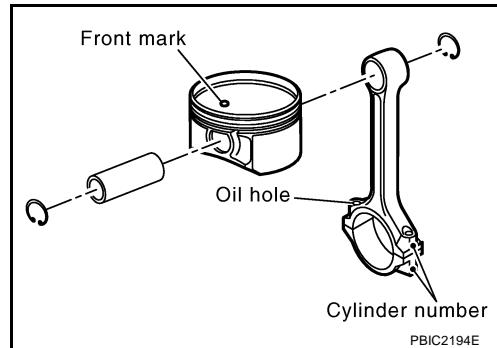
- ii. Turn M10 bolts 60 degrees clockwise (angle tightening) in order from No. 1 to 10 in the figure.

CAUTION:

Check and confirm the tightening angle by using an angle wrench (special service tool) or protractor. Avoid judgment by visual inspection without the tool.



- After installing mounting bolts, make sure that crankshaft can be rotated smoothly by hand.
 - Wipe off completely any protruding liquid gasket on front side of engine.
 - Check crankshaft end play. Refer to [EM-99, "CRANKSHAFT END PLAY"](#).
7. Install piston to connecting rod with the following procedure:
 - a. Using snap ring pliers, install new snap ring to the groove of the piston rear side.
 - Insert it fully into groove to install.
 - b. Assemble piston to connecting rod.
 - Using an industrial drier or similar tool, heat the piston until the 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 oil holes 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.



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

CAUTION:

Be careful not to damage piston.

CYLINDER BLOCK

[QR]

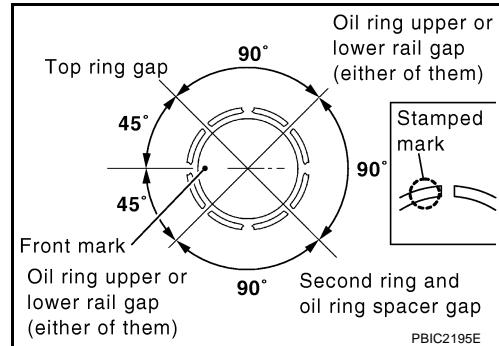
- Position each ring with the gap as shown in the figure referring to the piston front mark.
- Install second ring with the stamped surface facing upward.

Stamped mark:

Top ring : —
Second ring : 2F

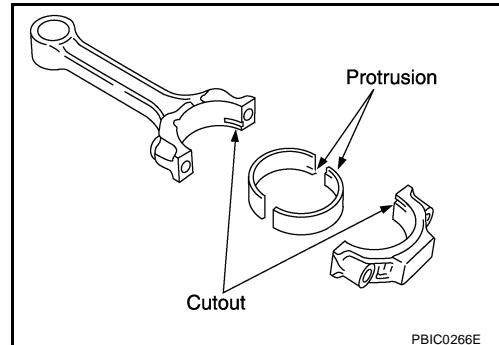
NOTE:

If there is no stamped mark on piston ring, no specific orientation is required for installation.



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

- When installing connecting rod bearings, apply new engine oil to the bearing surface (inside). Do not apply new engine oil to the back surface, but thoroughly clean it.
- When installing, align the connecting rod bearing stopper protrusion with the 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.

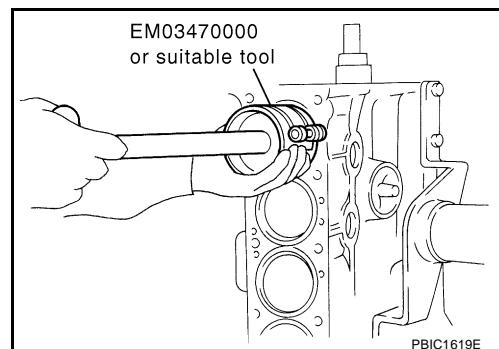


10. Install piston and connecting rod assembly to crankshaft.

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

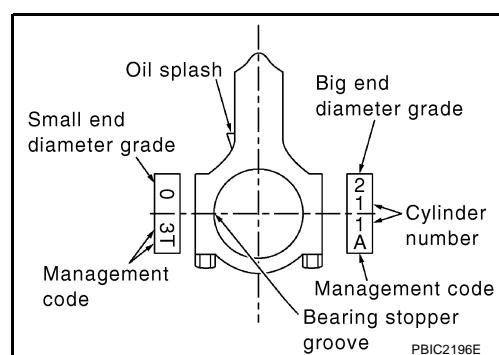
CAUTION:

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



11. Install connecting rod cap.

- Match the stamped cylinder number marks on connecting rod with those on connecting rod cap to install.



12. Tighten connecting rod bolt with the following procedure:

CYLINDER BLOCK

[QR]

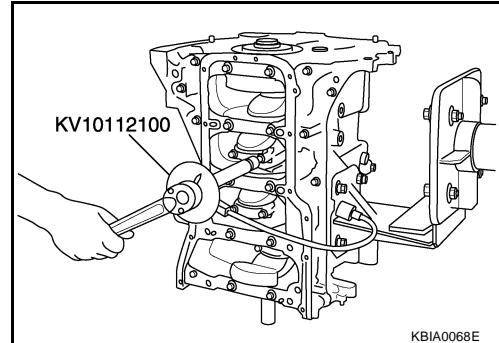
- a. Apply new engine oil to the threads and seats of connecting rod bolts.
- b. Tighten bolts.

 : 19.6 N·m (2.0 kg·m, 14 ft-lb)

- c. Then turn all bolts 90 degrees clockwise (Angle tightening).

CAUTION:

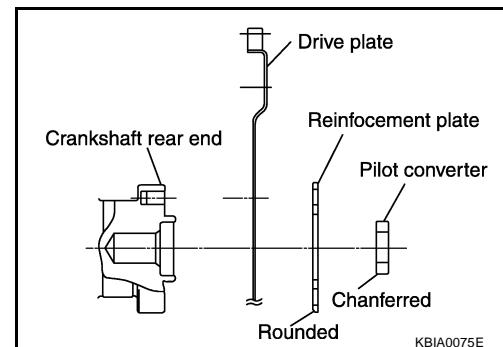
Check and confirm the tightening angle by using an angle wrench (special service tool) or protractor. Avoid judgement by visual inspection without the tool.



- After tightening connecting rod bolt, make sure that crankshaft rotates smoothly.
- Check the connecting rod side clearance. Refer to [EM-99, "CONNECTING ROD SIDE CLEARANCE"](#).

13. Install flywheel (M/T models) or drive plate (A/T models).

- Secure crankshaft with a stopper plate, and tighten mounting bolts crosswise over several times.
- Install drive plate, reinforcement plate and pilot converter as shown in figure (A/T models).
- Using a drift of 33 mm (1.30 in) in diameter, press-fit pilot converter into the end of crankshaft until it stops (A/T models).



14. Install knock sensor.

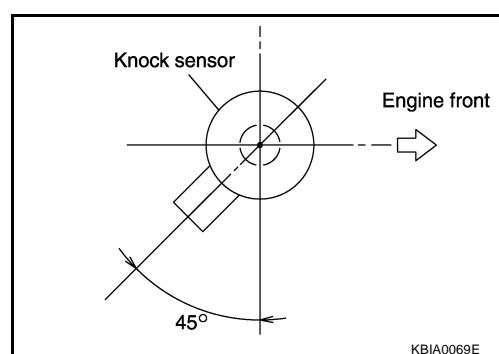
- Install knock sensor with connector facing lower left by 45 degrees as shown in the figure.

CAUTION:

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

NOTE:

- Make sure that there is no foreign material on the cylinder block mating surface and the back surface of knock sensor.
- Make sure that knock sensor does not interfere with other parts.



15. Install crankshaft position sensor (POS).

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

CYLINDER BLOCK

[QR]

How to Select Piston and Bearing DESCRIPTION

EBS00KNV

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 an assembly.)	Piston grade (piston outer diameter)	Piston grade = cylinder bore grade (inner diameter of bore)
Between piston and connecting rod*	—	—	—

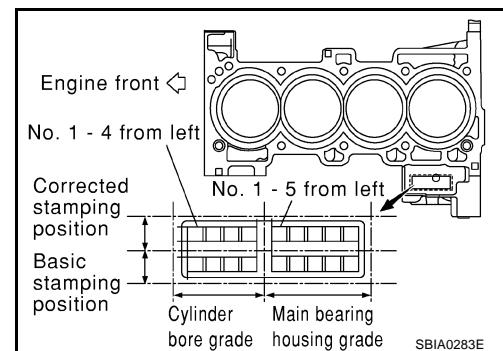
*For the service parts, the grade for fitting cannot be selected between piston pin and connecting rod. (Only grade "0" is available.) The information at the shipment from the plant is described as a reference.

- 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 on rear left side of cylinder block, and select piston of the same grade.
- If there is a corrected stamp mark on the cylinder block, use it as a correct reference.



When Cylinder Block is Reused

1. Measure the cylinder bore inner diameter. Refer to [EM-103, "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.

Piston Selection Table

Unit: mm (in)

Grade number (Mark)	2 (or no mark)	3
Cylinder bore Inner diameter	89.010 - 89.020 (3.5043 - 3.5047)	89.020 - 89.030 (3.5047 - 3.5051)
Piston skirt diameter	88.990 - 89.000 (3.5035 - 3.5039)	89.000 - 89.010 (3.5039 - 3.5043)

NOTE:

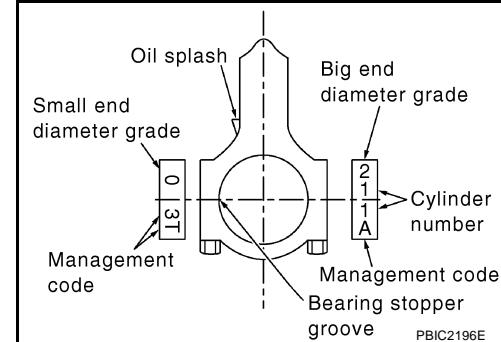
- There is no piston grade "1".
- Piston is available together with piston pin as an assembly.

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

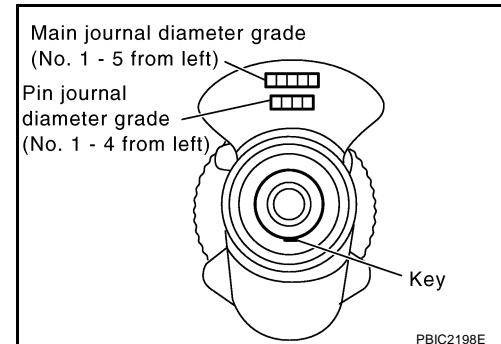
HOW TO SELECT CONNECTING ROD BEARING

When New Connecting Rod and Crankshaft are Used

- Apply connecting rod big end diameter grade stamped on connecting rod side face to the row in the "Connecting Rod Bearing Selection Table".



- Apply crankshaft pin journal diameter grade stamped on crankshaft front side to the column in the "Connecting Rod Bearing Selection Table".



- Read the symbol at the cross point of selected row and column in the "Connecting Rod Bearing Selection Table".
- Apply the symbol obtained to the "Connecting Rod Bearing Grade Table" to select connecting rod bearing.

When Crankshaft and Connecting Rod are Reused

- Measure the dimensions of the connecting rod big end diameter and crankshaft pin journal diameter individually. Refer to [EM-101, "CONNECTING ROD BIG END DIAMETER"](#) and [EM-105, "CRANKSHAFT PIN JOURNAL DIAMETER"](#).
- Apply the measured dimension to the "Connecting Rod Bearing Selection Table".
- Read the symbol at the cross point of selected row and column in the "Connecting Rod Bearing Selection Table".
- Apply the symbol obtained to the "Connecting Rod Bearing Grade Table" to select connecting rod bearing.

CYLINDER BLOCK

[QR]

Connecting Rod Bearing Selection Table

		Mark	Inner diameter Unit: mm (in)												
			0	1	2	3	4	5	6	7	8	9	A	B	C
Connecting rod big end diameter			48.000 - 48.001 (1.8898 - 1.8898)	48.001 - 48.002 (1.8898 - 1.8898)	48.002 - 48.003 (1.8898 - 1.8899)	48.003 - 48.004 (1.8899 - 1.8899)	48.004 - 48.005 (1.8899 - 1.8900)	48.005 - 48.006 (1.8900 - 1.8900)	48.006 - 48.007 (1.8900 - 1.8900)	48.007 - 48.008 (1.8900 - 1.8901)	48.008 - 48.009 (1.8901 - 1.8901)	48.009 - 48.010 (1.8901 - 1.8902)	48.010 - 48.011 (1.8902 - 1.8902)	48.011 - 48.012 (1.8902 - 1.8902)	
Crankshaft pin journal diameter		Mark	Outer diameter Unit: mm (in)												
A	44.974 - 44.973 (1.7706 - 1.7706)	0	0	0	0	0	0	0	0	0	1	1	1	1	1
B	44.973 - 44.972 (1.7706 - 1.7705)	0	0	0	0	0	0	0	0	1	1	1	1	1	1
C	44.972 - 44.971 (1.7705 - 1.7705)	0	0	0	0	0	0	1	1	1	1	1	1	1	1
D	44.971 - 44.970 (1.7705 - 1.7705)	0	0	0	0	0	1	1	1	1	1	1	1	1	1
E	44.970 - 44.969 (1.7705 - 1.7704)	0	0	0	0	1	1	1	1	1	1	1	1	1	2
F	44.969 - 44.968 (1.7704 - 1.7704)	0	0	0	1	1	1	1	1	1	1	1	1	2	2
G	44.968 - 44.967 (1.7704 - 1.7704)	0	0	1	1	1	1	1	1	1	1	1	2	2	2
H	44.967 - 44.966 (1.7704 - 1.7703)	0	1	1	1	1	1	1	1	1	1	2	2	2	2
J	44.966 - 44.965 (1.7703 - 1.7703)	1	1	1	1	1	1	1	1	2	2	2	2	2	2
K	44.965 - 44.964 (1.7703 - 1.7702)	1	1	1	1	1	1	1	1	2	2	2	2	2	2
L	44.964 - 44.963 (1.7702 - 1.7702)	1	1	1	1	1	1	1	2	2	2	2	2	2	2
M	44.963 - 44.962 (1.7702 - 1.7702)	1	1	1	1	1	2	2	2	2	2	2	2	2	2
N	44.962 - 44.961 (1.7702 - 1.7701)	1	1	1	1	2	2	2	2	2	2	2	2	2	3
P	44.961 - 44.960 (1.7701 - 1.7701)	1	1	1	2	2	2	2	2	2	2	2	2	3	3
R	44.960 - 44.959 (1.7701 - 1.7700)	1	1	2	2	2	2	2	2	2	2	2	3	3	3
S	44.959 - 44.958 (1.7700 - 1.7700)	1	2	2	2	2	2	2	2	2	2	3	3	3	3
T	44.958 - 44.957 (1.7700 - 1.7700)	2	2	2	2	2	2	2	2	2	3	3	3	3	3
U	44.957 - 44.956 (1.7700 - 1.7699)	2	2	2	2	2	2	2	2	3	3	3	3	3	3

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Connecting Rod Bearing Grade Table

Unit: mm (in)

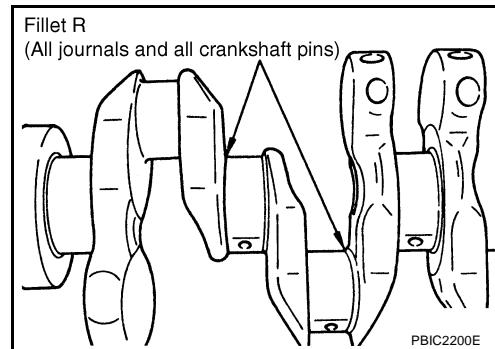
Grade number	0	1	2	3
Thickness	1.495 - 1.499 (0.0589 - 0.0590)	1.499 - 1.503 (0.0590 - 0.0592)	1.503 - 1.507 (0.0592 - 0.0593)	1.507 - 1.511 (0.0593 - 0.0595)
Identification color	Black	Brown	Green	Yellow

Undersize Bearings Usage Guide

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

CAUTION:

In grinding crankshaft pin to use undersize bearings, keep the fillet R [1.5 - 1.7 mm (0.059 - 0.067 in)].

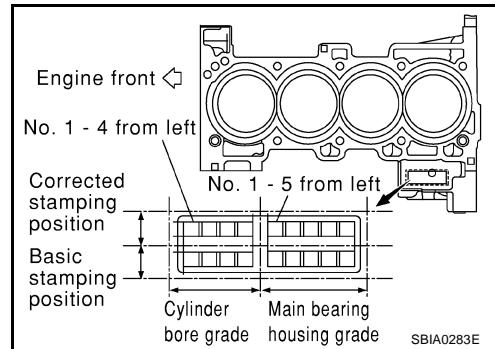
**Bearing undersize table**

Unit: mm (in)

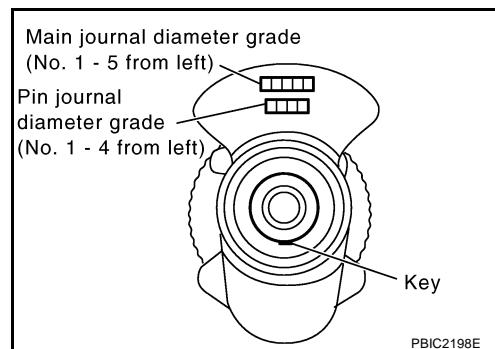
Size	Thickness
US 0.25 (0.0098)	1.624 - 1.632 (0.0639 - 0.0643)

HOW TO SELECT MAIN BEARING**When New Cylinder Block and Crankshaft are Used**

1. "Main Bearing Selection Table" rows correspond to main bearing housing grade on rear left side of cylinder block.
 - If there is a corrected stamp mark on cylinder block, use it as a correct reference.



2. Apply main journal diameter grade stamped on crankshaft front side to column in the "Main Bearing Selection Table".



3. Read the symbol at the cross point of selected row and column in the "Main Bearing Selection Table".

CAUTION:

There are two main bearing selection tables. One is for odd-numbered journals (No. 1, 3 and 5) and the other is for even-numbered journals (No. 2 and 4). Make certain to use the appropriate table. This is due to differences in the specified clearances.

4. Apply the symbol obtained to the "Main Bearing Grade Table" to select main bearing.

NOTE:

Service part is available as a set of both upper and lower.

When Cylinder Block and Crankshaft are Reused

1. Measure the dimensions of the cylinder block main bearing housing inner diameter and crankshaft main journal diameter individually. Refer to [EM-103, "MAIN BEARING HOUSING INNER DIAMETER"](#) and [EM-104, "CRANKSHAFT MAIN JOURNAL DIAMETER"](#).

CYLINDER BLOCK

[QR]

2. Apply the measured dimension to the "Main Bearing Selection Table".
3. Read the symbol at the cross point of selected row and column in the "Main Bearing Selection Table".

CAUTION:

There are two main bearing selection tables. One is for odd-numbered journals (No. 1, 3 and 5) and the other is for even-numbered journals (No. 2 and 4). Make certain to use the appropriate table. This is due to differences in the specified clearances.

4. Apply the symbol obtained to the "Main Bearing Grade Table" to select main bearing.

NOTE:

Service part is available as a set of both upper and lower.

Main Bearing Selection Table (No. 1, 3 and 5 journals)

		Cylinder block main bearing housing inner diameter	Mark	A	B	C	D	E	F	G	H	J	K	L	M	N	P	R	S	T	U	V	W	X	Y	4	7
Mark	Outer diameter Unit: mm (in)	Inner diameter Unit: mm (in)																									
A	54.979 - 54.978 (2.1645 - 2.1645)	0 0 01 01 01 1 1 1 12 12 12 12 2 2 2 23 23 23 3 3 3 34 34 4 4 4 45 45 45	58.944 - 58.945 (2.3206 - 2.3207)	58.945 - 58.946 (2.3207 - 2.3207)	58.946 - 58.947 (2.3207 - 2.3207)	58.947 - 58.948 (2.3207 - 2.3208)	58.948 - 58.949 (2.3208 - 2.3208)	58.949 - 58.950 (2.3208 - 2.3209)	58.950 - 58.951 (2.3209 - 2.3209)	58.951 - 58.952 (2.3209 - 2.3209)	58.952 - 58.953 (2.3209 - 2.3210)	58.953 - 58.954 (2.3210 - 2.3210)	58.954 - 58.955 (2.3210 - 2.3211)	58.955 - 58.956 (2.3211 - 2.3211)	58.956 - 58.957 (2.3211 - 2.3211)	58.957 - 58.958 (2.3211 - 2.3212)	58.958 - 58.959 (2.3212 - 2.3212)	58.959 - 58.960 (2.3212 - 2.3213)	58.960 - 58.961 (2.3213 - 2.3213)	58.961 - 58.962 (2.3213 - 2.3213)	58.962 - 58.963 (2.3213 - 2.3214)	58.963 - 58.964 (2.3214 - 2.3214)	58.964 - 58.965 (2.3214 - 2.3215)	58.965 - 58.966 (2.3215 - 2.3215)	58.966 - 58.967 (2.3215 - 2.3215)	58.967 - 58.968 (2.3215 - 2.3216)	
B	54.978 - 54.977 (2.1645 - 2.1644)	0 01 01 01 1 1 1 12 12 12 12 2 2 2 23 23 23 3 3 3 34 34 4 4 4 45 45 45																									
C	54.977 - 54.976 (2.1644 - 2.1644)	01 01 01 1 1 1 12 12 12 12 2 2 2 23 23 23 3 3 3 34 34 4 4 4 4 4 4 4 4																									
D	54.976 - 54.975 (2.1644 - 2.1644)	01 01 1 1 1 12 12 12 12 2 2 2 23 23 23 3 3 3 34 34 4 4 4 4 4 4 4 45 45																									
E	54.975 - 54.974 (2.1644 - 2.1643)	01 1 1 1 12 12 12 12 2 2 2 23 23 23 23 3 3 3 34 34 34 34 4 4 4 4 4 45 45 45																									
F	54.974 - 54.973 (2.1643 - 2.1643)	1 1 1 12 12 12 12 2 2 2 23 23 23 23 3 3 3 34 34 34 34 4 4 4 4 4 45 45 45																									
G	54.973 - 54.972 (2.1643 - 2.1642)	1 1 12 12 12 12 2 2 2 23 23 23 23 3 3 3 34 34 34 34 4 4 4 4 45 45 45 5																									
H	54.972 - 54.971 (2.1642 - 2.1642)	1 12 12 12 2 2 2 23 23 23 23 3 3 3 34 34 34 34 4 4 4 4 45 45 45 5 5																									
J	54.971 - 54.970 (2.1642 - 2.1642)	12 12 12 2 2 2 23 23 23 23 3 3 3 34 34 34 34 4 4 4 4 45 45 45 5 5																									
K	54.970 - 54.969 (2.1642 - 2.1641)	12 12 2 2 2 23 23 23 23 3 3 3 34 34 34 34 4 4 4 4 45 45 45 5 5 5 56																									
L	54.969 - 54.968 (2.1641 - 2.1641)	12 2 2 2 23 23 23 23 3 3 3 34 34 34 34 4 4 4 4 45 45 45 5 5 5 56 56 56																									
M	54.968 - 54.967 (2.1641 - 2.1641)	2 2 2 23 23 23 23 3 3 3 34 34 34 34 4 4 4 4 45 45 45 5 5 5 56 56 56																									
N	54.967 - 54.966 (2.1641 - 2.1640)	2 2 23 23 23 23 3 3 3 34 34 34 34 4 4 4 4 45 45 45 5 5 5 56 56 56 6																									
P	54.966 - 54.965 (2.1640 - 2.1640)	2 23 23 23 3 3 3 34 34 34 34 4 4 4 4 45 45 45 5 5 5 56 56 56 6 6																									
R	54.965 - 54.964 (2.1640 - 2.1639)	23 23 23 3 3 3 34 34 34 34 4 4 4 4 45 45 45 5 5 5 56 56 56 6 6																									
S	54.964 - 54.963 (2.1639 - 2.1639)	23 23 3 3 3 34 34 34 34 4 4 4 4 45 45 45 5 5 5 56 56 56 6 6 6 67																									
T	54.963 - 54.962 (2.1639 - 2.1639)	23 3 3 3 34 34 34 34 4 4 4 4 45 45 45 5 5 5 56 56 56 6 6 6 67																									
U	54.962 - 54.961 (2.1639 - 2.1638)	3 3 3 34 34 34 34 4 4 4 4 45 45 45 5 5 5 56 56 56 6 6 6 67																									
V	54.961 - 54.960 (2.1638 - 2.1638)	3 3 34 34 34 34 4 4 4 4 45 45 45 5 5 5 56 56 56 6 6 6 67																									
W	54.960 - 54.959 (2.1638 - 2.1637)	3 34 34 34 4 4 4 4 45 45 45 5 5 5 56 56 56 6 6 6 67																									
X	54.959 - 54.958 (2.1637 - 2.1637)	34 34 34 4 4 4 4 45 45 45 5 5 5 56 56 56 6 6 6 67																									
Y	54.958 - 54.957 (2.1637 - 2.1637)	34 34 4 4 4 45 45 45 5 5 5 56 56 56 6 6 6 67																									
4	54.957 - 54.956 (2.1637 - 2.1636)	34 4 4 45 45 45 5 5 5 56 56 56 6 6 6 67																									
7	54.956 - 54.955 (2.1636 - 2.1636)	4 4 4 45 45 45 5 5 5 56 56 56 6 6 6 67																									

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CYLINDER BLOCK

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Main Bearing Selection Table (No. 2 and 4 journals)

		Cylinder block main bearing housing inner diameter	Mark	A	B	C	D	E	F	G	H	J	K	L	M	N	P	R	S	T	U	V	W	X	Y	4	7
A	54.979 - 54.978 (2.1645 - 2.1645)	0	0	0	0	0	0	0	0	0	0	01	01	01	1	1	1	12	12	12	2	2	23	23	23	3	
B	54.978 - 54.977 (2.1645 - 2.1644)	0	0	0	0	0	0	0	0	0	0	01	01	01	1	1	1	12	12	12	2	2	23	23	3	3	
C	54.977 - 54.976 (2.1644 - 2.1644)	0	0	0	0	0	0	0	01	01	01	1	1	1	1	1	1	12	12	12	2	2	23	23	3	3	
D	54.976 - 54.975 (2.1644 - 2.1644)	0	0	0	0	0	0	01	01	01	1	1	1	1	12	12	12	2	2	23	23	3	3	3	34		
E	54.975 - 54.974 (2.1644 - 2.1643)	0	0	0	0	01	01	01	1	1	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34		
F	54.974 - 54.973 (2.1643 - 2.1643)	0	0	0	01	01	01	1	1	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34			
G	54.973 - 54.972 (2.1643 - 2.1642)	0	0	01	01	01	1	1	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	4			
H	54.972 - 54.971 (2.1642 - 2.1642)	0	01	01	01	1	1	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	4	4			
J	54.971 - 54.970 (2.1642 - 2.1642)	01	01	01	1	1	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	4	4	4			
K	54.970 - 54.969 (2.1642 - 2.1641)	01	01	1	1	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	4	4	4	45			
L	54.969 - 54.968 (2.1641 - 2.1641)	01	1	1	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45		
M	54.968 - 54.967 (2.1641 - 2.1641)	1	1	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45			
N	54.967 - 54.966 (2.1641 - 2.1640)	1	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45	5			
P	54.966 - 54.965 (2.1640 - 2.1640)	1	12	12	12	2	2	2	23	23	23	3	3	3	3	34	34	34	4	4	4	45	45	5	5		
R	54.965 - 54.964 (2.1640 - 2.1639)	12	12	12	2	2	2	23	23	23	3	3	3	3	34	34	34	4	4	4	4	45	45	5	5		
S	54.964 - 54.963 (2.1639 - 2.1639)	12	12	2	2	2	23	23	23	3	3	3	3	34	34	34	4	4	4	4	45	45	5	5	56		
T	54.963 - 54.962 (2.1639 - 2.1639)	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	4	45	45	45	5	5	56	56		
U	54.962 - 54.961 (2.1639 - 2.1638)	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	4	45	45	45	5	5	56	56	56		
V	54.961 - 54.960 (2.1638 - 2.1638)	2	2	23	23	23	3	3	3	34	34	34	4	4	4	4	45	45	45	5	5	56	56	56	6		
W	54.960 - 54.959 (2.1638 - 2.1637)	2	23	23	23	3	3	3	34	34	34	4	4	4	4	45	45	45	5	5	56	56	56	6	6		
X	54.959 - 54.958 (2.1637 - 2.1637)	23	23	23	3	3	3	34	34	34	4	4	4	4	45	45	45	5	5	56	56	56	6	6	67		
Y	54.958 - 54.957 (2.1637 - 2.1637)	23	23	3	3	34	34	34	4	4	4	4	45	45	45	5	5	56	56	56	6	6	6	67			
4	54.957 - 54.956 (2.1637 - 2.1636)	23	3	3	34	34	34	4	4	4	4	45	45	45	5	5	56	56	56	6	6	6	67	67			
7	54.956 - 54.955 (2.1636 - 2.1636)	3	3	3	34	34	34	4	4	4	4	45	45	45	5	5	56	56	56	6	6	67	67	67			

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A

C

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G

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M

EM

F

J

L

CYLINDER BLOCK

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Main Bearing Grade Table (All Journals)

Unit: mm (in)

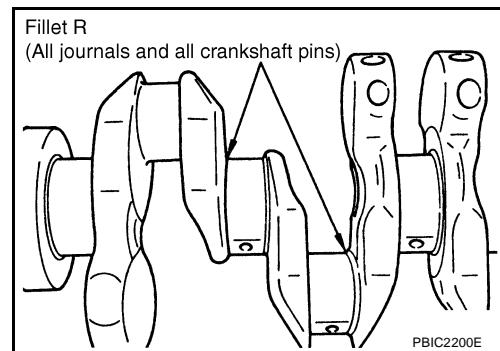
Grade number		Thickness	Identification color	Remarks
0		1.973 - 1.976 (0.0777 - 0.0778)	Black	Grade and color are the same for upper and lower bearings.
1		1.976 - 1.979 (0.0778 - 0.0779)	Brown	
2		1.979 - 1.982 (0.0779 - 0.0780)	Green	
3		1.982 - 1.985 (0.0780 - 0.0781)	Yellow	
4		1.985 - 1.988 (0.0781 - 0.0783)	Blue	
5		1.988 - 1.991 (0.0783 - 0.0784)	Pink	
6		1.991 - 1.994 (0.0784 - 0.0785)	Purple	
7		1.994 - 1.997 (0.0785 - 0.0786)	White	
01	UPR	1.973 - 1.976 (0.0777 - 0.0778)	Black	Grade and color are different for upper and lower bearings.
	LWR	1.976 - 1.979 (0.0778 - 0.0779)	Brown	
12	UPR	1.976 - 1.979 (0.0778 - 0.0779)	Brown	
	LWR	1.979 - 1.982 (0.0779 - 0.0780)	Green	
23	UPR	1.979 - 1.982 (0.0779 - 0.0780)	Green	
	LWR	1.982 - 1.985 (0.0780 - 0.0781)	Yellow	
34	UPR	1.982 - 1.985 (0.0780 - 0.0781)	Yellow	
	LWR	1.985 - 1.988 (0.0781 - 0.0783)	Blue	
45	UPR	1.985 - 1.988 (0.0781 - 0.0783)	Blue	
	LWR	1.988 - 1.991 (0.0783 - 0.0784)	Pink	
56	UPR	1.988 - 1.991 (0.0783 - 0.0784)	Pink	
	LWR	1.991 - 1.994 (0.0784 - 0.0785)	Purple	
67	UPR	1.991 - 1.994 (0.0784 - 0.0785)	Purple	
	LWR	1.994 - 1.997 (0.0785 - 0.0786)	White	

Use Undersize Bearing Usage Guide

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

CAUTION:

In grinding crankshaft main journal to use undersize bearings, keep fillet R [1.5 - 1.7 mm (0.059 - 0.067 in)].



Bearing undersize table

Unit: mm (in)

Size	Thickness
US 0.25 (0.0098)	2.106 - 2.114 (0.0829 - 0.0832)

Inspection After Disassembly

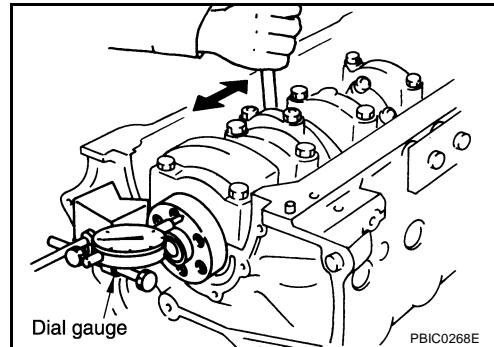
CRANKSHAFT END PLAY

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

Standard : 0.10 - 0.26 mm (0.0039 - 0.0102 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.



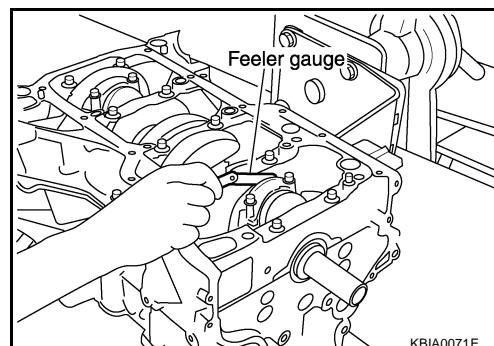
CONNECTING ROD SIDE CLEARANCE

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

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

Limit : 0.50 mm (0.0197 in)

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

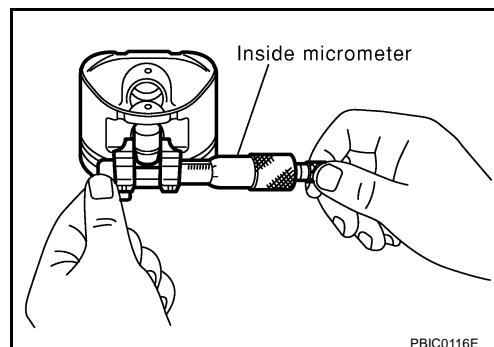


PISTON TO PISTON PIN OIL CLEARANCE

Piston Pin Hole Diameter

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

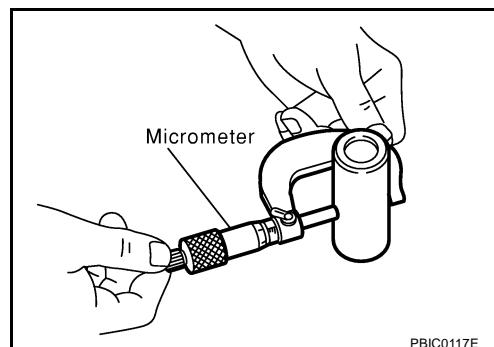
Standard: 19.993 - 20.005 mm (0.7871 - 0.7876 in)



Piston Pin Outer Diameter

Measure the outer diameter of piston pin with a micrometer.

Standard: 19.989 - 20.001 mm (0.7870 - 0.7874 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 oil clearance is out of the standard, replace piston and piston pin assembly.

- When replacing piston and piston pin assembly, refer to [EM-103, "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 grades can be selected. (Only grade "0" is available.)

PISTON RING SIDE CLEARANCE

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

Standard:

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

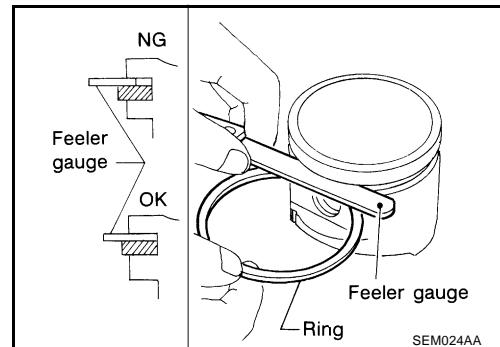
2nd ring : 0.030 - 0.070 mm (0.0012 - 0.0028 in)

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

Limit:

Top ring : 0.11 mm (0.0043 in)

2nd ring : 0.10 mm (0.0039 in)



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

PISTON RING END GAP

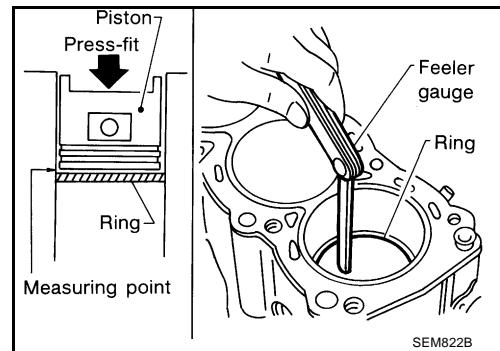
- Make sure that cylinder bore inner diameter is within specification. Refer to [EM-103, "Cylinder Bore Inner Diameter"](#).
- Lubricate with new engine oil to piston and piston ring, and then insert piston ring until middle of cylinder with piston, and measure piston ring end gap with a feeler gauge.

Standard:

Top ring : 0.21 - 0.31 mm (0.0083 - 0.0122 in)

2nd ring : 0.32 - 0.47 mm (0.0126 - 0.0185 in)

Oil ring : 0.20 - 0.60 mm (0.0079 - 0.0236 in)
(rail ring)

**Limit:**

Top ring : 0.54 mm (0.0213 in)

2nd ring : 0.67 mm (0.0264 in)

Oil ring : 0.95 mm (0.0374 in)
(rail ring)

- If the measured value exceeds the limit, replace piston ring, and measure again. If it still exceeds the limit, re-bore cylinder and use oversized piston and piston rings.

CONNECTING ROD BEND AND TORSION

- Check with a connecting rod aligner.

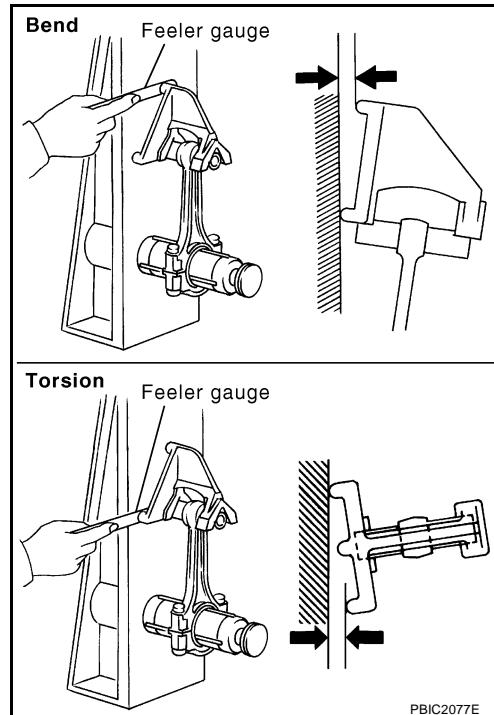
Bend:

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

Torsion:

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

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

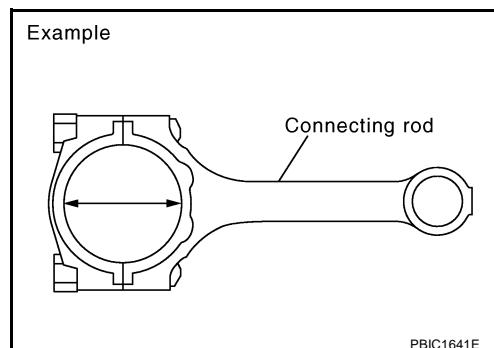


CONNECTING ROD BIG END DIAMETER

- Install connecting rod cap without connecting rod bearing installed, and tightening connecting rod bolts to the specified torque. Refer to [EM-87, "ASSEMBLY"](#) for the tightening procedure.
- Measure the inner diameter of connecting rod big end with an inside micrometer.

Standard: 48.000 - 48.013 mm (1.8898 - 1.8903 in)

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

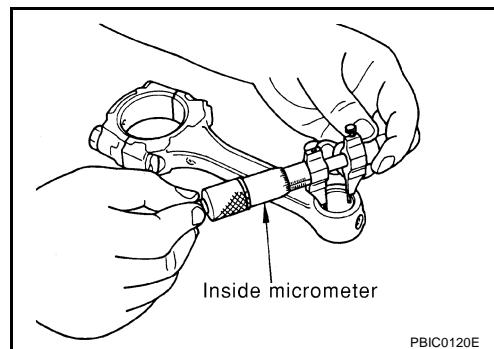


CONNECTING ROD BUSHING OIL CLEARANCE

Connecting Rod Bushing Inner Diameter

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

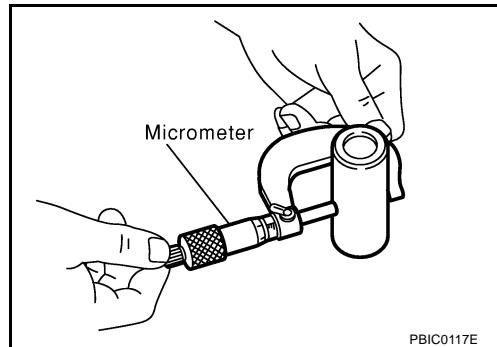
Standard: 20.000 - 20.012 mm (0.7874 - 0.7879 in)



Piston Pin Outer Diameter

Measure the outer diameter of piston pin with a micrometer.

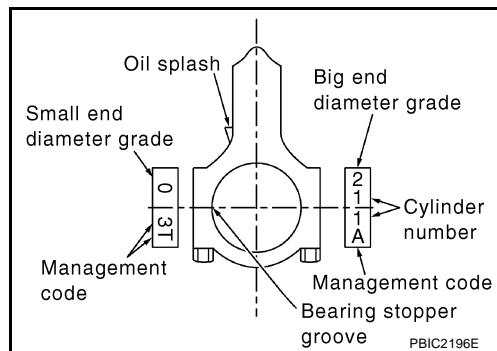
Standard: 19.989 - 20.001 mm (0.7870 - 0.7874 in)

**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)

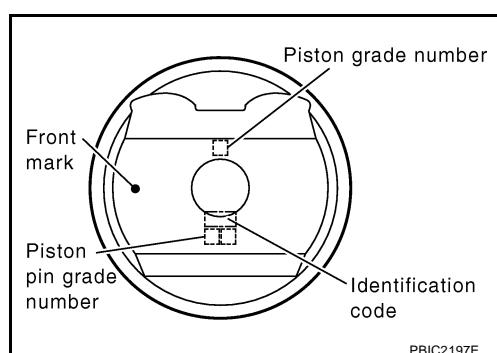
- If the measured value is out of the standard, replace connecting rod assembly and/or piston and piston pin assembly.
- If replacing piston and piston pin assembly, refer to [EM-103, "PISTON TO CYLINDER BORE CLEARANCE"](#).
- If replacing connecting rod assembly, refer to [EM-105, "CONNECTING ROD BEARING OIL CLEARANCE"](#) to select connecting rod bearing.

**Factory installed parts grading:**

- Service parts apply only to grade "0".

Grade	0	1
Connecting rod bushing inner diameter*	20.000 - 20.006 (0.7874 - 0.7876)	20.006 - 20.012 (0.7876 - 0.7879)
Piston pin hole diameter	19.993 - 19.999 (0.7871 - 0.7874)	19.999 - 20.005 (0.7874 - 0.7876)
Piston pin outer diameter	19.989 - 19.995 (0.7870 - 0.7872)	19.995 - 20.001 (0.7872 - 0.7874)

* : After installing in connecting rod.

**CYLINDER BLOCK DISTORTION**

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

CAUTION:

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

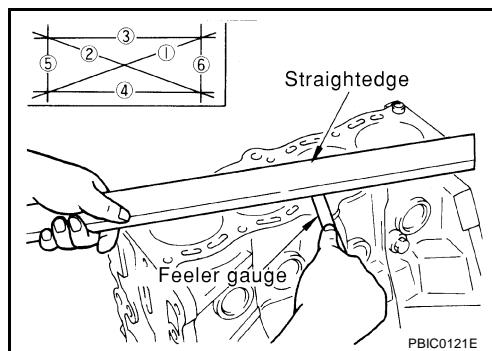
CYLINDER BLOCK

[QR]

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

Limit: 0.1 mm (0.004 in)

- If it exceeds the limit, replace cylinder block.



MAIN BEARING HOUSING INNER DIAMETER

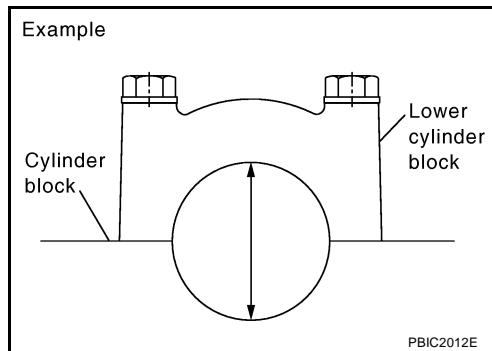
- Install lower cylinder block without main bearings installed, and tighten lower cylinder block mounting bolts to the specified torque. Refer to [EM-87, "ASSEMBLY"](#) for the tightening procedure.
- Measure the inner diameter of main bearing housing with a bore gauge.

Standard: 58.944 - 58.968 mm (2.3206 - 2.3216 in)

- If out of the standard, replace cylinder block and lower cylinder block assembly.

NOTE:

Cylinder block cannot be replaced as a single, because it is machined together with lower cylinder block.



PISTON TO CYLINDER BORE CLEARANCE

Cylinder Bore Inner Diameter

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

NOTE:

When determining cylinder bore grade, measure the cylinder bore at "B" position.

Standard inner diameter:

89.010 - 89.030 mm (3.5043 - 3.5051 in)

Wear limit:

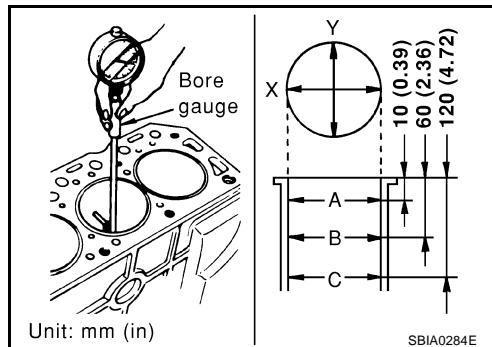
0.2 mm (0.008 in)

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 cylinder inner wall.
- Oversize piston is provided. When using oversize piston, re-bore the 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)

Piston Skirt Diameter

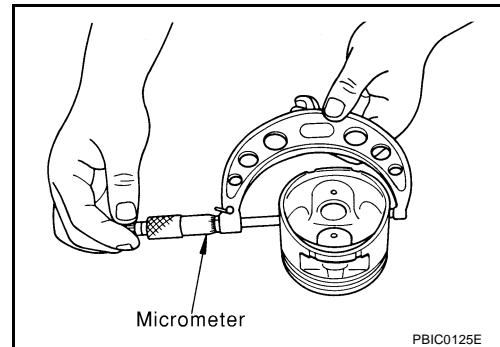
Measure the outer diameter of piston skirt with a micrometer.

Measure point

: Distance from the top 42.0 mm (1.654 in)

Standard

: 88.990 - 89.010 mm (3.5035 - 3.5043 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-92, "HOW TO SELECT PISTON"](#).

Re-boring Cylinder Bore

- 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 diameter as measured

B: Piston - to - cylinder bore clearance (standard value)

C: Honing allowance 0.02 mm (0.0008 in)

- Install lower cylinder block, and tighten mounting bolts to the specified torque. Otherwise, cylinder bores may be distorted in final assembly. Refer to [EM-87, "ASSEMBLY"](#) for the tightening procedure.
- 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.

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

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

NOTE:

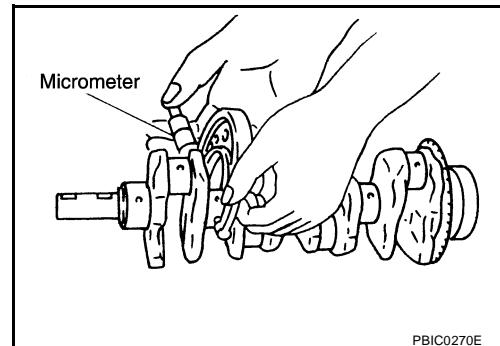
Measurement should be done after cylinder bore cools down.

CRANKSHAFT MAIN JOURNAL DIAMETER

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

Standard: 54.955 - 54.979 mm (2.1636 - 2.1645 in) dia.

- If out of the standard, measure the main bearing oil clearance. Then use undersize bearing. Refer to [EM-106, "MAIN BEARING OIL CLEARANCE"](#).



CRANKSHAFT PIN JOURNAL DIAMETER

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

Standard: 44.956 - 44.974 mm (1.7699-1.7706 in) dia.

- If out of the standard, measure the connecting rod bearing oil clearance. Then use undersize bearing. Refer to [EM-105, "CONNECTING ROD BEARING OIL CLEARANCE"](#).

A

EM

OUT-OF-ROUND AND TAPER OF CRANKSHAFT

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

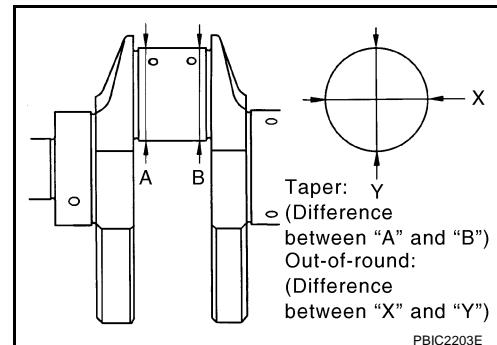
Limit:

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

: 0.005 mm (0.0002 in)

Taper (Difference between "A" and "B")

: 0.005 mm (0.0002 in)



C

D

E

F

G

H

I

J

K

L

M

- If the measured value exceeds the limit, correct or replace crankshaft.
- If corrected, measure the bearing oil clearance of the corrected main journal and/or pin journal. Then select main bearing and/or connecting rod bearing. Refer to [EM-106, "MAIN BEARING OIL CLEARANCE"](#) and/or [EM-105, "CONNECTING ROD BEARING OIL CLEARANCE"](#).

CRANKSHAFT RUNOUT

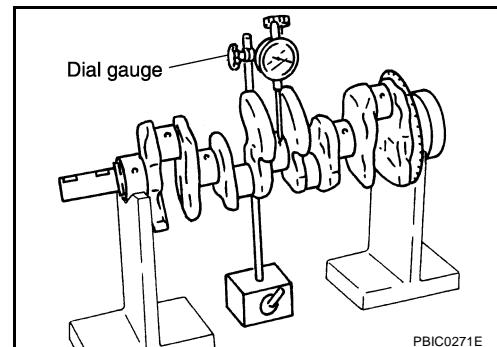
- Place a V-block on a precise flat table to support the journals on the both end of the crankshaft.
- Place a dial gauge straight up on the No. 3 journal.
- While rotating crankshaft, read the movement of the pointer on the dial gauge. (Total indicator reading)

Limit:

QR20DE : 0.03 mm (0.0012 in)

QR25DE : 0.05 mm (0.0020 in)

- If it exceeds the limit, replace crankshaft.



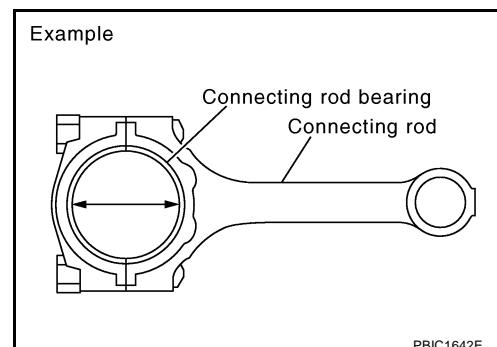
CONNECTING ROD BEARING OIL CLEARANCE

Method by Calculation

- Install connecting rod bearings to connecting rod and cap, and tighten connecting rod bolts to the specified torque. Refer to [EM-87, "ASSEMBLY"](#) for tightening procedure.
- Measure the inner diameter of connecting rod bearing with an inside micrometer.
(Bearing oil clearance) = (Connecting rod bearing inner diameter) - (Crankshaft pin journal diameter)

Standard : 0.028 - 0.045 mm (0.0011 - 0.0018 in)

Limit : 0.10 mm (0.0039 in)



- 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-93, "HOW TO SELECT CONNECTING ROD BEARING"](#).

Method of Using Plastigage

- Remove engine oil and dust on crankshaft pin and the surfaces of each bearing completely.

- Cut a plastigage slightly shorter than the bearing width, and place it in crankshaft axial direction, avoiding oil holes.
- Install connecting rod bearings to connecting rod and cap, and tighten connecting rod bolts to the specified torque. Refer to [EM-87, "ASSEMBLY"](#) for the tightening procedure.

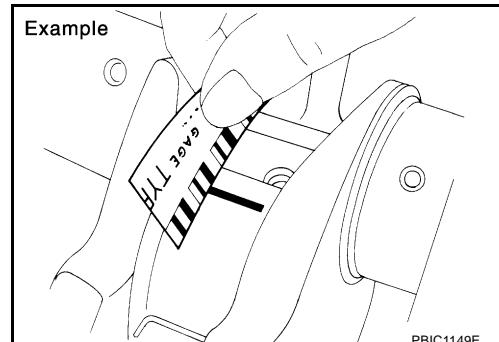
CAUTION:

Do not rotate crankshaft.

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

NOTE:

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

**MAIN BEARING OIL CLEARANCE****Method by Calculation**

- Install main bearings to cylinder block and lower cylinder block, and tighten lower cylinder block mounting bolts to the specified torque. Refer to [EM-87, "ASSEMBLY"](#) for the tightening procedure.
- Measure the inner diameter of main bearing with a bore gauge.
(Bearing oil clearance) = (Main bearing inner diameter) – (Crankshaft main journal diameter)

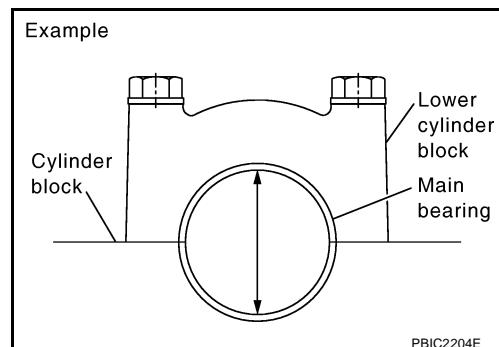
Standard:**No. 1, 3 and 5 journals**

: 0.012 - 0.022 mm (0.0005 - 0.0009 in)

No. 2 and 4 journals

: 0.018 - 0.028 mm (0.0007 - 0.0011 in)

Limit : 0.1 mm (0.004 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-95, "HOW TO SELECT MAIN BEARING"](#).

Method of Using Plastigage

- Remove engine oil and dust on crankshaft main journal and the surfaces of each bearing completely.
- Cut a plastigage slightly shorter than the bearing width, and place it in crankshaft axial direction, avoiding oil holes.
- Install main bearings to cylinder block and lower cylinder block, and tighten lower cylinder block mounting bolts to the specified torque. Refer to [EM-87, "ASSEMBLY"](#) for the tightening procedure.

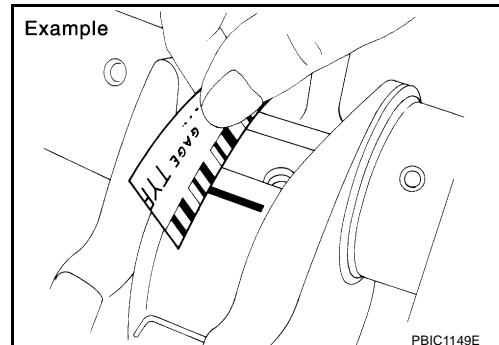
CAUTION:

Do not rotate crankshaft.

- Remove lower cylinder block and bearings, and using the scale on the plastigage bag, measure the plastigage width.

NOTE:

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

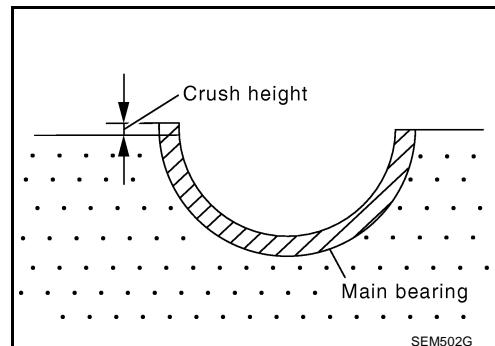


MAIN BEARING CRUSH HEIGHT

- When lower cylinder block is removed after being tightened to the specified torque with main bearings installed, the tip end of bearing must protrude. Refer to [EM-87, "ASSEMBLY"](#) for the tightening procedure.

Standard: There must be crush height.

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

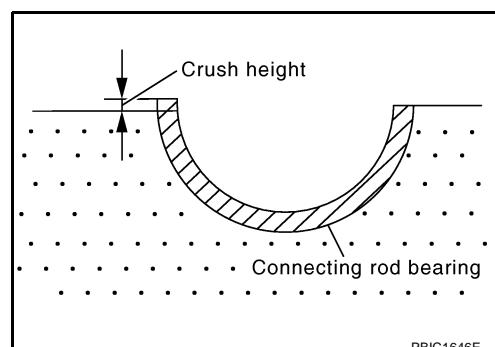


CONNECTING ROD BEARING CRUSH HEIGHT

- When connecting rod bearing cap is removed after being tightened to the specified torque with connecting rod bearings installed, the tip end of bearing must protrude. Refer to [EM-87, "ASSEMBLY"](#) for the tightening procedure.

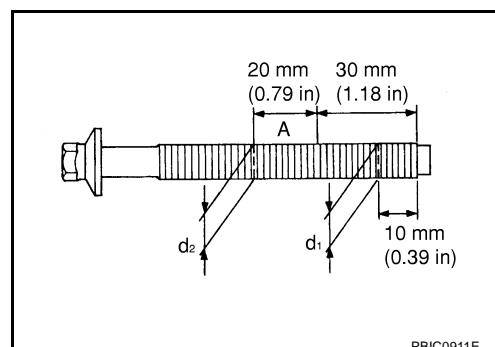
Standard : There must be crush height.

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



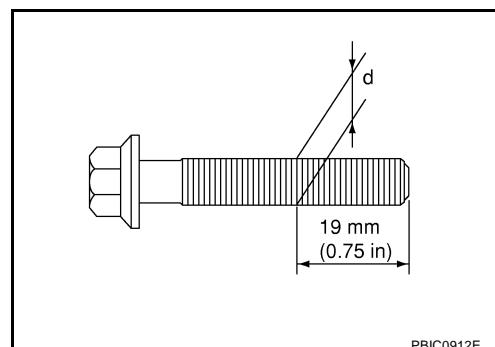
LOWER CYLINDER BLOCK MOUNTING BOLT OUTER DIAMETER

- Perform only with M10 bolts.
 - 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") : 0.13 mm (0.0051 in)**
- If it exceeds the limit (a large difference in dimensions), replace lower cylinder block mounting bolt with a new one.



CONNECTING ROD BOLT OUTER DIAMETER

- Measure the outer diameter "d" at position as shown in the figure.
 - If reduction appears in a position other than "d", regard it as "d".
- Limit : 7.75 mm (0.3051 in)**
- When "d" exceeds the limit (when it becomes thinner), replace connecting rod bolt with a new one.



FLYWHEEL DEFLECTION (M/T MODELS)

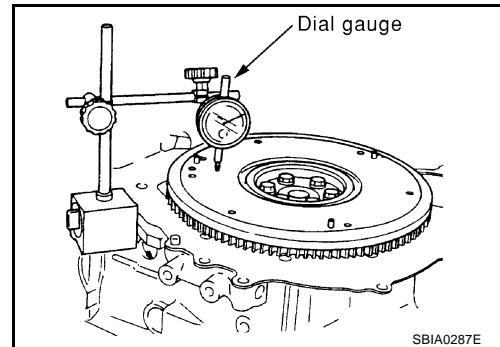
- Measure the deflection of flywheel contact surface to clutch with a dial gauge.
- Measure the deflection at 210 mm (8.27 in) dia.

Standard : 0.45 mm (0.0177 in) or less.

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

CAUTION:

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

**MOVEMENT AMOUNT OF FLYWHEEL (M/T MODELS)****CAUTION:**

Do not disassemble double mass flywheel.

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

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

Standard : 1.3 mm (0.051 in) or less

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

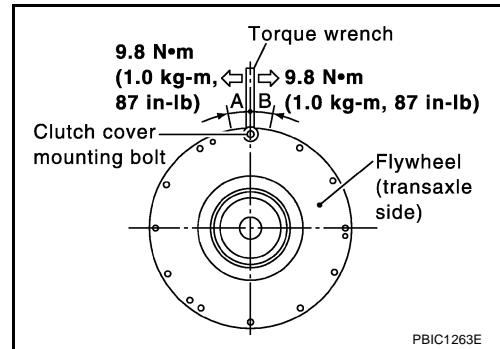
Movement Amount in Radial (Rotation) Direction

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

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

Standard: 28.3 mm (1.114 in) or less.

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



SERVICE DATA AND SPECIFICATIONS (SDS)

[QR]

SERVICE DATA AND SPECIFICATIONS (SDS)

PFP:00030

Standard and Limit

GENERAL SPECIFICATIONS

EBS00KNX

Engine type		QR20DE	QR25DE	EM
Cylinder arrangement			In-line 4	
Displacement	cm ³ (cu in)	1,998 (121.92)	2,488 (151.82)	
Bore and stroke	mm (in)	89.0 x 80.3 (3.504 x 3.161)	89.0 x 100.0 (3.504 x 3.937)	
Valve arrangement			DOHC	C
Firing order			1-3-4-2	D
Number of piston rings	Compression		2	E
	Oil		1	
Compression ratio		9.0	9.5	
Compression pressure kPa (bar, kg/cm ² , psi) / 250 rpm	Standard	1,190 (11.9, 12.1, 173)	1,250 (12.5, 12.8, 181)	
	Minimum	990 (9.9, 10.1, 144)	1,060 (10.6, 10.8, 154)	F
	Differential limit between cylinders	100 (1.0, 1.0, 14)		

DRIVE BELT

Tension of drive belt	Auto adjustment by auto-tensioner
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INTAKE MANIFOLD AND EXHAUST MANIFOLD

Unit: mm (in)

Items		Limit
	Intake manifold collector (QR25DE)	0.1 (0.004)
Surface distortion	Intake manifold (QR25DE)	0.1 (0.004)
	Exhaust manifold and three way catalyst assembly	0.3 (0.012)

SPARK PLUG

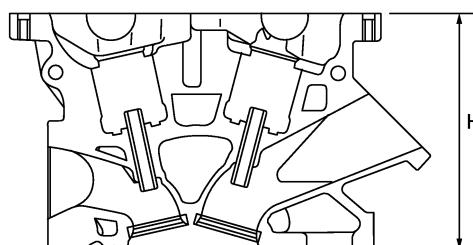
Unit: mm (in)

Make		NGK
Standard type		LFR5A-11
Hot type		LFR4A-11
Cold type		LFR6A-11
Spark plug gap	Standard	1.0 - 1.1 (0.039 - 0.043)

CYLINDER HEAD

Unit: mm (in)

Items		Limit
Head surface distortion		0.1 (0.004)



Nominal cylinder head height:
H = 129.4 mm (5.09 in)

PBIC0283E

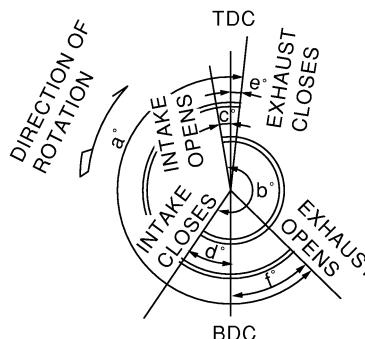
SERVICE DATA AND SPECIFICATIONS (SDS)

[QR]

VALVE

Valve Timing

Unit: degree

Valve timing	 <p>The diagram illustrates the valve timing for both intake and exhaust cycles. It shows the engine's rotation direction with an arrow labeled "DIRECTION OF ROTATION". Key points marked are TDC (Top Dead Center), BDC (Bottom Dead Center), and two intermediate points labeled 'a' and 'b'. The intake cycle is divided into "INTAKE OPENS" and "INTAKE CLOSES". The exhaust cycle is divided into "EXHAUST CLOSES" and "EXHAUST OPENS". The timing parameters are labeled as follows: 'a' is the angle from TDC to the start of intake opening; 'b' is the angle from TDC to the end of intake closing; 'c' is the angle from BDC to the start of exhaust closing; 'd' is the angle from BDC to the end of exhaust opening; and 'e' is the angle from TDC to the end of exhaust closing.</p> <p>PBIC0187E</p>					
Engine type	a	b	c	d	e	f
QR20DE	212	236	-4 (26)	60 (30)	3	29
QR25DE	224	244	0 (30)	64 (27)		41

(): Valve timing control "ON"

Valve Dimensions

Unit: mm (in)

T (Margin thickness)		
	D	T
Valve head diameter "D"	Intake	35.5 - 35.8 (1.398 - 1.409)
	Exhaust	30.5 - 30.8 (1.201 - 1.213)
Valve length "L"	Intake	97.16 (3.8252)
	Exhaust	98.82 (3.8905)
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 Clearance

Unit: mm (in)

Items	Hot	Cold* (reference data)
Intake	0.32 - 0.40 (0.013 - 0.016)	0.24 - 0.32 (0.009 - 0.013)
Exhaust	0.33 - 0.41 (0.013 - 0.016)	0.26 - 0.34 (0.010 - 0.013)

*: Approximately 20°C (68°F)

SERVICE DATA AND SPECIFICATIONS (SDS)

[QR]

Available Valve Lifter

Thickness mm (in)	Identification mark
	EM
	C
	D
	E
	F
	G
	H
	I
	J
	K
	L
	M
6.96 (0.2740)	696
6.98 (0.2748)	698
7.00 (0.2756)	700
7.02 (0.2764)	702
7.04 (0.2772)	704
7.06 (0.2780)	706
7.08 (0.2787)	708
7.10 (0.2795)	710
7.12 (0.2803)	712
7.14 (0.2811)	714
7.16 (0.2819)	716
7.18 (0.2827)	718
7.20 (0.2835)	720
7.22 (0.2843)	722
7.24 (0.2850)	724
7.26 (0.2858)	726
7.28 (0.2866)	728
7.30 (0.2874)	730
7.32 (0.2882)	732
7.34 (0.2890)	734
7.36 (0.2898)	736
7.38 (0.2906)	738
7.40 (0.2913)	740
7.42 (0.2921)	742
744 (0.2929)	744
7.46 (0.2937)	746

Valve Spring

Free height mm (in)	Standard	Intake	44.84 - 45.34 (1.7654 - 1.7850)
		Exhaust	45.28 - 45.78 (1.7827 - 1.8024)
Pressure N (kg, lb) at height mm (in)	Standard	Intake and exhaust	151 - 175 (15.4 - 17.8, 34 - 39) at 35.30 (1.390)
Squareness mm (in)	Limit		1.9 (0.075)

SERVICE DATA AND SPECIFICATIONS (SDS)

[QR]

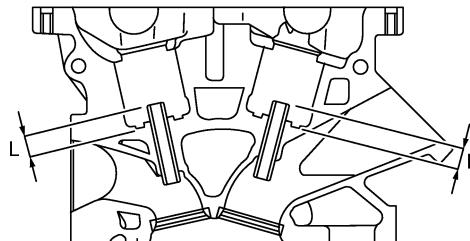
Valve Lifter

Unit: mm (in)

Items	Standard
Valve lifter outer diameter	33.965 - 33.980 (1.3372 - 1.3378)
Valve lifter hole diameter	34.000 - 34.021 (1.3386 - 1.3394)
Valve lifter clearance	0.020 - 0.056 (0.0008 - 0.0022)

Valve Guide

Unit: mm (in)



PBIC0184E

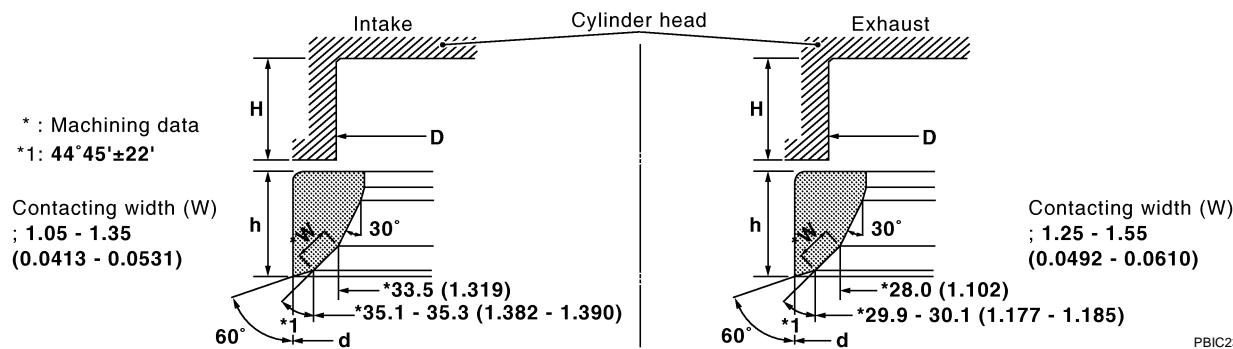
Items	Standard part	Service part
Valve guide	Outer diameter	10.023 - 10.034 (0.3946 - 0.3950)
	Inner diameter (Finished size)	6.000 - 6.018 (0.2362 - 0.2369)
Cylinder head valve guide hole diameter	9.975 - 9.996 (0.3927 - 0.3935)	10.175 - 10.196 (0.4006 - 0.4014)
Interference fit of valve guide		0.027 - 0.059 (0.0011 - 0.0023)
Items	Standard	Limit
Valve guide clearance	Intake	0.020 - 0.053 (0.0008 - 0.0021)
	Exhaust	0.030 - 0.063 (0.0012 - 0.0025)
Projection length "L"	Intake	10.1 - 10.3 (0.398 - 0.406)
	Exhaust	10.0 - 10.4 (0.394 - 0.409)

SERVICE DATA AND SPECIFICATIONS (SDS)

[QR]

Valve Seat

Unit: mm (in)



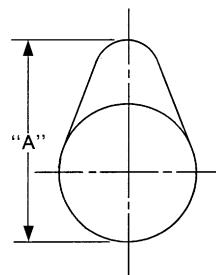
PBIC2397E

Items		Standard	Oversize [0.5 (0.02)] (Service)
Cylinder head seat recess diameter "D"	Intake	36.500 - 36.516 (1.4370 - 1.4376)	37.000 - 37.016 (1.4567 - 1.4573)
	Exhaust	31.500 - 31.516 (1.2402 - 1.2408)	32.000 - 32.016 (1.2598 - 1.2605)
Valve seat outer diameter "d"	Intake	36.597 - 36.613 (1.4408 - 1.4415)	37.097 - 37.113 (1.4605 - 1.4611)
	Exhaust	31.600 - 31.616 (1.2441 - 1.2447)	32.100 - 32.116 (1.2638 - 1.2644)
Valve seat interference fit	Intake	0.081 - 0.113 (0.0032 - 0.0044)	
	Exhaust	0.084 - 0.116 (0.0033 - 0.0046)	
Items		Standard	Service
Height "h"	Intake	5.9 - 6.0 (0.232 - 0.236)	5.0 - 5.1 (0.197 - 0.201)
	Exhaust	5.9 - 6.0 (0.232 - 0.236)	4.91 - 5.01 (0.1933 - 0.1972)
Depth "H"		6.0 (0.236)	

CAMSHAFT AND CAMSHAFT BEARING

Unit: mm (in)

Items		Standard	Limit
Camshaft runout [TIR*]		Less than 0.02 (0.0008)	—



SEM671

Camshaft cam height "A"	Intake	QR20DE	45.015 - 45.205 (1.7722 - 1.7797)	—
		QR25DE	45.665 - 45.855 (1.7978 - 1.8053)	—
	Exhaust	QR20DE	42.825 - 43.015 (1.6860 - 1.6935)	—
		QR25DE	43.975 - 44.165 (1.7313 - 1.7388)	—
Camshaft journal outer diameter	No. 1		27.935 - 27.955 (1.0998 - 1.1006)	—
	No. 2, 3, 4, 5		23.435 - 23.455 (0.9226 - 0.9234)	—
Camshaft bracket inner diameter	No. 1		28.000 - 28.021 (1.1024 - 1.1032)	—
	No. 2, 3, 4, 5		23.500 - 23.521 (0.9252 - 0.9260)	—
Camshaft journal oil clearance	0.045 - 0.086 (0.0018 - 0.0034)			—

SERVICE DATA AND SPECIFICATIONS (SDS)

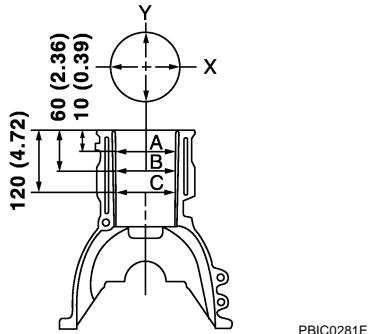
[QR]

Items	Standard	Limit
Camshaft end play	0.115 - 0.188 (0.0045 - 0.0074)	—
Camshaft sprocket runout [TIR*]	—	0.15 (0.0059)

*: Total indicator reading

CYLINDER BLOCK

Unit: mm (in)



PBIC0281E

Surface distortion	Limit		0.1 (0.004)
Cylinder bore	Inner diameter	Standard	Grade No. 2 89.010 - 89.020 (3.5043 - 3.5047)
		Grade No. 3	89.020 - 89.030 (3.5047 - 3.5051)
		Wear limit	0.2 (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			Grade No. A 58.944 - 58.945 (2.3206 - 2.3207) Grade No. B 58.945 - 58.946 (2.3207 - 2.3207) Grade No. C 58.946 - 58.947 (2.3207 - 2.3207) Grade No. D 58.947 - 58.948 (2.3207 - 2.3208) Grade No. E 58.948 - 58.949 (2.3208 - 2.3208) Grade No. F 58.949 - 58.950 (2.3208 - 2.3209) Grade No. G 58.950 - 58.951 (2.3209 - 2.3209) Grade No. H 58.951 - 58.952 (2.3209 - 2.3209) Grade No. J 58.952 - 58.953 (2.3209 - 2.3210) Grade No. K 58.953 - 58.954 (2.3210 - 2.3210) Grade No. L 58.954 - 58.955 (2.3210 - 2.3211) Grade No. M 58.955 - 58.956 (2.3211 - 2.3211) Grade No. N 58.956 - 58.957 (2.3211 - 2.3211) Grade No. P 58.957 - 58.958 (2.3211 - 2.3212) Grade No. R 58.958 - 58.959 (2.3212 - 2.3212) Grade No. S 58.959 - 58.960 (2.3212 - 2.3213) Grade No. T 58.960 - 58.961 (2.3213 - 2.3213) Grade No. U 58.961 - 58.962 (2.3213 - 2.3213) Grade No. V 58.962 - 58.963 (2.3213 - 2.3214) Grade No. W 58.963 - 58.964 (2.3214 - 2.3214) Grade No. X 58.964 - 58.965 (2.3214 - 2.3215) Grade No. Y 58.965 - 58.966 (2.3215 - 2.3215) Grade No. 4 58.966 - 58.967 (2.3215 - 2.3215) Grade No. 7 58.967 - 58.968 (2.3215 - 2.3216)
Difference in inner diameter between cylinders	Standard		Less than 0.03 (0.0012)

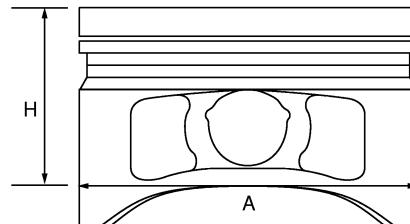
SERVICE DATA AND SPECIFICATIONS (SDS)

[QR]

PISTON, PISTON RING AND PISTON PIN

Available Piston

Unit: mm (in)



PBIC0188E

Piston skirt diameter "A"	Standard	Grade No. 2	88.990 - 89.000 (3.5035 - 3.5039)
		Grade No. 3	89.000 - 89.010 (3.5039 - 3.5043)
		0.20 (0.008) oversize (Service)	89.180 - 89.210 (3.5110 - 3.5122)
Piston height "H" dimension			42.0 (1.654)
Piston pin hole diameter	Grade No. 0		19.993 - 19.999 (0.7871 - 0.7874)
	Grade No. 1		19.999 - 20.005 (0.7874 - 0.7876)
Piston to cylinder bore clearance	Standard		0.010 - 0.030 (0.0004 - 0.0012)
	Limit		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)	0.10 (0.0039)
	Oil ring	0.065 - 0.135 (0.0026 - 0.0053)	—
End gap	Top	0.21 - 0.31 (0.0083 - 0.0122)	0.54 (0.0213)
	2nd	0.32 - 0.47 (0.0126 - 0.0185)	0.67 (0.0264)
	Oil (rail ring)	0.20 - 0.60 (0.0079 - 0.0236)	0.95 (0.0374)

Piston Pin

Unit: mm (in)

Piston pin outer diameter	Grade No. 0	19.989 - 19.995 (0.7870 - 0.7872)
	Grade No. 1	19.995 - 20.001 (0.7872 - 0.7874)
Piston to piston pin oil clearance	Standard	0.002 - 0.006 (0.0001 - 0.0002)
Connecting rod bushing oil clearance	Standard	0.005 - 0.017 (0.0002 - 0.0007)

SERVICE DATA AND SPECIFICATIONS (SDS)

[QR]

CONNECTING ROD

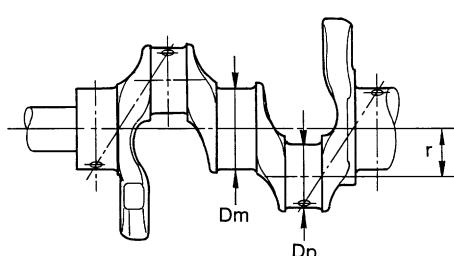
Unit: mm (in)

Center distance	QR20DE	152.85 - 152.95 (6.018 - 6.022)
	QR25DE	143.00 - 143.10 (5.630 - 5.634)
Bend [per 100 (3.94)]	Limit	0.15 (0.0059)
Torsion [per 100 (3.94)]	Limit	0.30 (0.0118)
Connecting rod bushing inner diameter*	Grade No. 0	20.000 - 20.006 (0.7874 - 0.7876)
	Grade No. 1	20.006 - 20.012 (0.7876 - 0.7879)
Side clearance	Standard	0.20 - 0.35 (0.0079 - 0.0138)
	Limit	0.50 (0.0197)
Connecting rod big end diameter	Grade No. 0	48.000 - 48.001 (1.8898 - 1.8898)
	Grade No. 1	48.001 - 48.002 (1.8898 - 1.8898)
	Grade No. 2	48.002 - 48.003 (1.8898 - 1.8899)
	Grade No. 3	48.003 - 48.004 (1.8899 - 1.8899)
	Grade No. 4	48.004 - 48.005 (1.8899 - 1.8900)
	Grade No. 5	48.005 - 48.006 (1.8900 - 1.8900)
	Grade No. 6	48.006 - 48.007 (1.8900 - 1.8900)
	Grade No. 7	48.007 - 48.008 (1.8900 - 1.8901)
	Grade No. 8	48.008 - 48.009 (1.8901 - 1.8901)
	Grade No. 9	48.009 - 48.010 (1.8901 - 1.8902)
	Grade No. A	48.010 - 48.011 (1.8902 - 1.8902)
	Grade No. B	48.011 - 48.012 (1.8902 - 1.8902)
	Grade No. C	48.012 - 48.013 (1.8902 - 1.8903)

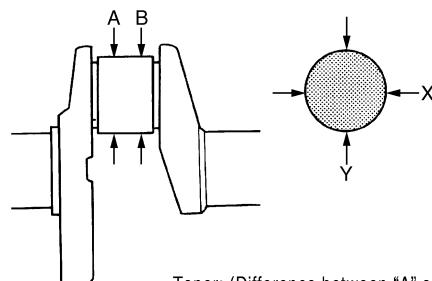
*: After installing in connecting rod

CRANKSHAFT

Unit: mm (in)



SEM645



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

SBIA0535E

Center distance "r"	QR20DE	40.11 - 40.19 (1.5791 - 1.5823)
	QR25DE	49.96 - 50.04 (1.9669 - 1.9701)
Out-of-round (Difference between "X" and "Y")	Limit	0.005 (0.0002)
Taper (Difference between "A" and "B")	Limit	0.005 (0.0002)
Runout [TIR*]	Limit	0.03 (0.0012)
	QR25DE	0.05 (0.0020)
Crankshaft end play	Standard	0.10 - 0.26 (0.0039 - 0.0102)
	Limit	0.30 (0.0118)

SERVICE DATA AND SPECIFICATIONS (SDS)

[QR]

	Grade No. A	44.974 - 44.973 (1.7706 - 1.7706)	A
	Grade No. B	44.973 - 44.972 (1.7706 - 1.7705)	
	Grade No. C	44.972 - 44.971 (1.7705 - 1.7705)	
	Grade No. D	44.971 - 44.970 (1.7705 - 1.7705)	
	Grade No. E	44.970 - 44.969 (1.7705 - 1.7704)	
	Grade No. F	44.969 - 44.968 (1.7704 - 1.7704)	
	Grade No. G	44.968 - 44.967 (1.7704 - 1.7704)	
	Grade No. H	44.967 - 44.966 (1.7704 - 1.7703)	EM
Pin journal diameter grade. "DP"	Grade No. J	44.966 - 44.965 (1.7703 - 1.7703)	C
	Grade No. K	44.965 - 44.964 (1.7703 - 1.7702)	
	Grade No. L	44.964 - 44.963 (1.7702 - 1.7702)	
	Grade No. M	44.963 - 44.962 (1.7702 - 1.7702)	D
	Grade No. N	44.962 - 44.961 (1.7702 - 1.7701)	
	Grade No. P	44.961 - 44.960 (1.7701 - 1.7701)	
	Grade No. R	44.960 - 44.959 (1.7701 - 1.7700)	
	Grade No. S	44.959 - 44.958 (1.7700 - 1.7700)	E
	Grade No. T	44.958 - 44.957 (1.7700 - 1.7700)	
	Grade No. U	44.957 - 44.956 (1.7700 - 1.7699)	
	Grade No. A	54.979 - 54.978 (2.1645 - 2.1645)	F
	Grade No. B	54.978 - 54.977 (2.1645 - 2.1644)	
	Grade No. C	54.977 - 54.976 (2.1644 - 2.1644)	
	Grade No. D	54.976 - 54.975 (2.1644 - 2.1644)	
	Grade No. E	54.975 - 54.974 (2.1644 - 2.1643)	G
	Grade No. F	54.974 - 54.973 (2.1643 - 2.1643)	
	Grade No. G	54.973 - 54.972 (2.1643 - 2.1642)	
	Grade No. H	54.972 - 54.971 (2.1642 - 2.1642)	H
	Grade No. J	54.971 - 54.970 (2.1642 - 2.1642)	
Main journal diameter grade. "Dm"	Grade No. K	54.970 - 54.969 (2.1642 - 2.1641)	
	Grade No. L	54.969 - 54.968 (2.1641 - 2.1641)	
	Grade No. M	54.968 - 54.967 (2.1641 - 2.1641)	
	Grade No. N	54.967 - 54.966 (2.1641 - 2.1640)	I
	Grade No. P	54.966 - 54.965 (2.1640 - 2.1640)	
	Grade No. R	54.965 - 54.964 (2.1640 - 2.1639)	
	Grade No. S	54.964 - 54.963 (2.1639 - 2.1639)	J
	Grade No. T	54.963 - 54.962 (2.1639 - 2.1639)	
	Grade No. U	54.962 - 54.961 (2.1639 - 2.1638)	
	Grade No. V	54.961 - 54.960 (2.1638 - 2.1638)	
	Grade No. W	54.960 - 54.959 (2.1638 - 2.1637)	K
	Grade No. X	54.959 - 54.958 (2.1637 - 2.1637)	
	Grade No. Y	54.958 - 54.957 (2.1637 - 2.1637)	
	Grade No. 4	54.957 - 54.956 (2.1637 - 2.1636)	
	Grade No. 7	54.956 - 54.955 (2.1636 - 2.1636)	L

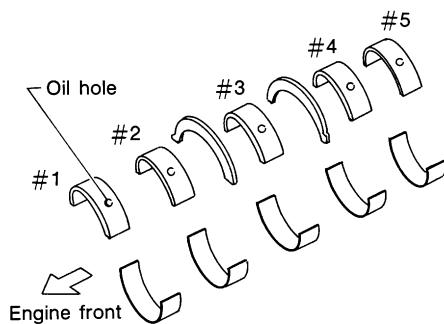
*: Total indicator reading

SERVICE DATA AND SPECIFICATIONS (SDS)

[QR]

MAIN BEARING

Unit: mm (in)



SEM685D

Grade number		Thickness	Identification color	Remarks
0		1.973 - 1.976 (0.0777 - 0.0778)	Black	Grade and color are the same for upper and lower bearings.
1		1.976 - 1.979 (0.0778 - 0.0779)	Brown	
2		1.979 - 1.982 (0.0779 - 0.0780)	Green	
3		1.982 - 1.985 (0.0780 - 0.0781)	Yellow	
4		1.985 - 1.988 (0.0781 - 0.0783)	Blue	
5		1.988 - 1.991 (0.0783 - 0.0784)	Pink	
6		1.991 - 1.994 (0.0784 - 0.0785)	Purple	
7		1.994 - 1.997 (0.0785 - 0.0786)	White	
01	UPR	1.973 - 1.976 (0.0777 - 0.0778)	Black	
	LWR	1.976 - 1.979 (0.0778 - 0.0779)	Brown	
12	UPR	1.976 - 1.979 (0.0778 - 0.0779)	Brown	
	LWR	1.979 - 1.982 (0.0779 - 0.0780)	Green	
23	UPR	1.979 - 1.982 (0.0779 - 0.0780)	Green	Grade and color are different for upper and lower bearings.
	LWR	1.982 - 1.985 (0.0780 - 0.0781)	Yellow	
34	UPR	1.982 - 1.985 (0.0780 - 0.0781)	Yellow	
	LWR	1.985 - 1.988 (0.0781 - 0.0783)	Blue	
45	UPR	1.985 - 1.988 (0.0781 - 0.0783)	Blue	
	LWR	1.988 - 1.991 (0.0783 - 0.0784)	Pink	
56	UPR	1.988 - 1.991 (0.0783 - 0.0784)	Pink	
	LWR	1.991 - 1.994 (0.0784 - 0.0785)	Purple	
67	UPR	1.991 - 1.994 (0.0784 - 0.0785)	Purple	
	LWR	1.994 - 1.997 (0.0785 - 0.0786)	White	

Undersize

Unit: mm (in)

Item	Thickness	Main journal diameter
US 0.25 (0.0098)	2.106 - 2.114 (0.0829 - 0.0832)	Grind so that bearing clearance is the specified value.

Bearing Oil Clearance

Unit: mm (in)

Main bearing oil clearance	Standard	No. 1, 3 and 5	0.012 - 0.022 (0.0005 - 0.0009)
		No. 2 and 4	0.018 - 0.028 (0.0007 - 0.0011)
	Limit		0.1 (0.004)

SERVICE DATA AND SPECIFICATIONS (SDS)

[QR]

CONNECTING ROD BEARING

Grade number	Thickness mm (in)	Identification color
0	1.495 - 1.499 (0.0589 - 0.0590)	Black
1	1.499 - 1.503 (0.0590 - 0.0592)	Brown
2	1.503 - 1.507 (0.0592 - 0.0593)	Green
3	1.507 - 1.511(0.0593 - 0.0595)	Yellow

Undersize

Unit: mm (in)

Item	Thickness	Crank pin journal diameter
US 0.25 (0.0098)	1.624 - 1.632 (0.0639 - 0.0643)	Grind so that bearing clearance is the specified value.

Bearing Oil Clearance

Unit: mm (in)

Connecting rod bearing oil clearance	Standard	0.028 - 0.045 (0.0011 - 0.0018)
	Limit	0.10 (0.0039)

Tightening Torque

EBS00KNY

Unit: N·m (kg·m, ft·lb)

Unit: N·m (kg·m, in·lb)^{*2}

*1: Parts to be tightened in particular orders.

1)-: Order of tightening when tightening two or more times separately.

Auto-tensioner		21.6 (2.2, 16)
Mass air flow sensor		3.8 (0.39, 34) * ²
Resonator		3.8 (0.39, 34)* ²
Air cleaner case lower		3.8 (0.39, 34)* ²
*1 Intake manifold		19.6 (2.0, 14)
Intake manifold collector (QR25DE)		19.6 (2.0, 14)
Intake manifold support (QR20DE)		19.6 (2.0, 14)
Intake manifold support (QR25DE)	M6 bolt	8.83 (0.90, 78) * ²
	M10 bolt	46.6 (4.8, 34)
Intake manifold rear support (QR25DE)		19.6 (2.0, 14)
Electric throttle control actuator		8.43 (0.86, 75) * ²
EVAP canister purge volume control solenoid valve		5.1 (0.52, 45) * ²
*1 Exhaust manifold and three way catalyst assembly		41.7 (4.3, 31)
Exhaust manifold covers (upper and lower)		5.8 (0.59, 51) * ²
Three way catalyst cover		5.8 (0.59, 51) * ²
Heated oxygen sensor 1		45 (4.6, 33)
Heated oxygen sensor 2		45 (4.6, 33)
*1 Oil pan upper	M6 bolt	8.8 (0.90, 78) * ²
	M8 bolt	21.6 (2.2, 16)
Oil pan upper to transaxle joint bolts		42.7 (4.4, 31)
*1 Oil pan lower		6.9 (0.70, 61) * ²
Oil pan drain plug		34.3 (3.5, 25)
Rear plate cover		6.9 (0.70, 61) * ²
Oil level gauge guide		21.6 (2.2, 16)

SERVICE DATA AND SPECIFICATIONS (SDS)

[QR]

Oil strainer	M6 bolt	8.8 (0.90, 78) *2
	M8 bolt	21.6 (2.2, 16)
Ignition coil		6.4 (0.65, 57) *2
Spark plug		24.5 (2.5, 18)
*1 Fuel tube		1) 10.1 (1.0, 7) 2) 23.6 (2.4, 17)
*1 Rocker cover		1) 2.0 (0.20, 18) *2 2) 8.3 (0.85, 73) *2
PCV valve		2.5 (0.26, 22) *2
Intake valve timing control solenoid valve		6.4 (0.65, 57) *2
*1 Intake valve timing control cover		12.8 (1.3, 9)
Camshaft position sensor (PHASE)		6.4 (0.65, 57) *2
Camshaft sprockets (Intake and Exhaust)		142 (14, 105)
Chain tensioner		7.0 (0.71, 62) *2
*1 Camshaft bracket		1) 2.0 (0.2, 1) 2) 5.9 (0.6, 4) 3) 10.4 (1.1, 8)
Crankshaft pulley		1) 42.1 (4.3, 31) 2) 60° (Angle tightening)
*1 Front cover		12.8 (1.3, 9)
Timing chain slack guide		16.7 (1.7, 12)
Timing chain tension guide		16.7 (1.7, 12)
Balancer unit timing chain tensioner		7.0 (0.71, 62) *2
*1 Balancer unit		1) 48.1 (4.9, 35) 2) 90° (Angle tightening) 3) 0 (0, 0) 4) 48.1 (4.9, 35) 5) 90° (Angle tightening)
*1 Cylinder head		1) 5.0 (0.51, 4) 2) 60° (Angle tightening) 3) 0 (0.0, 0) 3) 39.2 (4.0, 29) 4) 75° (Angle tightening) 5) 75° (Angle tightening)
Flywheel (M/T)		108 (11, 80)
Drive plate (A/T)		108 (11, 80)
Connecting rod bearing cap		1) 19.6 (2.0, 14) 2) 90° (Angle tightening)
*1 Lower cylinder block	M8 bolt	1) 25.1 (2.6, 19)
	M10 bolt	2) 39.2 (4.0, 29)
	M10 bolt	3) 60° (Angle tightening)
Signal plate		13.0 (1.3, 10)
Water drain plug		9.8 (1.0, 87) *2

SERVICE DATA AND SPECIFICATIONS (SDS)

[QR]

Knock sensor	21.1 (2.2, 16)	A
Crankshaft position sensor (POS)	6.4 (0.65, 57) *2	
	EM	
	C	
	D	
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	I	
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	M	

PRECAUTIONS

[YD22DDTi]

PRECAUTIONS

PFP:00001

Precautions for Draining Engine Coolant

EBS00LQZ

Drain engine coolant when engine is cooled.

Precautions for Disconnecting Fuel Piping

EBS00LR0

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

Precautions for Removal and Disassembly

EBS00LR1

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

Precautions for Inspection, Repair and Replacement

EBS00LR2

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

Precautions for Assembly and Installation

EBS00LR3

- Use torque wrench to tighten bolts or nuts to specification.
- When tightening nuts and bolts, as a basic rule, equally tighten in several different steps starting with the ones in center, then ones on inside and outside diagonally in this order. If the order of tightening is specified, do exactly as specified.
- Replace with new liquid gasket, packing, oil seal or O-ring.
- 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, engine oil sliding surfaces well.
- Release air within route when refilling after draining coolant.
- After repairing, start engine and increase engine speed to check engine coolant, fuel, engine oil, and exhaust systems for leakage.

Parts Requiring Angle Tightening

EBS00LR4

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

EBS000DW

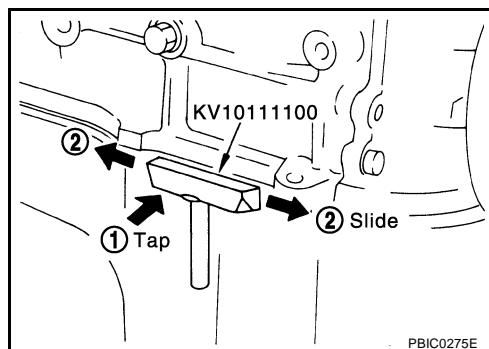
- After removing the mounting bolts and nuts, separate the mating surface using the seal cutter (special service tool) and remove the old liquid gasket sealing.

CAUTION:**Be careful not to damage the mating surfaces.**

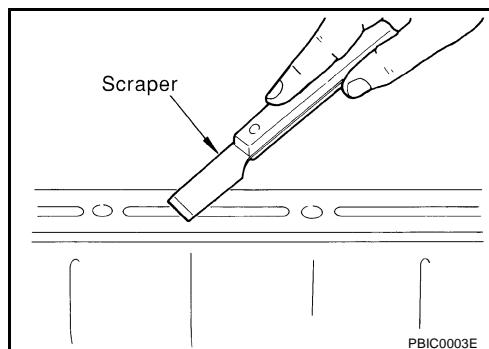
- In areas where the seal cutter (special service tool) is difficult to use, use a plastic hammer to lightly tap (1) the seal cutter where the liquid gasket is applied. Use a plastic hammer to slide the seal cutter (2) by tapping on the side.

CAUTION:

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

**LIQUID GASKET APPLICATION PROCEDURE**

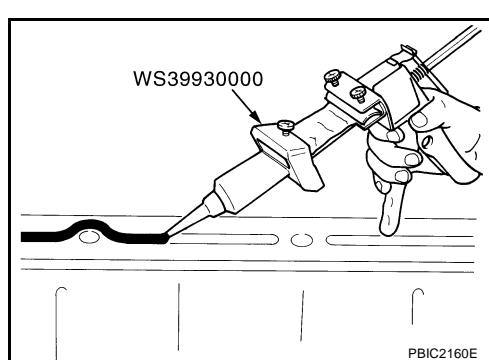
- Using a scraper, remove the old liquid gasket adhering to the liquid gasket application surface and the mating surface.
 - Remove the liquid gasket completely from the groove of the liquid gasket application surface, mounting bolts and bolt holes.
- Wipe the liquid gasket application surface and the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



- Attach the liquid gasket tube to the tube presser (special service tool).

Use Genuine Liquid Gasket or equivalent.

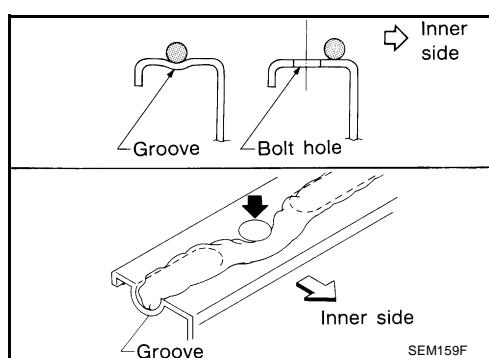
- Apply the liquid gasket without breaks to the specified location with the specified dimensions.
 - If there is a groove for the liquid gasket application, apply the liquid gasket to the groove.



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

CAUTION:

If there are instructions in this manual, observe them.



PREPARATION

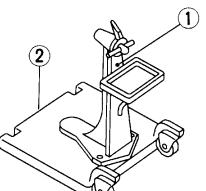
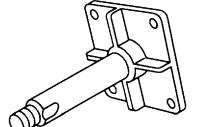
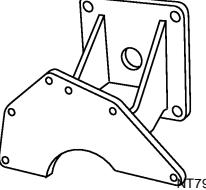
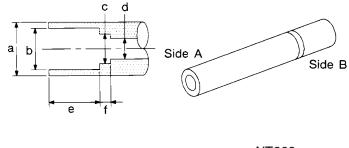
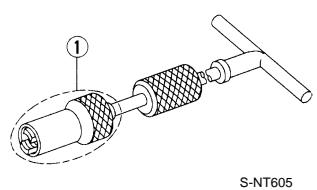
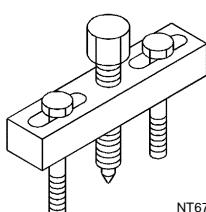
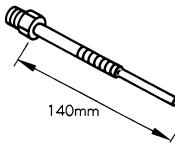
[YD22DDTi]

PREPARATION

PFP:00002

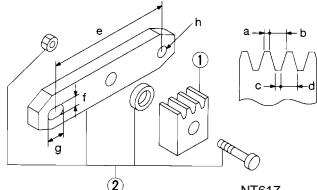
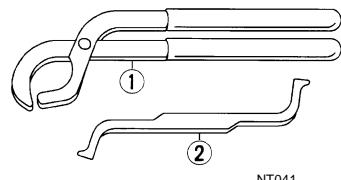
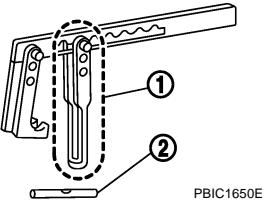
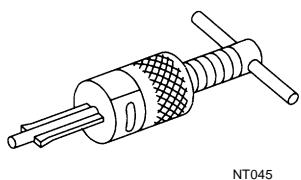
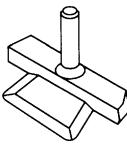
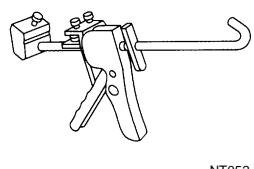
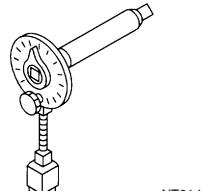
Special Service Tools

EBS00LR6

Tool number Tool name	Description
ST0501S000 Engine stand assembly 1. ST05011000 Engine stand 2. ST05012000 Base	 <p>NT042</p> <p>Disassembling and assembling</p>
KV10106500 Engine stand shaft	 <p>NT028</p>
KV11105900 Engine sub-attachment	 <p>NT799</p> <p>Used with KV10106500</p>
KV10115600 Valve oil seal drift	 <p>NT603</p> <p>Installing valve oil seal Use side A. Side A a: 20 (0.79) dia. b: 13 (0.51) dia. c: 10.3 (0.406) dia. d: 8 (0.31) dia. e: 10.7 (0.421) f: 5 (0.20) Unit: mm (in)</p>
KV10107902 Valve oil seal puller 1. KV10116100 Valve oil seal puller adapter	 <p>S-NT605</p> <p>Removing valve oil seal</p>
KV11103000 Pulley puller	 <p>NT676</p> <p>Removing crankshaft pulley</p>
ED19600610 Compression gauge adapter	 <p>ZZA1188D</p> <p>Checking compression pressure</p>

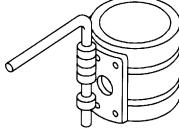
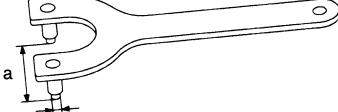
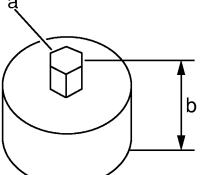
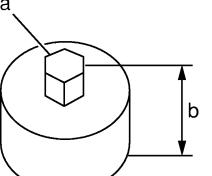
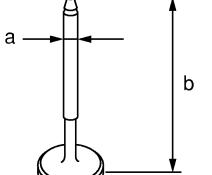
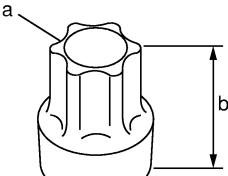
PREPARATION

[YD22DDTi]

Tool number Tool name	Description
KV101056S0 Ring gear stopper 1. KV10105630 Adapter 2. KV10105610 Plate	 <p>Preventing crankshaft from rotating a: 3 (0.12) b: 6.4 (0.252) c: 2.8 (0.110) d: 6.6 (0.260) e: 107 (4.21) f: 14 (0.55) g: 20 (0.79) h: 14 (0.55) dia. Unit: mm (in)</p>
KV101151S0 Lifter stopper set 1. KV10115110 Camshaft pliers 2. KV10115120 Lifter stopper	 <p>Changing adjusting shim</p>
KV10116200 Valve spring compressor 1. KV10115900 Attachment 2. KV10109220 Adapter	 <p>Disassembling and assembling valve mechanism Part (1) is a component of KV10116200, but Part (2) is not so.</p>
ST16610001 Pilot bushing puller	 <p>Removing crankshaft pilot bush</p>
KV10111100 Seal cutter	 <p>Removing steel oil pan and rear chain case, etc.</p>
WS39930000 Tube presser	 <p>Pressing the tube of liquid gasket</p>
KV10112100 Angle wrench	 <p>Tightening bolts for bearing cap, cylinder head, etc.</p>

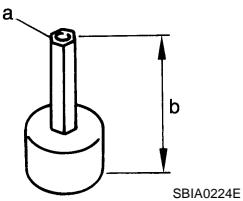
PREPARATION

[YD22DDTi]

Tool number Tool name	Description
EM03470000 Piston ring compressor	Installing piston assembly into cylinder bore  NT044
KV10109300 Pulley holder	Fixing crankshaft pulley a: 68 mm (2.68 in) b: 8 mm (0.31 in) dia.  NT628
KV11106010 Hexagon wrench	Removing and installing chain tensioner a: 5 mm (0.20 in) (Face to face) b: 20 mm (0.79 in)  NT801
KV11106020 Hexagon wrench	Removing and installing slack guide a: 6 mm (0.24 in) (Face to face) b: 20 mm (0.79 in)  NT803
KV11106030 Positioning stopper pin	Fixing fuel pump sprocket a: 6 mm (0.24 in) dia. b: 80 mm (3.15 in)  NT804
KV11106040 TORX wrench	Removing and installing fuel pump sprocket nut a: T70 b: 26 mm (1.02 in)  NT805

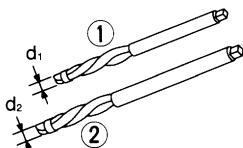
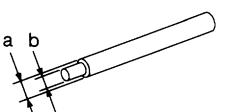
PREPARATION

[YD22DDTi]

Tool number Tool name	Description
KV11106050 Hexagonal wrench	<p>Removing and installing fuel pump sprocket</p> <p>a: 6 mm (0.24 in) (Face to face) b: 42 mm (1.65 in)</p>  <p>SBIA0224E</p>
KV11106060 Sprocket holder	Holding fuel pump sprocket

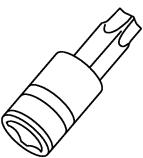
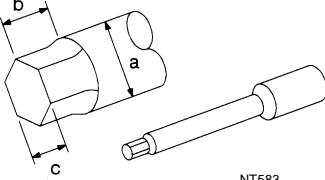
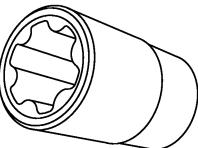
Commercial Service Tools

EBS00LR7

Tool name	Description
Valve seat cutter set	Finishing valve seat dimensions
Piston ring expander	Removing and installing piston ring
Manual lift table caddy	Removing and installing engine
Valve guide reamer	<p>Reaming valve guide with (1) or hole for oversize valve guide with (2)</p> <p>Intake and Exhaust:</p> <p>d₁ = 6.0 mm (0.236 in) dia. d₂ = 10.2 mm (0.402 in) dia.</p>  <p>NT016</p>
Valve guide drift	<p>Removing and installing valve guide</p> <p>Intake and Exhaust:</p> <p>a = 9.5 mm (0.374 in) dia. b = 5.5 mm (0.217 in) dia.</p>  <p>NT015</p>

PREPARATION

[YD22DDTi]

Tool name	Description
Torx socket	<p>Removing and installing flywheel Size: T55</p>  <p>PBIC1113E</p>
Cylinder head bolt wrench	<p>Loosening and tightening cylinder head bolt, and used with angle wrench [SST: KV10112100] a: 13 (0.51) dia. b: 12 (0.47) c: 10 (0.39) Unit: mm (in)</p>  <p>NT583</p>
TORX socket	<p>Loosening and tightening main bearing cap bolt Size: E14</p>  <p>NT807</p>

NOISE, VIBRATION AND HARSHNESS (NVH) TROUBLESHOOTING

PFP:00003

NVH Troubleshooting — Engine Noise

EBS00LR8

A

EM

C

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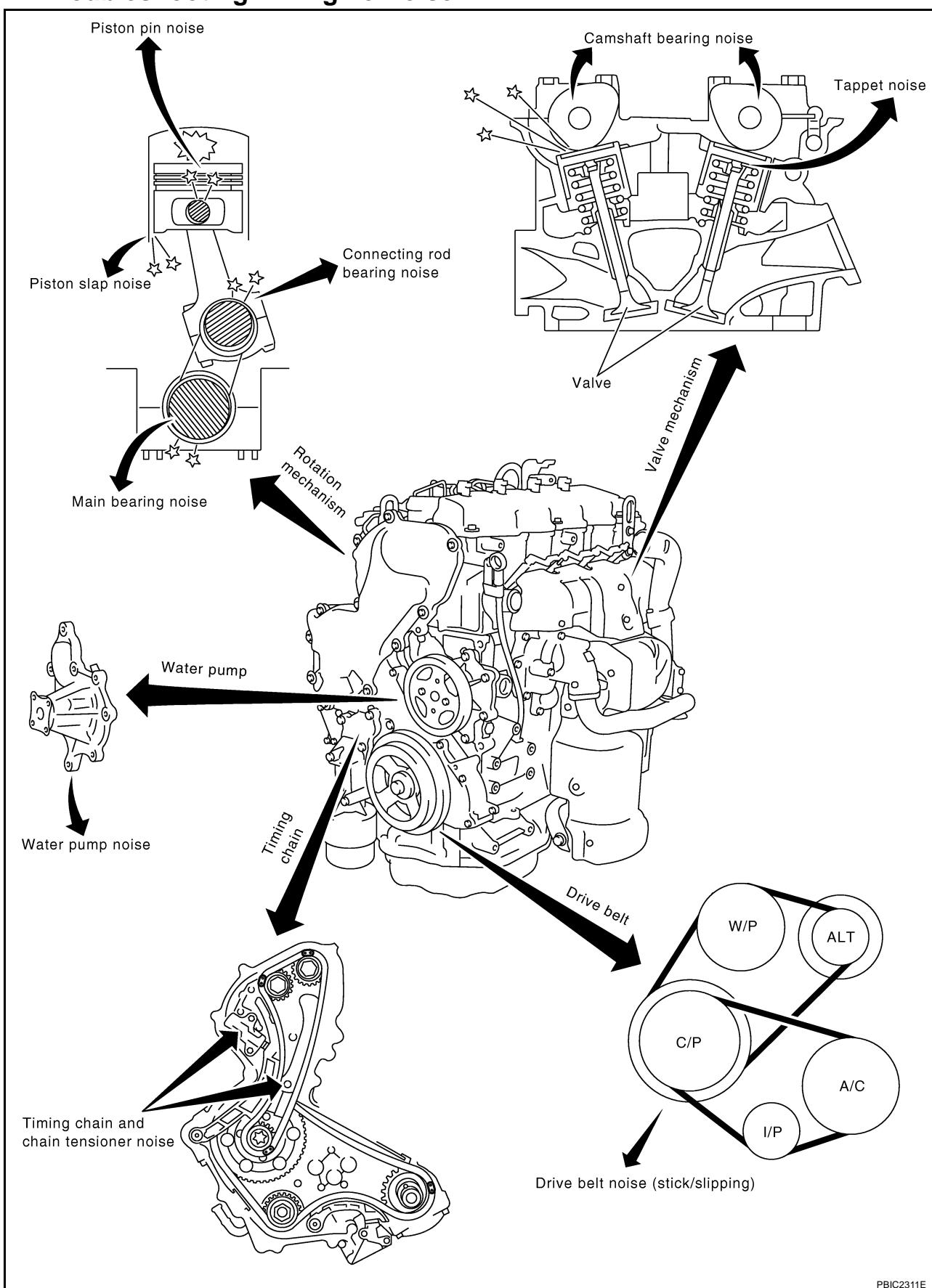
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PBIC2311E

NOISE, VIBRATION AND HARSHNESS (NVH) TROUBLESHOOTING

[YD22DDTi]

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

EBS00LR9

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-175
	Rattle	C	A	—	A	B	C	Camshaft bearing noise	Camshaft oil clearance Camshaft runout	EM-172 EM-171
Crank-shaft pulley Cylinder block (Side of engine) Oil pan	Slap or knock	—	A	—	B	B	—	Piston pin noise	Piston to piston pin clearance Connecting rod bushing oil clearance	EM-226 EM-228
	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-230 EM-227 EM-227 EM-228
	Knock	A	B	C	B	B	B	Connecting rod bearing noise	Connecting rod bushing oil clearance Connecting rod bearing oil clearance (Big end)	EM-228 EM-232
	Knock	A	B	—	A	B	C	Main bearing noise	Main bearing oil clearance Crankshaft runout	EM-233 EM-232
Front of engine Timing chain case	Tapping or ticking	A	A	—	B	B	B	Timing chain and chain tensioner noise	Timing chain cracks and wear Timing chain tensioner operation	EM-180 EM-185
Front of engine	Squeaking or fizzing	A	B	—	B	—	C	Drive belts (Sticking or slipping)	Drive belts deflection	EM-131
	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-42 "WATER PUMP"

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

DRIVE BELTS

PFP:02117

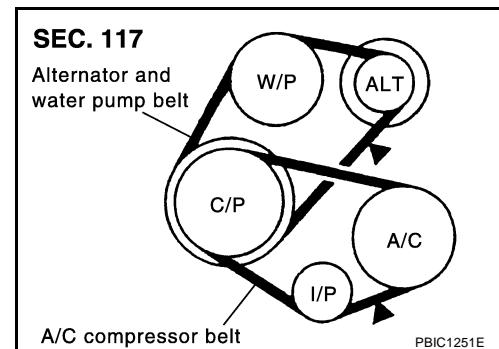
Checking Drive Belts

EBS00LRA

- Before inspecting engine, make sure engine has cooled down; wait approximately 30 minutes after engine has been stopped.
- Visually inspect all belts for wear, damage or cracks on contacting surfaces and edge areas.
- When measuring deflection, apply 98 N (10 kg, 22 lb) at the marked point (▲).

CAUTION:

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



Belt Deflection:

Applied belt	Belt deflection with 98 N (10 kg, 22 lb) force applied* mm (in)		
	New	Adjusted	Limit for re-adjusting
A/C compressor belt	4 - 5 (0.16 - 0.20)	6 - 7 (0.24 - 0.28)	8.5 (0.335)
Alternator and water pump belt	9.0 - 10.5 (0.354 - 0.413)	11.0 - 12.5 (0.433 - 0.492)	16.5 (0.650)

*: When engine is cold.

Tension Adjustment

EBS00LRB

- Adjust belts with the parts shown below.

Applied belt	Belt adjustment method
A/C compressor belt	Adjusting bolt on idler pulley
Alternator and water pump belt	Adjusting bolt on alternator

CAUTION:

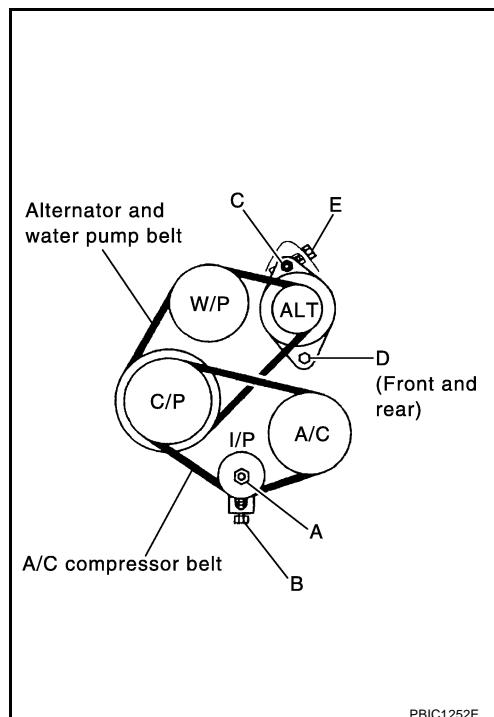
- When a new belt is installed as a replacement, adjust it to the specified value under "New" value because of insufficient adaptability with pulley grooves.
- If the belt deflection of the current belt is out of the "Limit for re-adjusting", adjust to the "Adjusted" value.
- When checking belt deflection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

A/C COMPRESSOR BELT

1. Remove RH engine undercover.
2. Loosen idler pulley lock nut (A).
3. Turn adjusting bolt (B) to adjust. Refer to [EM-131, "Checking Drive Belts"](#).
4. Tighten lock nut (A).

Nut A:

: 31 - 39 N·m (3.1 - 4.0 kg-m, 23 - 28 ft-lb)

**ALTERNATOR AND WATER PUMP BELT**

1. Loosen adjusting lock nut (C).
2. Loosen alternator fixing bolts (D) (each on front and rear).
3. Turn adjusting bolt (E) to adjust. Refer to [EM-131, "Tension Adjustment"](#).
4. Tighten nut (C) and bolt (D) in this order.

Nut C:

: 19 - 24 N·m (1.9 - 2.5 kg-m, 14 - 18 ft-lb)

Bolt D:

: 44 - 57 N·m (4.4 - 5.9 kg-m, 32 - 42 ft-lb)

Removal and Installation

EBS00LR

REMOVAL

1. Loosen each belt. Refer to [EM-131, "Tension Adjustment"](#).
2. Remove A/C compressor belt. Refer to [EM-132, "A/C COMPRESSOR BELT"](#).
3. Remove alternator and water pump belt. Refer to [EM-132, "ALTERNATOR AND WATER PUMP BELT"](#).

INSTALLATION

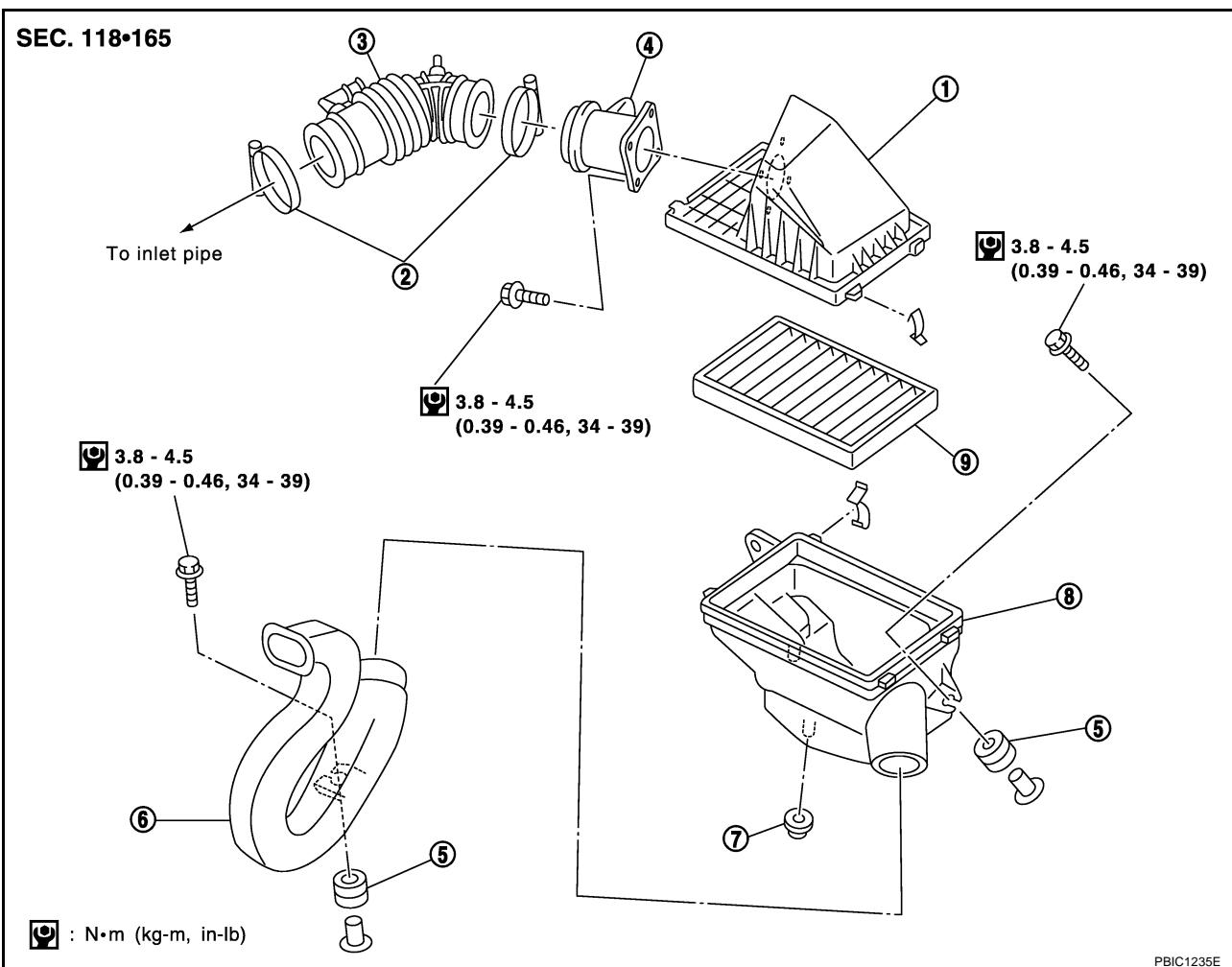
1. Install each belt on pulley in the reverse order of removal.
2. Adjust belt tension. Refer to [EM-131, "Tension Adjustment"](#).
3. Tighten nuts and bolts provided for adjustment to the specified torque.
4. Make sure again that each belt tension is as specified.

AIR CLEANER AND AIR DUCT

PFP:16500

Removal and Installation

EBS00LRD

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

PBIC1235E

1. Air cleaner case (upper)
2. Clamp
3. Air duct
4. Mass air flow sensor
5. Grommet
6. Air duct side
7. Mounting rubber
8. Air cleaner case (lower)
9. Air cleaner filter

REMOVAL

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

CAUTION:

Handle mass air flow sensor with following cares.

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

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

INSTALLATION

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

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

CHANGING AIR CLEANER FILTER

Removal

1. Unfasten clips and lift up air cleaner case (upper).
2. Remove air cleaner filter.

Installation

Install in the reverse order of removal.

CHARGE AIR COOLER

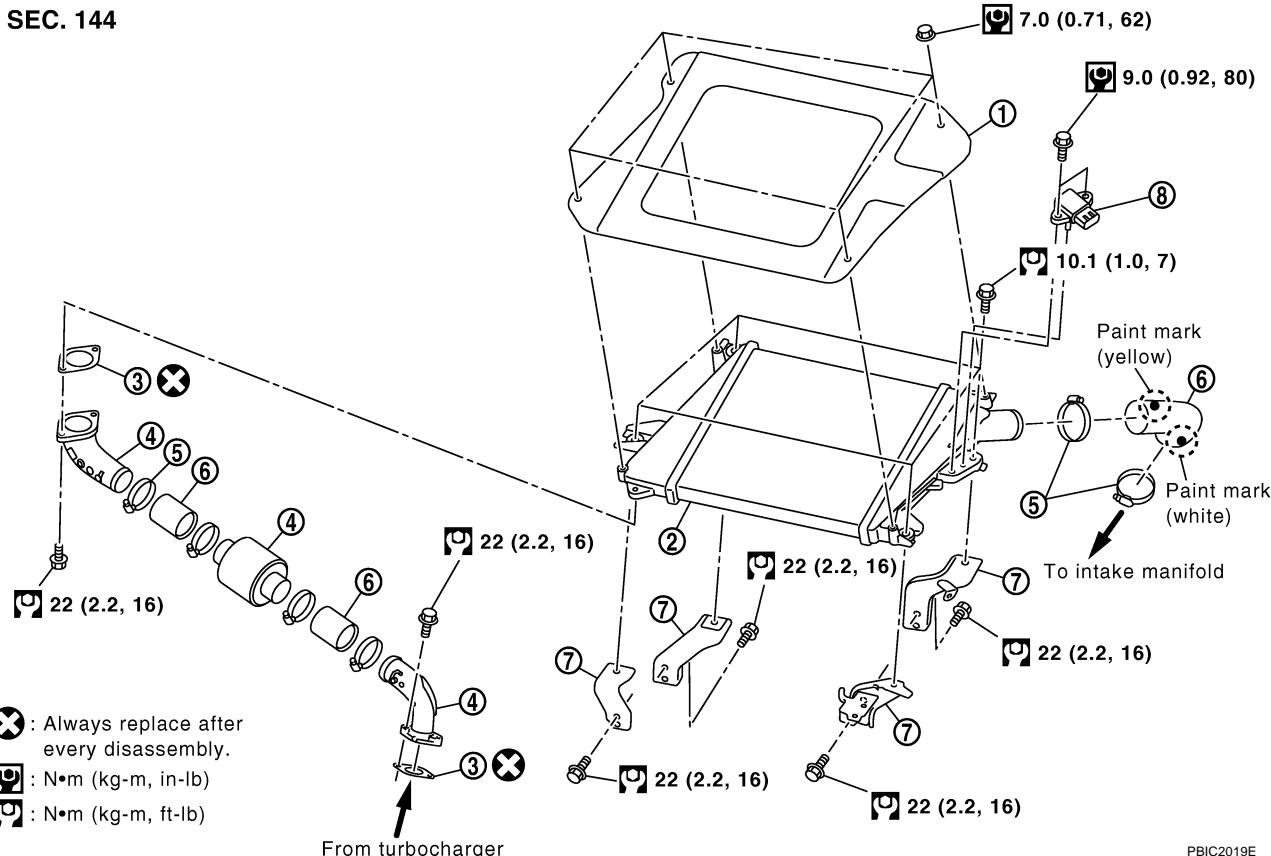
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Removal and Installation

EBS00LRE

A
EM
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PBIC2019E

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|----------------------------|------------------------------|-------------------|
| 1. Charge air cooler cover | 2. Charge air cooler | 3. Gasket |
| 4. Air inlet tube | 5. Clamp | 6. Air inlet hose |
| 7. Bottom bracket | 8. Turbocharger boost sensor | |

REMOVAL

1. Remove charge air cooler cover.
2. Disconnect harness connector from turbocharger boost sensor.
3. Remove air inlet tube and air inlet hose.
 - Add marks as necessary for easier installation.
4. Remove charge air cooler.
5. Remove air inlet tube from charge air cooler.
6. Remove turbocharger boost sensor if necessary.

CAUTION:

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

INSPECTION AFTER REMOVAL

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

- Be careful not to deform core fins.
- For cleaning procedure of charge air cooler core, refer to [CO-35, "Checking Radiator"](#).

INSTALLATION

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

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

INTAKE MANIFOLD

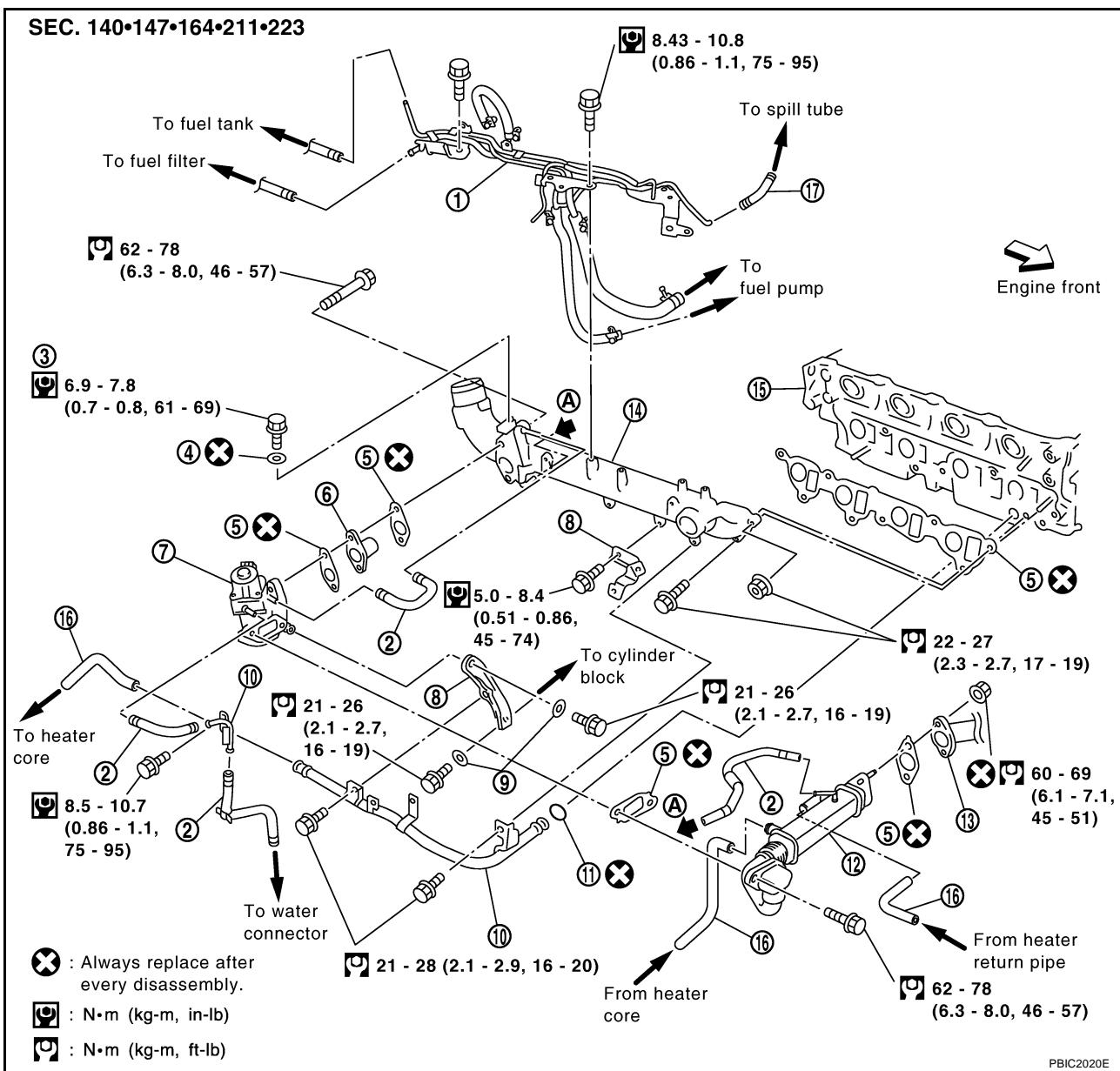
[YD22DDTi]

INTAKE MANIFOLD

PFP:14003

Removal and Installation

EBS00LRF



PBIC2020E

1. Fuel gallery
2. Water hose
3. Air relief plug
4. Copper washer
5. Gasket
6. EGR passage
7. EGR volume control valve
8. Bracket
9. Washer
10. Water pipe
11. O-ring
12. EGR cooler
13. Exhaust manifold
14. Intake manifold
15. Cylinder head
16. Heater hose
17. Spill hose

REMOVAL

WARNING:

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

1. Drain engine coolant. Refer to [CO-31, "Changing Engine Coolant"](#).
2. Remove air duct. Refer to [EM-133, "Removal and Installation"](#).
3. Remove charge air cooler. Refer to [EM-135, "Removal and Installation"](#).
4. Remove air inlet pipes. Refer to [EM-141, "Removal and Installation"](#).
5. Remove exhaust manifold insulator. Refer to [EM-141, "EXHAUST MANIFOLD AND TURBOCHARGER"](#).

INTAKE MANIFOLD

[YD22DDTi]

6. Disconnect EGR volume control valve water hoses and wiring harness.
7. Disconnect heater hose.
8. Remove EGR Cooler.
9. Remove injection tube center. Refer to [EM-157, "Removal and Installation"](#).

CAUTION:

Be careful not to spill fuel in the engine component.

10. Remove water pipe.
11. Remove fuel hoses and fuel gallery.

- To prevent fuel from flowing out, plug the opening of the hose with plug after disconnection.

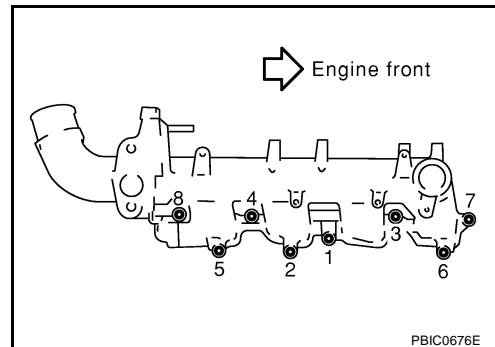
CAUTION:

Be careful not to spill fuel in the engine component.

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

CAUTION:

Cover engine openings to avoid entry of foreign materials.

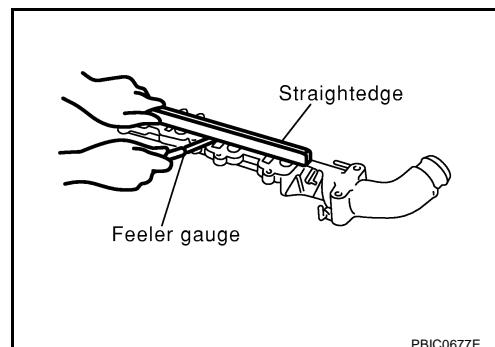


13. Remove EGR volume control valve from intake manifold.

INSPECTION AFTER REMOVAL

Surface Distortion

- Check distortion on the mounting surface with a straightedge and feeler gauge.
Limit : 0.1 mm (0.004 in)
- If it exceeds the limit, replace intake manifold.



INSTALLATION

Following instructions below, install in the reverse order of removal.

1. Install EGR volume control valve.
 - Handle with care avoiding any shocks.
 - Do not disassemble.
2. Install intake manifold.
 - Tighten fixing bolts and nuts in numerical order as shown in the figure.
 - When stud bolts come off, install with the following torque.
Key : 10 - 11 N·m (1.0 - 1.2 kg·m, 87 - 104 in-lb)

INTAKE MANIFOLD

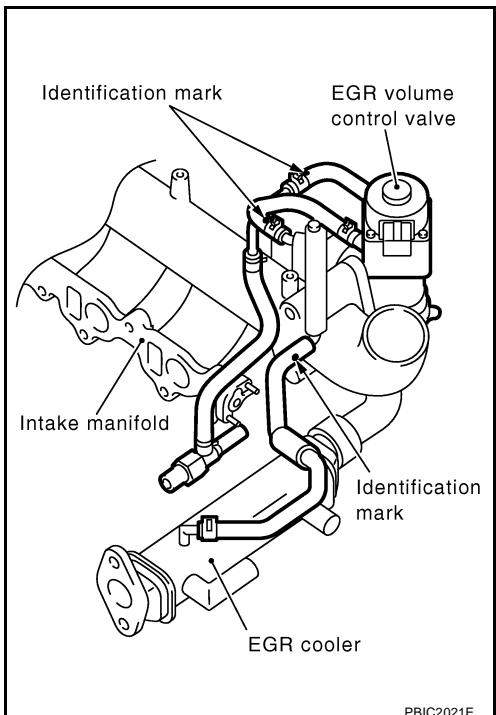
[YD22DDTi]

3. Install water hose.

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

Dimension A : 25 - 30 mm (0.984 - 1.181 in)

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



PBIC2021E

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

5. Before starting engine, bleed air from fuel piping. Refer to [FL-18, "Air Bleeding"](#).

INSPECTION AFTER INSTALLATION

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

CAUTION:

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

NOTE:

Use mirrors for checking at points out of clear sight.

CATALYST

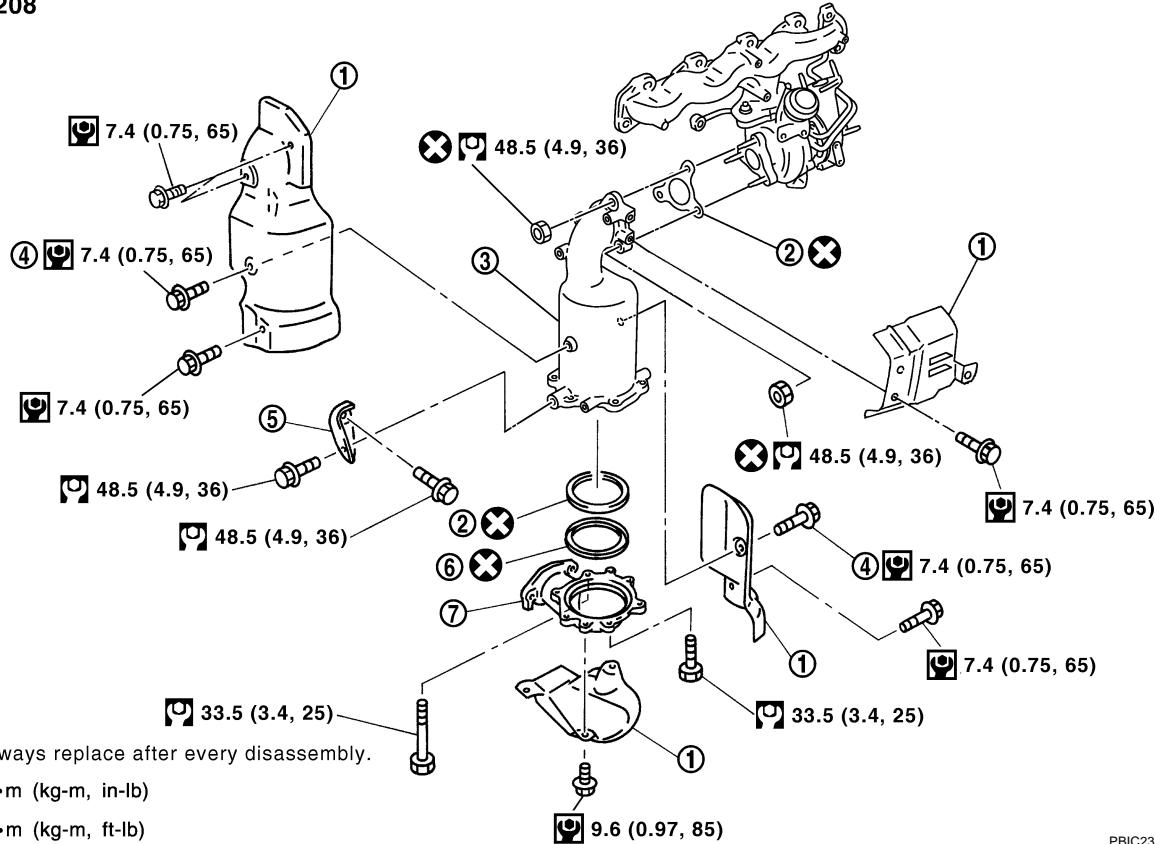
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Removal and Installation

EBS00LRG

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PBIC2312E

1. Catalyst insulator
2. Gasket
3. Catalyst
4. Locking pin
5. Gusset
6. Gasket cap
7. Catalyst rear diffuser

REMOVAL

1. Remove engine undercover.
2. Drain engine coolant. Refer to [CO-31, "Changing Engine Coolant"](#).
3. Remove radiator upper and lower hoses. Refer to [CO-34, "RADIATOR"](#).
4. Remove cooling fan. Refer to [CO-36, "DISASSEMBLY AND ASSEMBLY"](#).
5. Remove radiator mounting bracket and radiator. Refer to [CO-34, "Removal and Installation"](#).
6. Remove water inlet pipe. Refer to [CO-44, "THERMOSTAT AND WATER PIPING"](#).
7. Remove catalyst insulators.
8. Remove exhaust front tube. Refer to [EX-2, "EXHAUST SYSTEM"](#).
9. Remove catalyst.

CAUTION:**Do not disassemble.****NOTE:**

Install two locking pins into both sides of the catalyst. Be careful not to confuse locking pins with insulator mounting bolts.

Catalyst locking pin : Flange bolt (black)

INSTALLATION

Install in the reverse order of removal.

- Pushing gussets against the oil pan and the catalyst, temporarily tighten the mounting bolt. And then tighten it to the specified torque.

EXHAUST MANIFOLD AND TURBOCHARGER

[YD22DDTi]

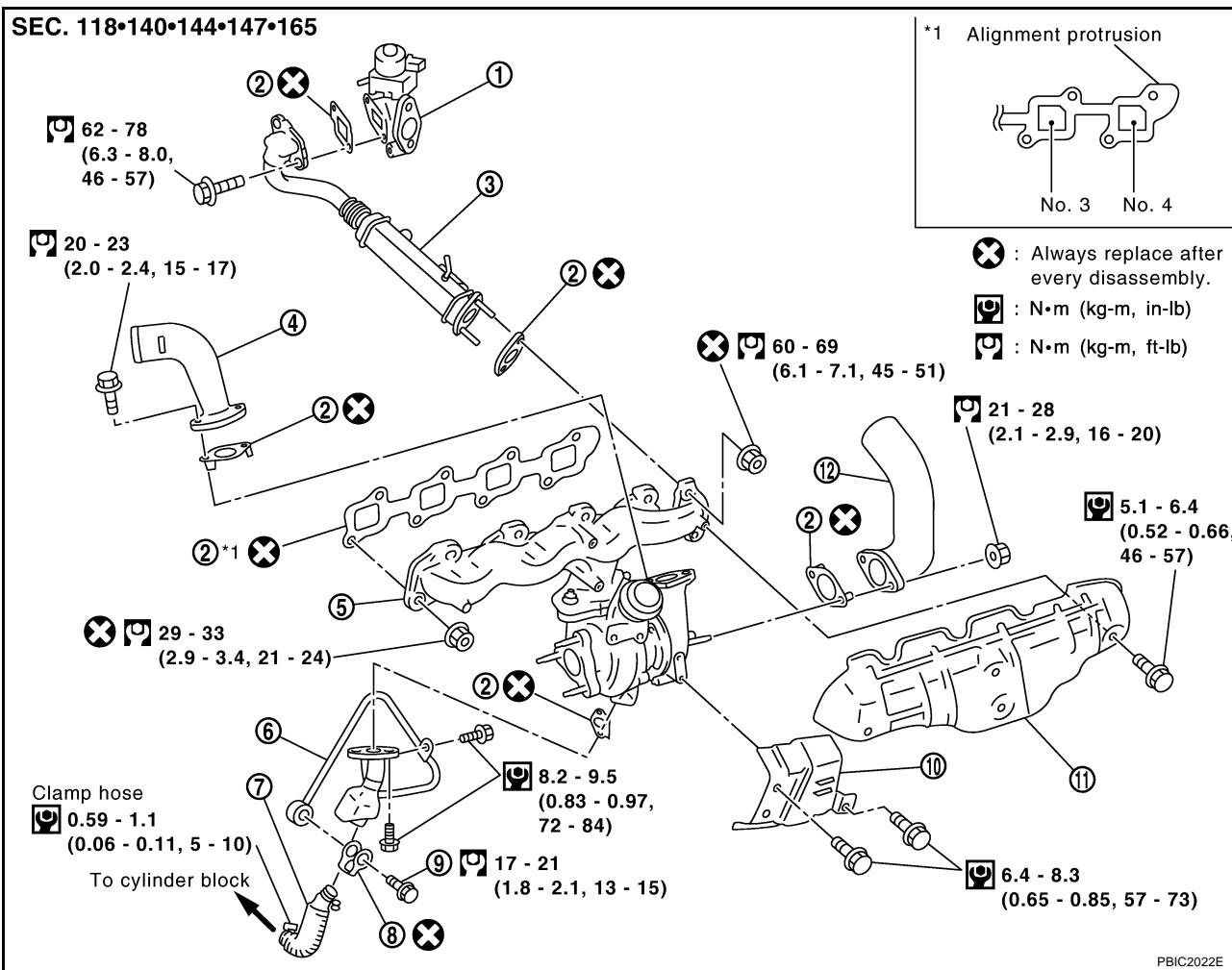
EXHAUST MANIFOLD AND TURBOCHARGER

PFP:14004

Removal and Installation

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1. EGR volume control valve
2. Gasket
3. EGR cooler
4. Air inlet pipe
5. Exhaust manifold and turbocharger assembly
6. Oil feed tube and oil return tube
7. Oil return hose
8. Copper washer
9. Eye-bolt
10. Turbocharger insulator
11. Exhaust manifold insulator
12. Air inlet pipe

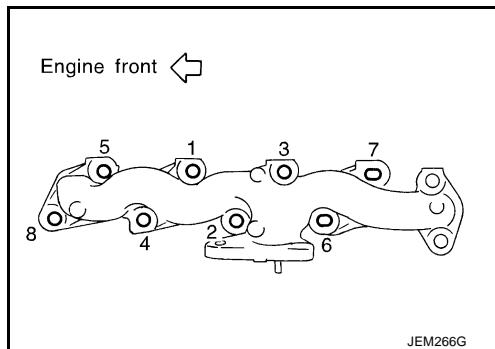
REMOVAL

1. Drain engine coolant. Refer to [CO-31, "Changing Engine Coolant"](#).
2. Remove charge air cooler. Refer to [EM-135, "Removal and Installation"](#).
3. Remove air duct. Refer to [EM-133, "Removal and Installation"](#).
4. Remove air inlet pipe.
5. Remove engine undercover.
6. Remove radiator upper and lower hoses. Refer to [CO-34, "RADIATOR"](#).
7. Remove cooling fan. Refer to [CO-36, "DISASSEMBLY AND ASSEMBLY"](#).
8. Remove radiator mounting bracket and radiator. Refer to [CO-34, "Removal and Installation"](#).
9. Remove water inlet pipe. Refer to [CO-44, "THERMOSTAT AND WATER PIPING"](#).
10. Remove catalyst. Refer to [EM-139, "Removal and Installation"](#).
11. Remove exhaust manifold insulator.
12. Remove turbocharger insulator.
13. Remove oil feed tube and oil return tube.

EXHAUST MANIFOLD AND TURBOCHARGER

[YD22DDTi]

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



15. Rotate exhaust manifold and turbocharger assembly so that the rear side (EGR cooler mounting side) faces upward. And then pull out the assembly from between the engine and the A/C piping.

CAUTION:

Be careful not to deform each turbocharger piping when pulling out the assembly.

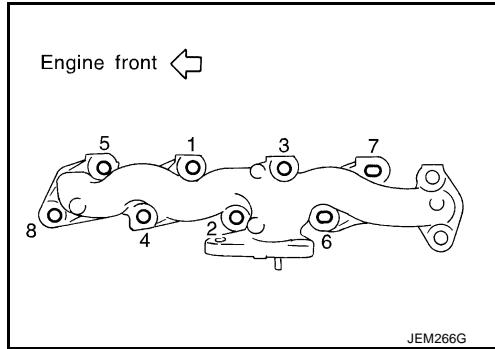
INSTALLATION

- When a stud bolt is pulled out, tighten it to the following torque:

: 12.7 - 16.7 N·m (1.3 - 1.7 kg-m, 9 - 12 ft-lb)

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

- Install gasket so that the alignment protrusion faces the No. 4 port. Refer to [EM-141, "Removal and Installation"](#).
- Tighten the nuts in order specified in the figure.
- Re-tighten the nuts 1 to 4.
- Install in the reverse order of removal.



INSPECTION AFTER INSTALLATION

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

EXHAUST MANIFOLD AND TURBOCHARGER

[YD22DDTi]

Disassembly and Assembly

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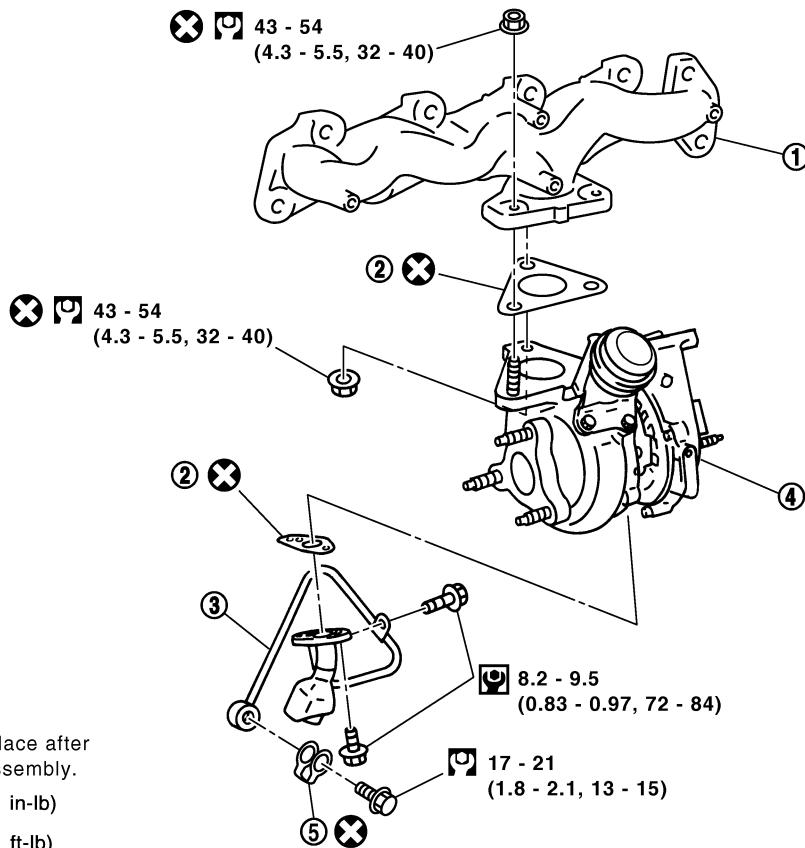
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PBIC2435E

1. Exhaust manifold
2. Gasket
3. Oil feed tube and oil return tube
4. Turbocharger
5. Copper washer

DISASSEMBLY

- After applying penetrative lubricant to the mounting nuts, check for the penetration of the lubricant, and then loosen the nuts to remove.

CAUTION:

Do not disassemble or adjust the turbocharger body.

ASSEMBLY

- When a stud bolt is pulled out, tighten it to the following torque:

24 - 27 N·m (2.4 - 2.8 kg·m, 18 - 20 ft·lb)

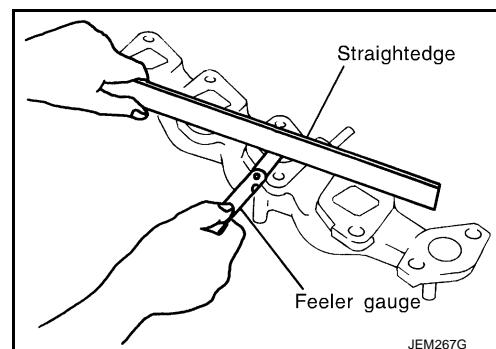
INSPECTION AFTER DISASSEMBLY

Surface Distortion

- Check the distortion on the mounting surface in the six directions using a straightedge and a feeler gauge.

Limit : 0.3 mm (0.012 in)

- If it exceeds the limit, replace exhaust manifold.



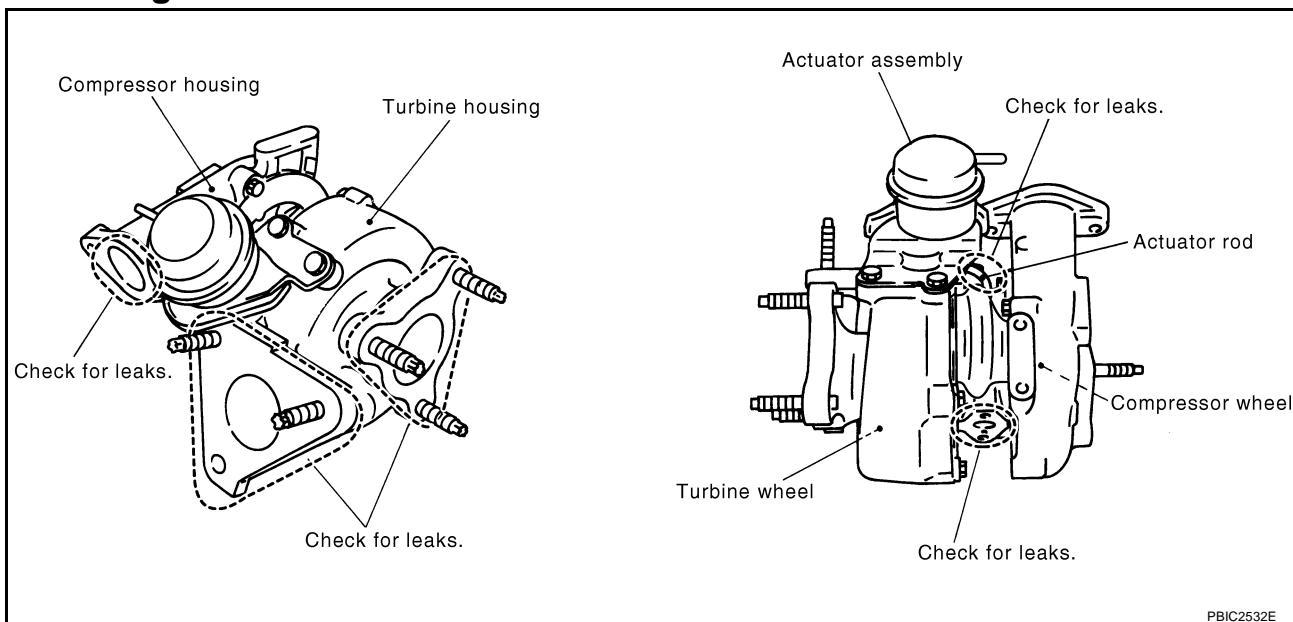
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EXHAUST MANIFOLD AND TURBOCHARGER

[YD22DDTi]

Turbocharger

EBS00LRJ



CAUTION:

When the compressor wheel, turbine wheel or rotor shaft is damaged, remove all the fragments and foreign matter left in the following passages in order to prevent a secondary malfunction:

Suction side : Between turbocharger and air cleaner

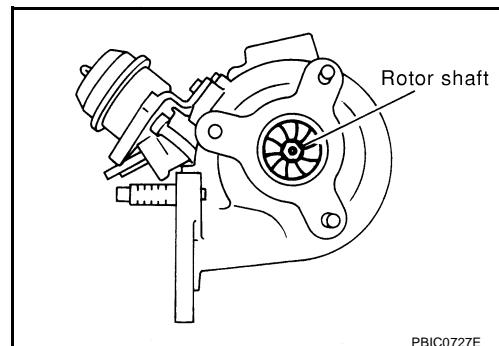
Exhaust side : Between turbocharger and catalyst

ROTOR SHAFT CLEARANCE

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

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

- Replace turbocharger if out of standard.

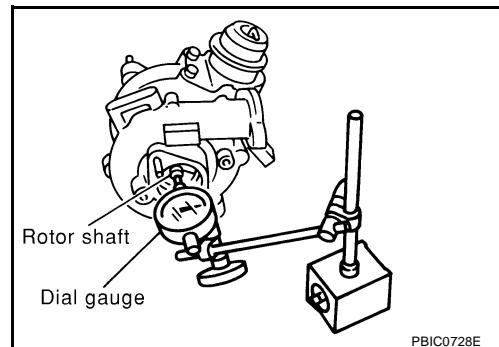


ROTOR SHAFT END PLAY

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

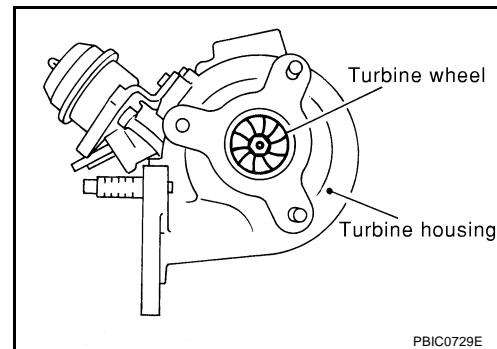
Standard : 0.036 - 0.090 mm (0.0014 - 0.0035 in)

- Replace turbocharger if out of standard.



TURBINE WHEEL

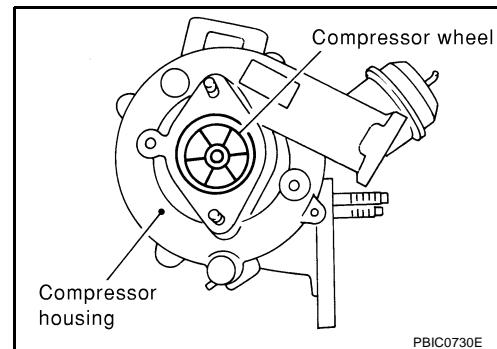
- Make sure that there is no engine oil adhesion.
- Make sure that there is no carbon accumulation.
- Make sure that blades of turbine wheel are not bent or broken.
- Make sure that turbine wheel does not interfere with turbine housing.



PBIC0729E

COMPRESSOR WHEEL

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



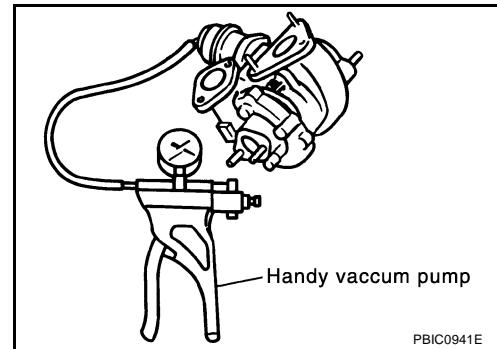
PBIC0730E

TURBOCHARGER BOOST CONTROL ACTUATOR

- Connect the handy vacuum pump to the actuator, and make sure that the rod strokes smoothly in compliance with the following pressure.
- Pressure to be applied at actuator part to move rod end as follows:

Standard (Pressure/rod stroke amount):

: -52.0 to -54.6 kPa (-520 to -546 mbar, -390 to -410 mmHg, -15.4 to -16.1 inHg)/0.2 mm (0.0079 in)
 : -32.0 to -40.0 kPa (-320 to -400 mbar, -240 to -300 mmHg, -9.45 to -11.8 inHg)/5.0 mm (0.197 in)



PBIC0941E

EXHAUST MANIFOLD AND TURBOCHARGER

[YD22DDTi]

TROUBLE DIAGNOSIS OF TURBOCHARGER

Preliminary check:

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

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

A: Large possibility

B: Medium possibility

C: Small possibility

OIL PAN AND OIL STRAINER

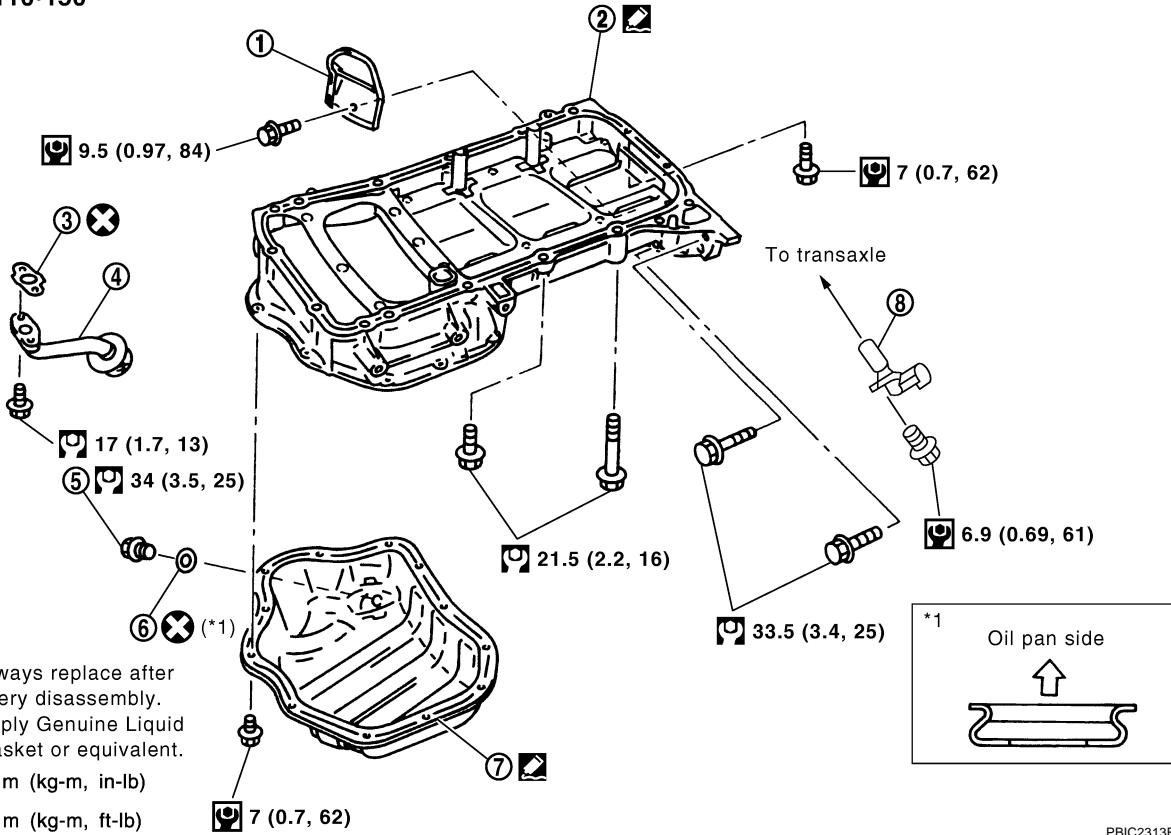
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Removal and Installation

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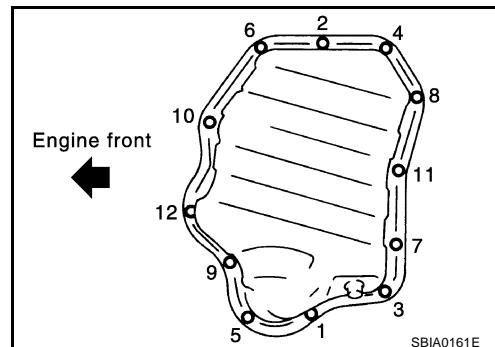
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|---------------------|-------------------------------|----------------------|
| 1. Rear plate cover | 2. Oil pan upper | 3. Gasket |
| 4. Oil strainer | 5. Oil pan drain plug | 6. Drain plug washer |
| 7. Oil pan lower | 8. Crankshaft position sensor | |

REMOVAL

WARNING:

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

1. Remove engine undercover.
2. Drain engine oil. Refer to [LU-21, "Changing Engine Oil"](#).
3. Remove oil pan lower bolts. Loosen bolts in reverse order of that shown in the figure.



SBIA0161E

4. Remove oil pan lower.

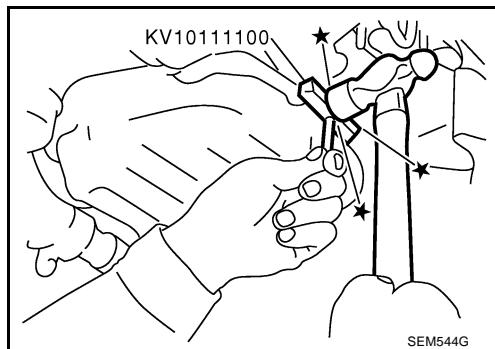
OIL PAN AND OIL STRAINER

[YD22DDTi]

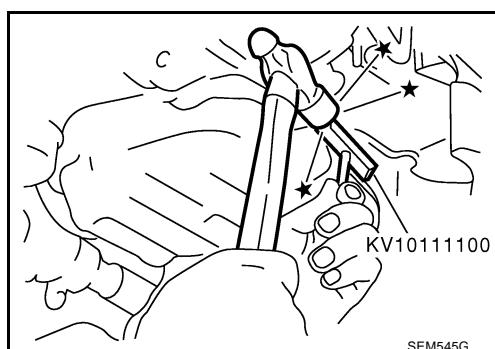
- a. Insert the Seal cutter (special service tool) between oil pan upper and oil pan lower.

CAUTION:

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



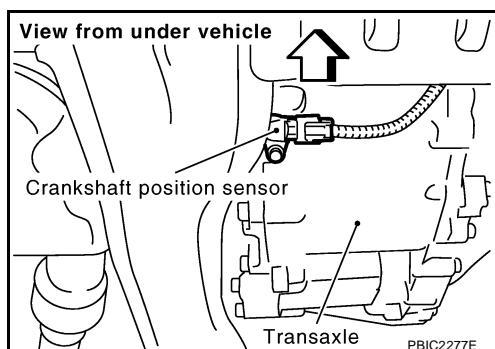
- b. Slide the Seal cutter by tapping on the side of the Seal cutter with a hammer.
- c. Remove oil pan lower.



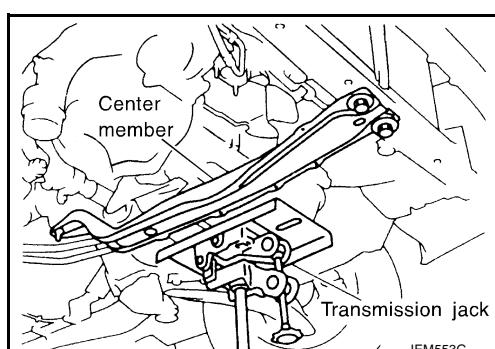
5. Remove A/C compressor belt. Refer to [EM-131, "Tension Adjustment"](#).
6. Remove A/C compressor and bracket. Refer to [ATC-144, "Removal and Installation of Compressor"](#).
7. Remove front exhaust tube and its support. Refer to [EX-2, "EXHAUST SYSTEM"](#).
8. Remove crankshaft position sensor from transaxle.

CAUTION:

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



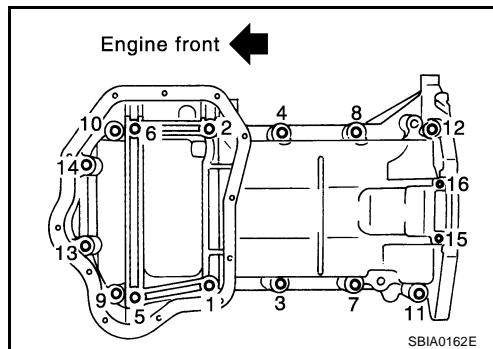
9. Set a suitable transmission jack under transaxle and hoist engine with engine slinger. Refer to [EM-208, "Removal and Installation"](#).
10. Remove center member. Refer to [EM-208, "ENGINE ASSEMBLY"](#).
11. Remove rear plate cover and transaxle joint bolts.
12. Remove catalyst and catalyst rear diffuser. Refer to [EM-139, "Removal and Installation"](#).



OIL PAN AND OIL STRAINER

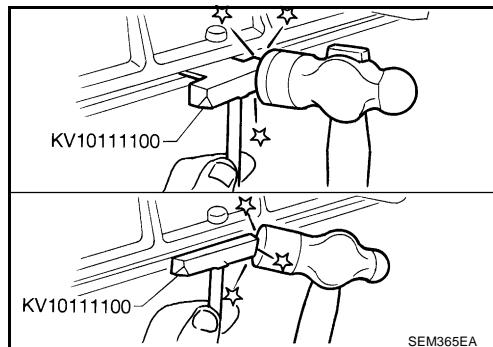
[YD22DDTi]

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



14. Remove oil pan upper.

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



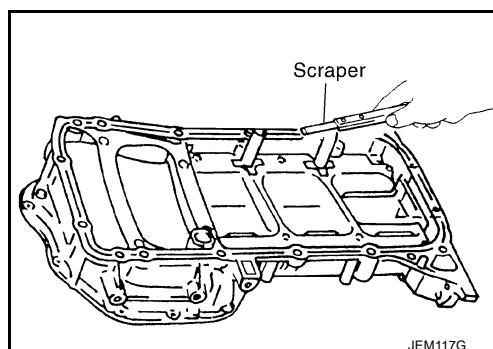
15. Remove oil strainer.

INSPECTION AFTER REMOVAL

Clean oil strainer if any object attached.

INSTALLATION

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

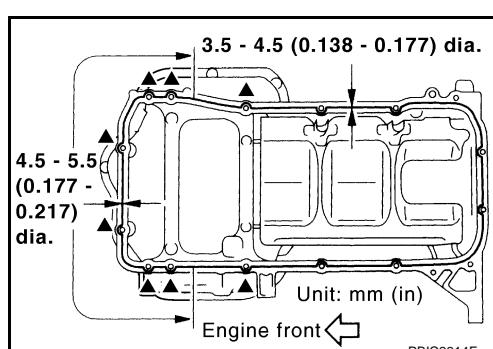


- Apply a continuous bead of liquid gasket with the tube presser (special service tool: WS39930000) to areas shown in the figure.

Use Genuine Liquid Gasket or equivalent.

CAUTION:

- At the 8 bolt holes marked ▲, liquid gasket should be applied outside holes.
- Be sure liquid gasket is 3.5 to 4.5 mm (0.138 to 0.177 in) or 4.5 to 5.5 mm (0.177 to 0.217 in) wide. (Be careful that the diameter of the silicon bead is different around the front.)
- Attaching should be done within 5 minutes after coating.



- Install oil pan upper.

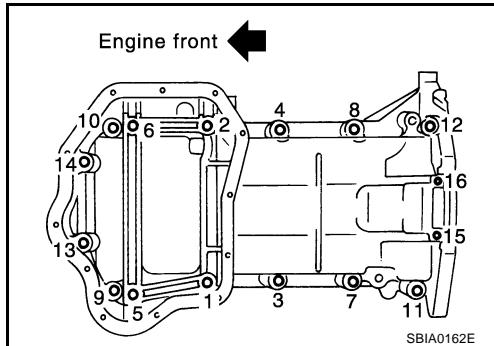
OIL PAN AND OIL STRAINER

[YD22DDTi]

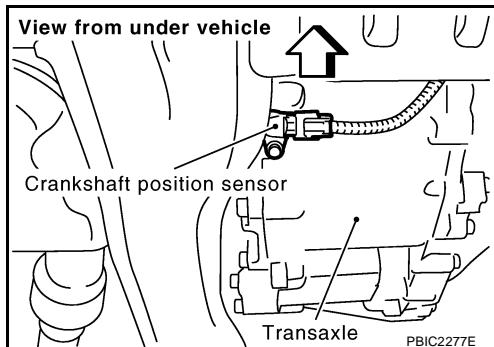
- Tighten bolts in numerical order to the specified torque.
- Bolt dimensions vary depending on the installation location. Refer to the following and use appropriate bolts.

M6 x 30 mm (1.18 in) : Bolt No. 15, 16
M8 x 25 mm (0.98 in) : Bolt No. 3, 4, 9, 10
M8 x 60 mm (2.36 in) : Bolt No. 1, 2, 5, 6, 7, 8,
 11, 12, 13, 14

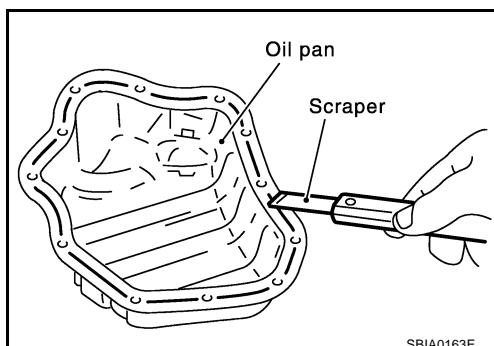
- The shank length under the bolt neck above is the length of the threaded part (pilot portion not included).



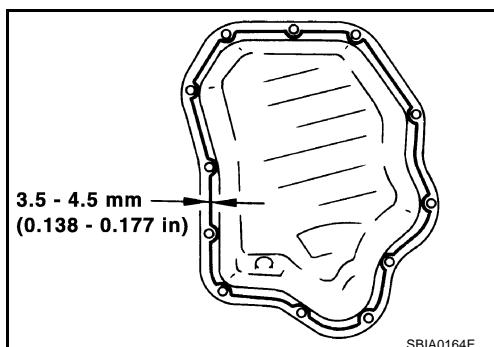
3. Tighten transaxle joint bolts.
4. Install rear plate cover.
5. Install center member. Refer to [EM-208, "ENGINE ASSEMBLY"](#).
6. Install crankshaft position sensor.



7. Install oil pan lower with the following procedure.
 - a. Use a scraper to remove old liquid gasket from mating surfaces.
- CAUTION:**
- Also remove old liquid gasket from mating surface of oil pan upper.
 - Remove old liquid gasket from bolt hole and thread.

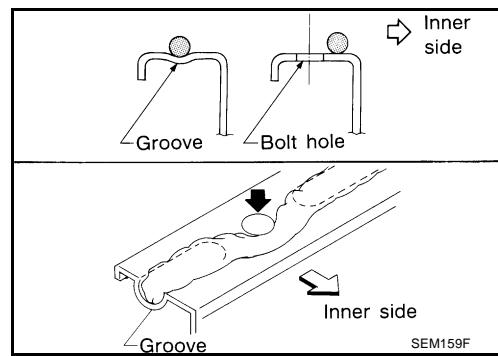


- b. Apply a continuous bead of liquid gasket with the tube presser (special service tool: WS39930000) as shown in the figure. **Use Genuine Liquid Gasket or equivalent.**
- Be sure liquid gasket is 3.5 to 4.5 mm (0.138 to 0.177 in) wide.
 - Attaching should be done within 5 minutes after coating.

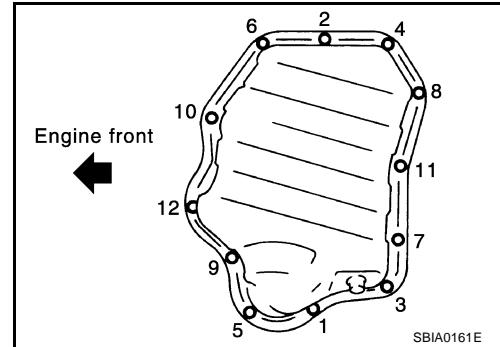


OIL PAN AND OIL STRAINER

[YD22DDTi]



- c. Install oil pan lower.
 - Tighten bolts in numerical order to the specified torque.



8. Install oil pan drain plug.
 - Refer to figure in [EM-147, "Removal and Installation"](#).
9. Install in the reverse order of removal.

NOTE:

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

INSPECTION AFTER INSTALLATION

1. Check engine oil level and add engine oil. Refer to [LU-20, "ENGINE OIL"](#).
2. Check for leakage of engine oil when engine is warmed.
3. Stop engine and wait for 10 minutes.
4. Check engine oil level again. Refer to [LU-20, "ENGINE OIL"](#).

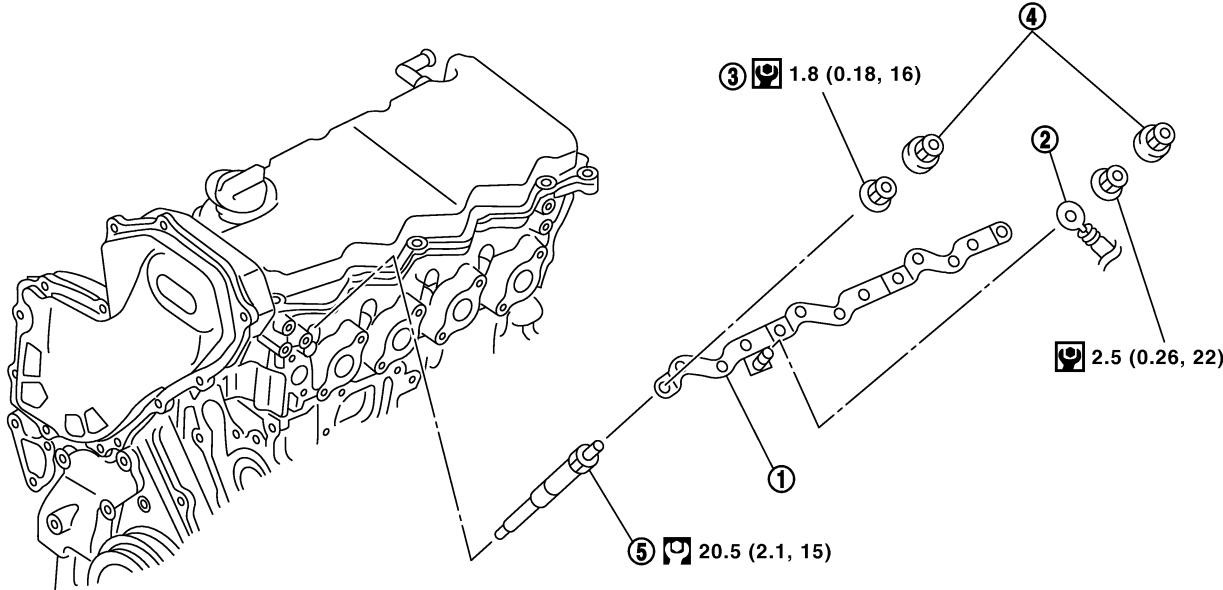
GLOW PLUG

PFP:22401

Removal and Installation

EBS00LRL

SEC. 220



: N·m (kg-m, in-lb)

: N·m (kg-m, ft-lb)

PBIC2436E

- | | | |
|---------------|-----------------|-------------|
| 1. Glow plate | 2. Glow harness | 3. Glow nut |
| 4. Cap | 5. Glow plug | |

REMOVAL**CAUTION:**

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

1. Remove charge air cooler. Refer to [EM-135, "Removal and Installation"](#).
2. Disconnect glow harness from glow plate.
3. Remove glow nut to remove glow plate.
4. Remove glow plug.

CAUTION:

- When removing or installing, do not use such tools as an air impact wrench.
- Handle it carefully without giving any impact, even after removal. [As a guide, if it drops from height of 10 cm (3.94 in) or higher, always replace it.]

INSTALLATION

1. Remove adhered carbon from glow plug installation hole with a reamer.
2. Install glow plug.
3. Install remaining parts in the reverse order of removal.

VACUUM PUMP

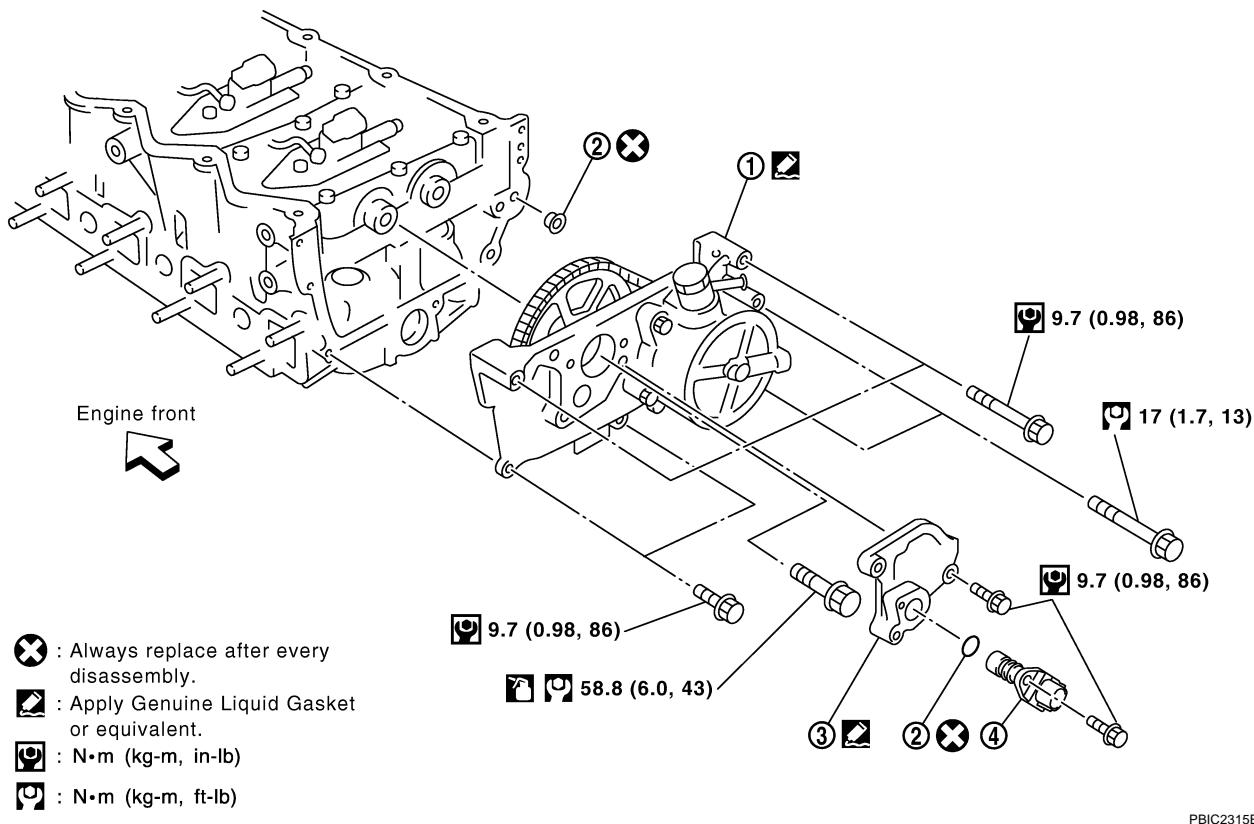
PFP:41920

Removal and Installation

EBS00LRM

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SEC. 130•135



1. Vacuum pump and cylinder head rear cover assembly
2. O-ring
3. Cylinder head rear cover plate
4. Camshaft position sensor

INSPECTION BEFORE REMOVAL

1. Disconnect vacuum hose, and connect a vacuum gauge via 3-way connector.
 - Disconnect point where vacuum from vacuum pump can be measured directly and install 3-way connector.
2. Start engine and measure generated vacuum at idle speed.

Standard:

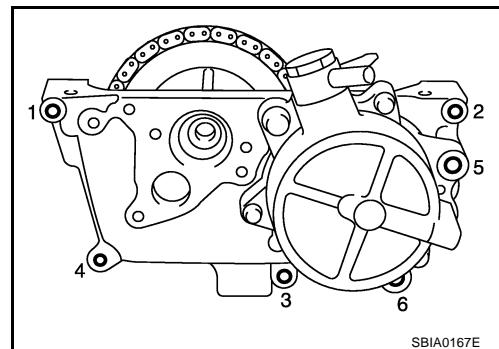
– 86.6 to – 101.3 kPa (– 866 to – 1,013 mbar, – 650 to – 760 mmHg, – 25.59 to – 29.92 inHg)

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

REMOVAL

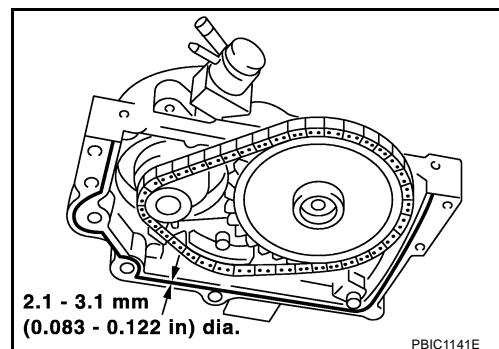
1. Drain engine coolant. Refer to [CO-31, "Changing Engine Coolant"](#).
2. Remove air duct and air cleaner case. Refer to [EM-133, "Removal and Installation"](#).
3. Remove charge air cooler. Refer to [EM-135, "Removal and Installation"](#).
4. Disconnect harness connector from fuel injector.
5. Remove injection tubes. Refer to [EM-157, "Removal and Installation"](#).
6. Remove rocker cover. Refer to [EM-168, "Removal and Installation"](#).
7. Remove spill tube. Refer to [EM-157, "Removal and Installation"](#).
8. Remove nozzle support from No. 2 cylinder and No. 2 fuel injector. Refer to [EM-157, "Removal and Installation"](#). (To fix the hexagonal portion of the camshaft.)
9. Remove air inlet pipes. Refer to [EM-141, "Removal and Installation"](#).

10. Remove exhaust manifold cover. Refer to [EM-141, "Removal and Installation"](#) .
11. Disconnect heater hose. Refer to [EM-136, "INTAKE MANIFOLD"](#) .
12. Remove EGR cooler. Refer to [EM-136, "INTAKE MANIFOLD"](#) .
13. Disconnect vacuum hose from vacuum pump side.
14. Remove camshaft position sensor.
15. Remove cylinder head rear cover plate.
16. Loosen and remove the mounting bolts in rear camshaft sprocket. Refer to [EM-155, "Disassembly and Assembly"](#) .
 - Loosen rear camshaft sprocket mounting bolt by fixing the hexagonal portion of camshaft.
17. Remove vacuum pump and cylinder head rear cover assembly.
 - Remove and install vacuum pump, sprocket, drive chain and chain guide as an assembly.
 - Loosen mounting bolts in reverse order shown in figure.
 - Do not remove any bolts not shown in figure. (Especially never remove M6 bolts on vacuum pump.)
 - Use the seal cutter (special service tool: KV10111100) or other suitable tool to remove.

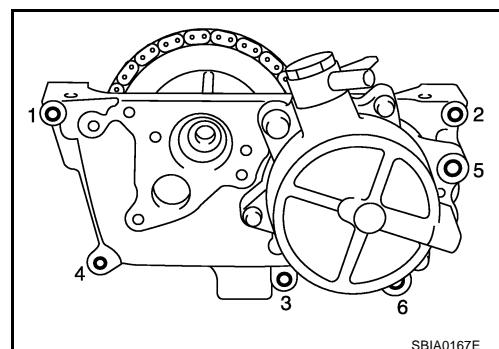


INSTALLATION

1. Install vacuum pump and cylinder head rear cover assembly onto cylinder head. Refer to [EM-156, "ASSEMBLY"](#) .
 - Apply a continuous bead of liquid gasket with the tube presser (special service tool: WS39930000) to area shown in the figure.
Use Genuine Liquid Gasket or equivalent.
 - Attaching should be done within 5 minutes after coating.

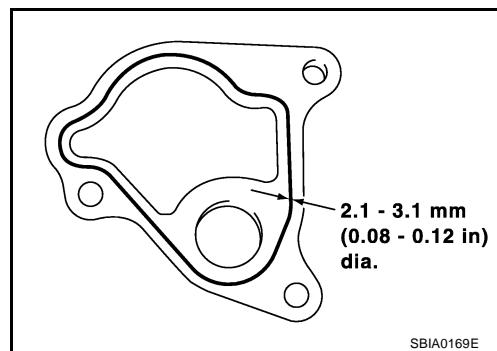


2. Tighten mounting bolts in order shown in the figure.
3. Install rear camshaft sprocket mounting bolts by fixing the hexagonal portion of camshaft.
4. Tighten rear camshaft sprocket mounting bolts.



5. Install cylinder head rear cover plate.

- Apply a continuous bead of liquid gasket with the tube presser (special service tool: WS39930000) to area shown in the figure.
Use Genuine Liquid Gasket or equivalent.
- Attaching should be done within 5 minutes after coating.



6. Install in reverse order of removal.

- When vacuum hose is connected, insert it securely by at least 15 mm (0.59 in).

CAUTION:

Do not start engine with vacuum circuit being open. If engine is started and vehicle is running while vacuum pump is open (with vacuum hose disconnected), blow-by flow rate will increase and engine may be damaged.

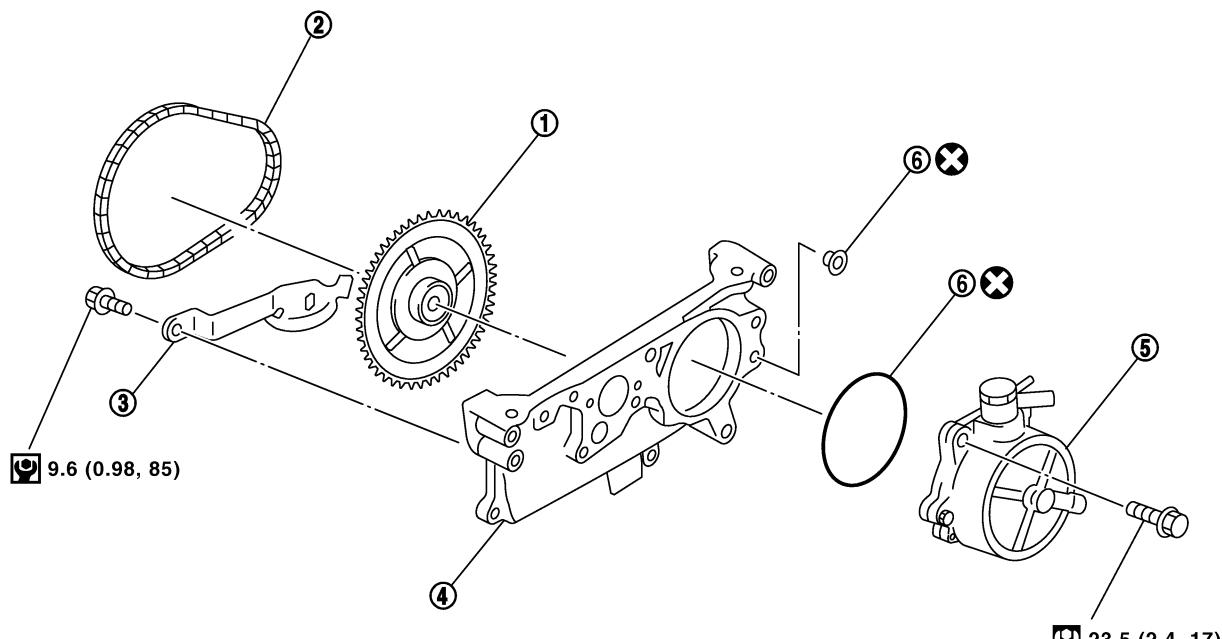
INSPECTION AFTER INSTALLATION

Check generated vacuum satisfies the specification at idle speed. Refer to [EM-153, "INSPECTION BEFORE REMOVAL"](#).

Disassembly and Assembly

EBS00LRN

SEC. 130•135



: Always replace after every disassembly.

: N•m (kg-m, in-lb)

: N•m (kg-m, ft-lb)

PBIC2316E

- | | | |
|-----------------------------|----------------|----------------|
| 1. Rear camshaft sprocket | 2. Drive chain | 3. Chain guide |
| 4. Cylinder head rear cover | 5. Vacuum pump | 6. O-ring |

DISASSEMBLY

1. Push on chain guide lightly so that clearance between drive chain and chain guide part reaches 0 mm (0 in). Then loosen chain guide mounting bolts.
2. Remove drive chain from rear camshaft sprocket and vacuum pump sprocket.

3. Remove rear camshaft sprocket.
4. Remove vacuum pump.

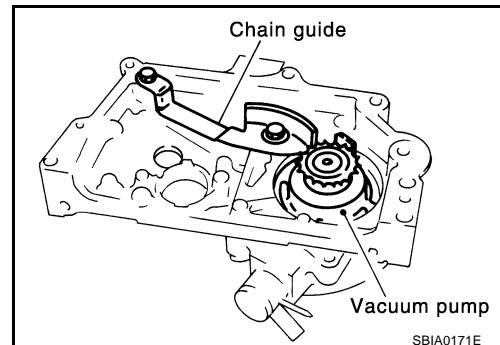
CAUTION:

Do not disassemble vacuum pump.

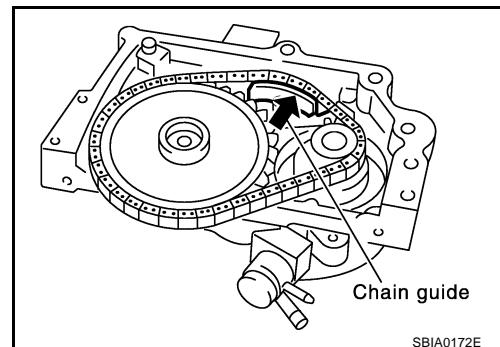
ASSEMBLY

Follow procedure below to install each part onto cylinder head rear cover.

1. Install vacuum pump.
2. Temporarily fit chain guide.



3. Install rear camshaft sprocket.
4. Fit drive chain onto rear camshaft sprocket and vacuum pump sprocket.
5. Push on chain guide lightly so that clearance between drive chain and chain guide sliding part reaches 0 mm (0 in). Then tighten chain guide mounting bolts.



INJECTION TUBE AND FUEL INJECTOR

[YD22DDTi]

INJECTION TUBE AND FUEL INJECTOR

PFP:00018

Removal and Installation

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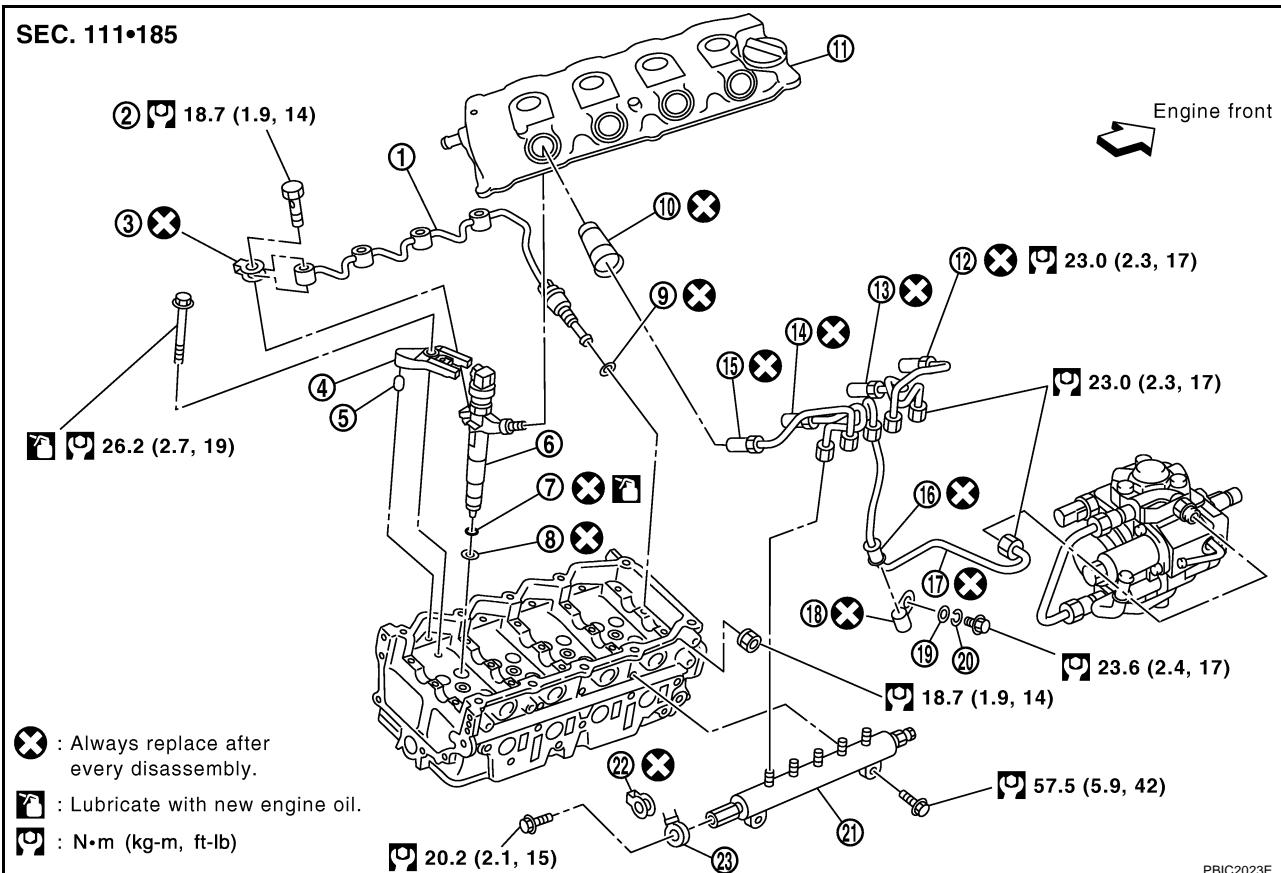
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PBIC2023E

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

REMOVAL

1. Remove charge air cooler. Refer to [EM-135, "Removal and Installation"](#).
2. Disconnect harness connector from fuel injector.
3. Remove spill hose. Refer to [EM-136, "INTAKE MANIFOLD"](#).
4. Following steps below, remove injection tubes.
 - a. Put a paint mark or tag on injection tubes to identify each cylinder.
 - Use a fuel-resistant method.

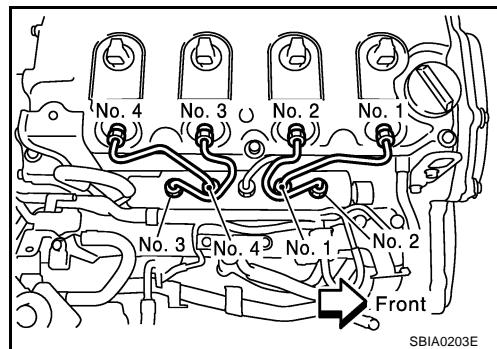
INJECTION TUBE AND FUEL INJECTOR

[YD22DDTi]

- b. Remove injection tubes in order of 2-1-4-3 individually.

CAUTION:

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

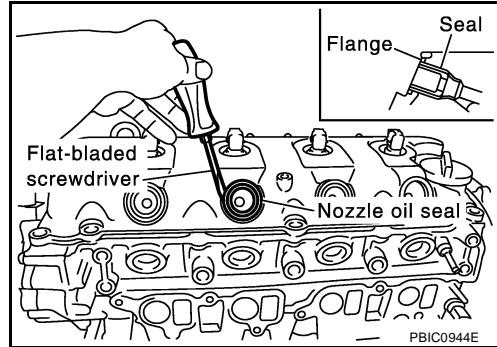


5. Remove nozzle oil seal.

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

NOTE:

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



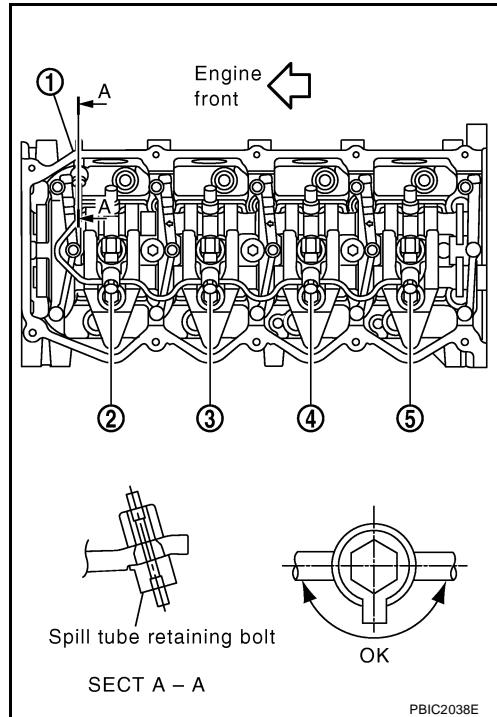
6. Remove rocker cover. Refer to [EM-168, "Removal and Installation"](#).

7. Remove spill tube mounting bolts and nut.

- Loosen bolts and nut to the reverse order in the figure and remove them.

CAUTION:

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



INJECTION TUBE AND FUEL INJECTOR

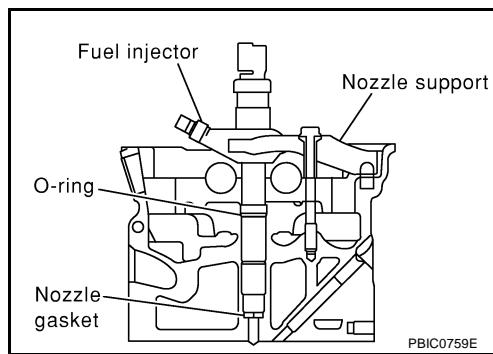
[YD22DDTi]

8. Following steps below, remove fuel injector.
 - a. Remove nozzle support.
 - b. Remove fuel injector. While rotating it to left and right, raise it to remove.

CAUTION:

- Handle fuel injector carefully without giving any impact.
- Do not disassemble fuel injector.

- c. If nozzle gasket remains in cylinder head, hook it with tip of a flat-bladed screwdriver and pull it out.
- d. Remove O-ring from fuel injector.



INSTALLATION

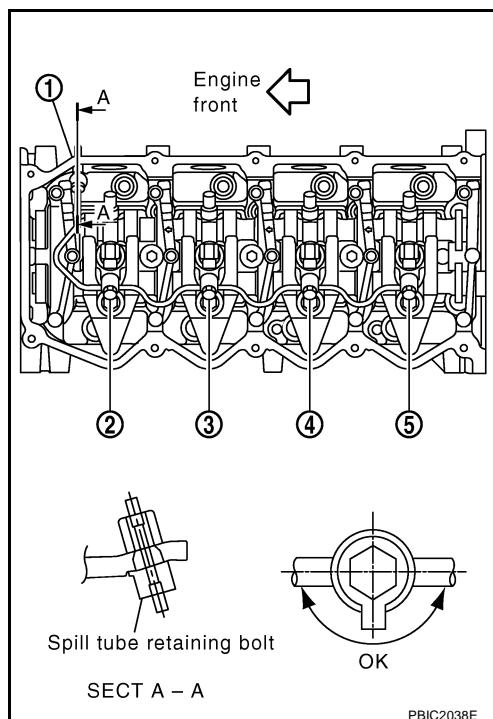
1. Following steps below, install fuel injector.
 - a. Install O-ring and nozzle gasket to fuel injector, and insert them into cylinder head.
 - b. Tighten injection tubes temporarily in the order of 3-4-1-2.
 - c. Be sure to fit nozzle support without looseness.
 - d. Tighten nozzle support bolts.
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

CAUTION:

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

NOTE:

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

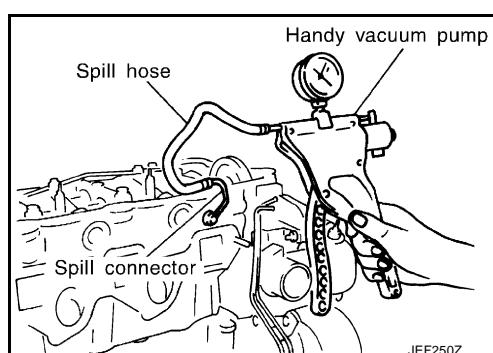


3. Perform air tightness test for spill tube.
 - Connect a handy vacuum pump to spill connector. Make sure that vacuum is retained while applying following vacuum.

Standard:

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

- If outside of standard, reconnect spill tube. (Replace gasket in this case.)
4. Install rocker cover. Refer to [EM-168, "Removal and Installation"](#).
5. Install nozzle oil seal.
 - Insert it straight until its flange fully contacts rocker cover.



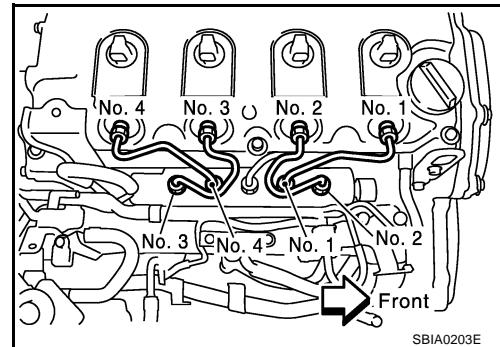
INJECTION TUBE AND FUEL INJECTOR

[YD22DDTi]

CAUTION:

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

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



7. Connect spill hose. Refer to [EM-136, "INTAKE MANIFOLD"](#).
8. Install remaining parts in the reverse order of removal.

INSPECTION AFTER INSTALLATION

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

CAUTION:

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

NOTE:

Use mirrors for checking at points out of clear sight.

FUEL PUMP

PFP:17042

Removal and Installation

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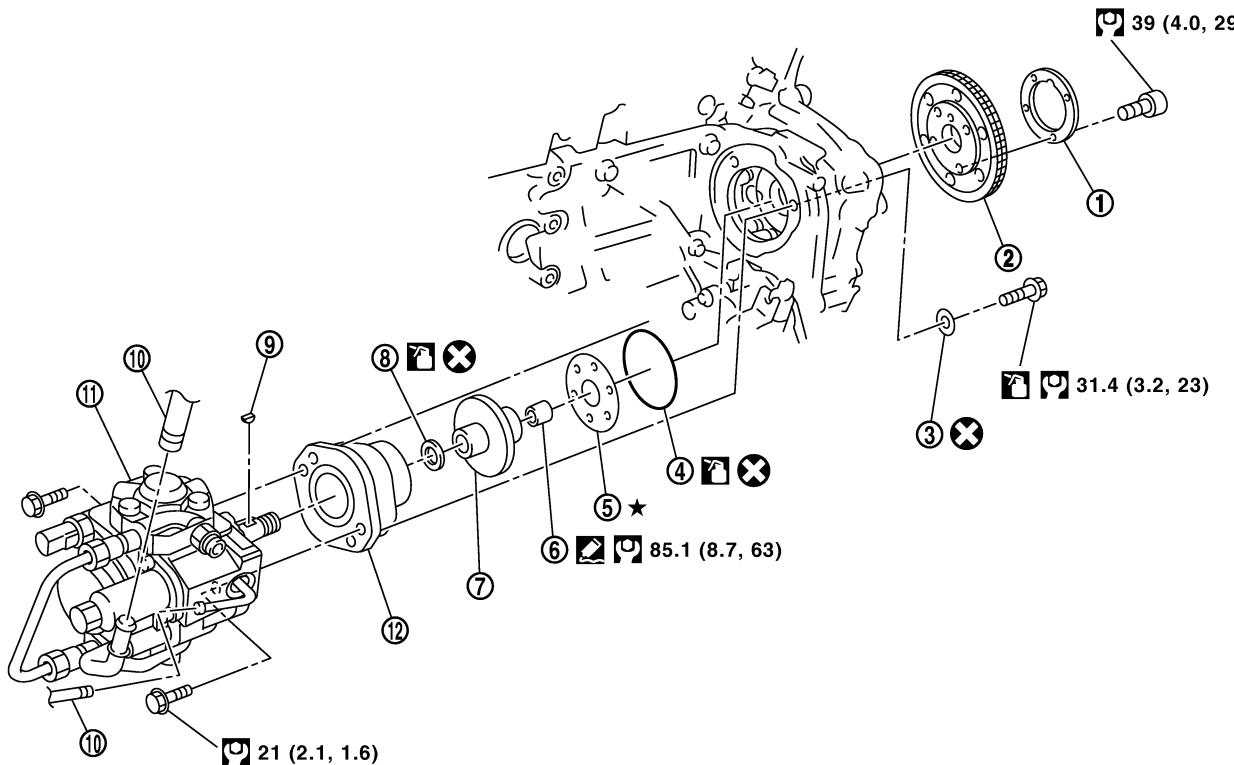
L

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CAUTION:

- Before removing and installing fuel pump, be sure to remove sprocket. Do not loosen or remove installation nut in the center of fuel pump. If loosened or removed, replace fuel pump.
- After removing timing chain, do not turn crankshaft and camshaft separately, or valves will strike piston heads.
- When installing camshafts, chain tensioners, oil seals, or other sliding parts, lubricate contacting surfaces with new engine oil.

SEC. 186



: Always replace after every disassembly.

: Selective parts

: Apply thread locking sealant.

: Lubricate with new engine oil.

: N·m (kg-m, ft-lb)

PBIC2317E

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

REMOVAL

- Remove engine coolant reservoir tank. Refer to [CO-34, "RADIATOR"](#).
- Remove charge air cooler. Refer to [EM-135, "Removal and Installation"](#).
- Remove RH engine mounting insulator and bracket. Refer to [EM-208, "Removal and Installation"](#).
- Pull power steering reservoir tank out of brackets to move power steering piping. Refer to [PS-34, "HYDRAULIC LINE"](#).

CAUTION:

To avoid removing power steering reservoir tank out of brackets, move it with power steering piping aside.

- Remove RH front wheel.

FUEL PUMP

[YD22DDTi]

6. Remove RH engine undercover.
7. Remove front exhaust tube. Refer to [EX-2, "EXHAUST SYSTEM"](#).
8. Remove fuel hoses from fuel pump.

CAUTION:

Be careful not to spill fuel in the engine component.

9. Disconnect harness connector from fuel pump.
10. Remove injection tube center, clip and insert rubber. Refer to [EM-157, "INJECTION TUBE AND FUEL INJECTOR"](#).

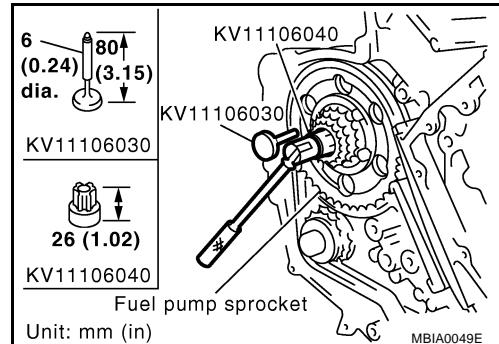
CAUTION:

Be careful not to spill fuel in the engine component.

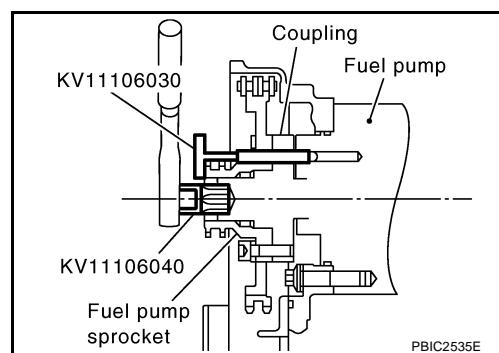
11. Remove secondary timing chain. Refer to [EM-180, "Removal and Installation"](#).

12. Hold fuel pump sprocket and remove bolt.

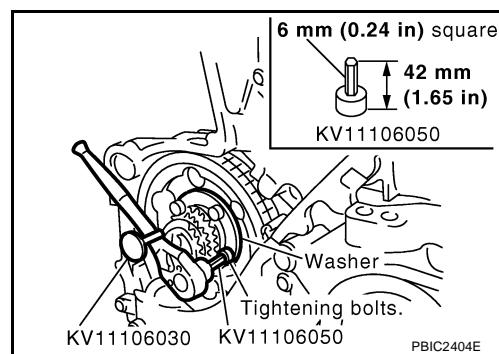
- a. Insert the positioning stopper pin (special service tool) into the hole 6 mm (0.24 in) in the diameter on the fuel pump sprocket.
- b. Using the TORX wrench (special service tool), turn pump shaft little by little to adjust the position of fuel pump sprocket so that the holes align.
- c. Push the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

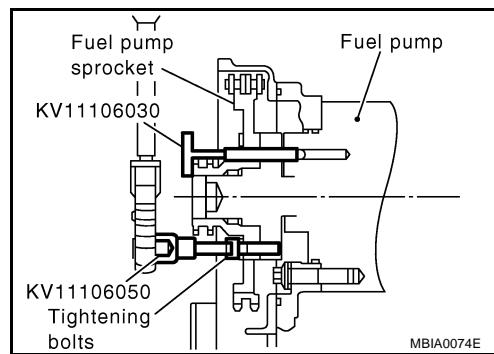


- Insert the positioning stopper pin until its flange contacts the fuel pump sprocket.



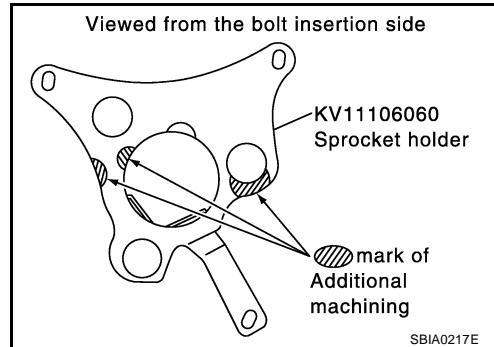
13. Using the hexagon wrench (special service tool) remove tightening bolts of fuel pump sprocket.



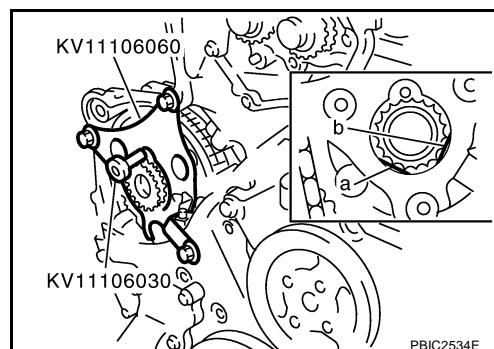


14. Using the sprocket holder (special service tool), hold fuel pump sprocket to prevent falling.

- For sprocket holder, use KV11106060 machined as shown in the figure, because the previous bore is not fitting.

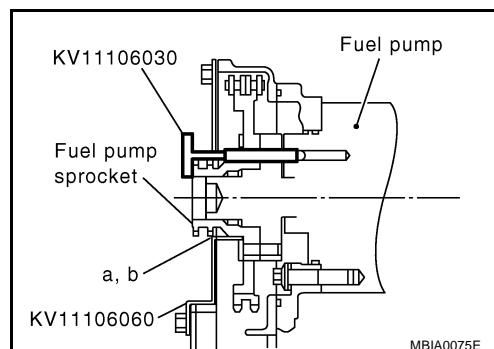


- When the sprocket holder is installed, if the positioning stopper pin (special service tool) interferes, pull out the positioning stopper pin approximately 10 mm (0.39 in), then install it.
- After the sprocket holder is installed temporarily, tighten the sprocket holder after making extension bar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



CAUTION:
Do not remove the sprocket holder (special service tool) until fuel pump is installed.

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



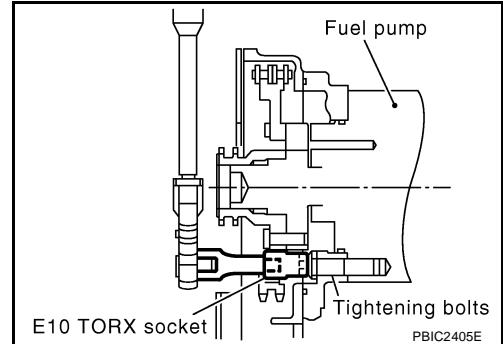
FUEL PUMP

[YD22DDTi]

15. Using the extension bar and the TORX socket (size: E10), remove the tightening bolts.

CAUTION:

Do not disassemble or adjust fuel pump.



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

CAUTION:

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

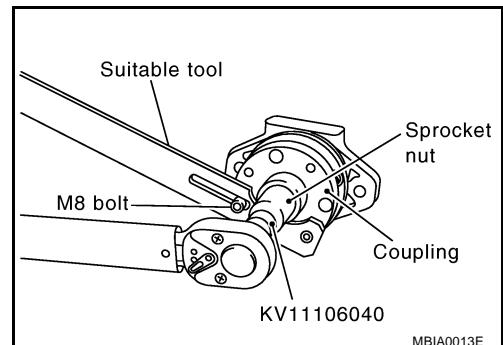
NOTE:

The seal washer of the tightening bolts cannot be reused.

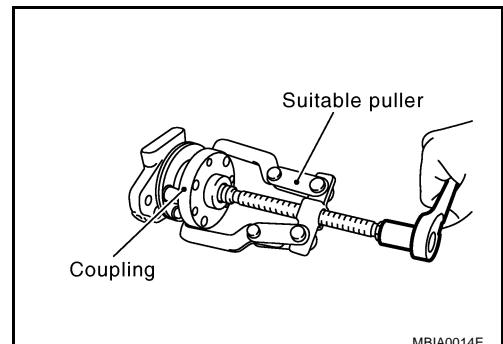
17. Remove adjust shim.

18. Attach a suitable tool in the M8 bolt hole on coupling.

19. Loosen sprocket nut with the TORX wrench (special service tool).



20. Remove coupling with a suitable puller.

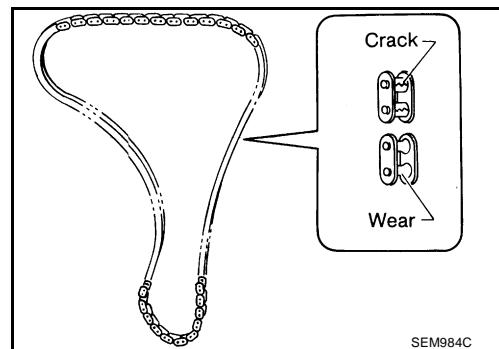


21. Remove spacer from fuel pump.

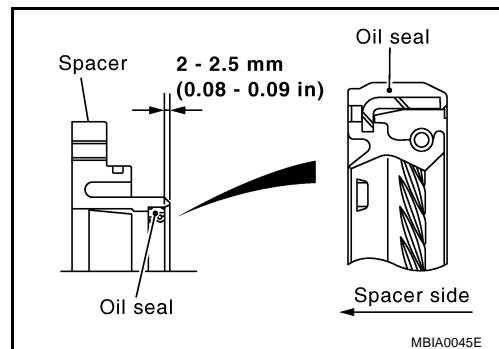
22. Remove oil seal from spacer.

INSPECTION AFTER REMOVAL**Timing Chain**

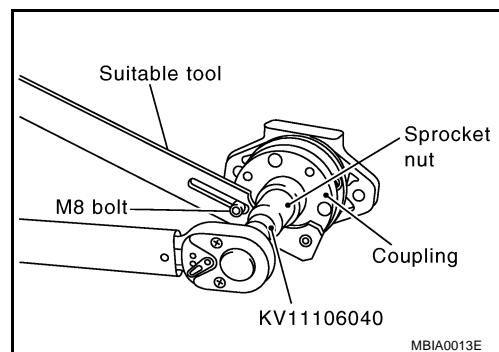
Check for cracks and excessive wear at roller links. Replace timing chain if necessary.

**INSTALLATION**

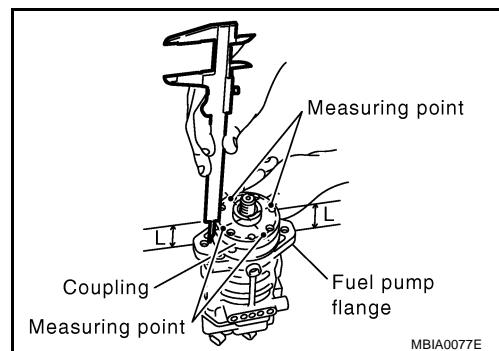
1. Install new oil seal to spacer.



2. Install spacer to fuel pump.
3. Install coupling to fuel pump of spacer.
 - Using the TORX wrench (special service tool), tighten the sprocket nut to fix the coupling.



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

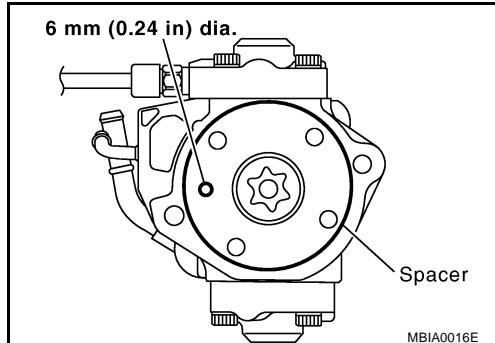


FUEL PUMP

[YD22DDTi]

Part No. of adjusting shim	Grade number	Measuring dimension L mm (in)
16614 8H800	0.5 t	39.23 - 39.77 (1.5445 - 1.5657)
16614 8H810	1.0 t	38.76 - 39.23 (1.5260 - 1.5445)
16614 8H860	1.2 t	38.57 - 38.76 (1.5185 - 1.5260)
16614 8H820	1.6 t	38.18 - 38.57 (1.5031 - 1.5185)

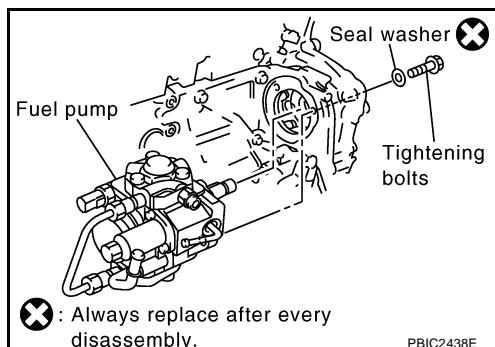
5. Before fuel pump is installed, make sure that spacer and the 6 mm (0.24 in) dia. hole on coupling are aligned.



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

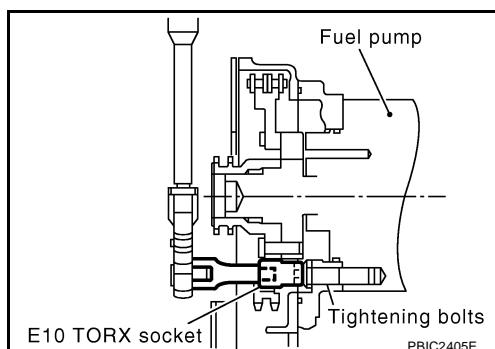
CAUTION:

Be careful not to drop the seal washer into engine.



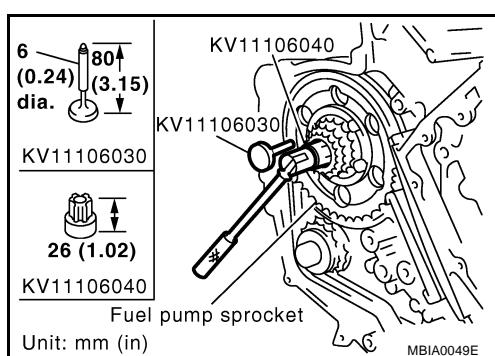
7. Using the extension bar and the TORX socket (size: E10), tighten the tightening bolts of fuel pump.

8. Remove the sprocket holder (special service tool).



9. Using the TORX wrench (special service tool), turn the pump shaft gradually to adjust the position of fuel pump sprocket. Then, insert the positioning stopper pin (special service tool) to the 6 mm (0.24 in) dia. hole of the fuel pump sprocket through the pump body.

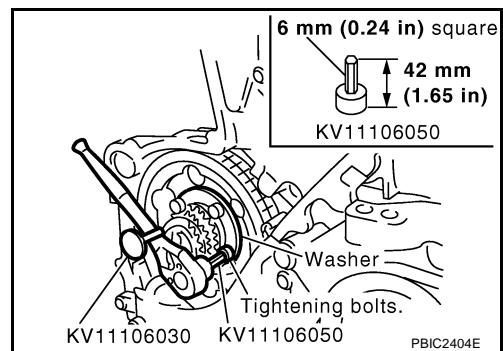
10. Remove the TORX wrench (special service tool).



FUEL PUMP

[YD22DDTi]

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



13. Install secondary timing chain. Refer to [EM-180, "Removal and Installation"](#).
14. Following steps below, install injection tube center. Refer to [EM-157, "INJECTION TUBE AND FUEL INJECTOR"](#).
 - a. Pre-set clip and insert rubber to injection tube center.
 - b. Pre-tight nut of injection tube center to fuel pump and fuel rail by hand. (until seal surface touched)
 - c. Adjust clip dimension and tight bolt for clip to intake manifold by tool.
 - d. Tight nut of injection tube center to fuel pump by tool.
 - e. Tight nut of injection tube center to fuel rail by tool.
15. Connect the harness connector to fuel pump.
16. Install fuel hoses.
17. Hereafter, install in the reverse order of removal.

ROCKER COVER

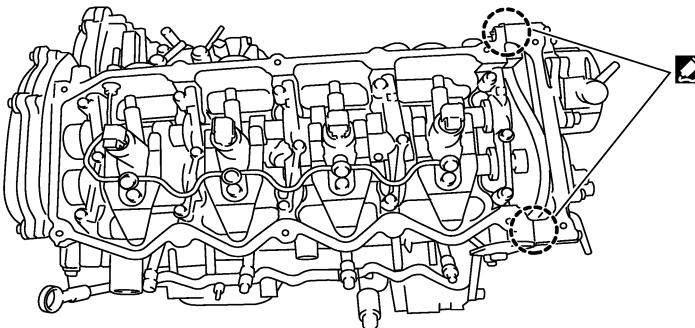
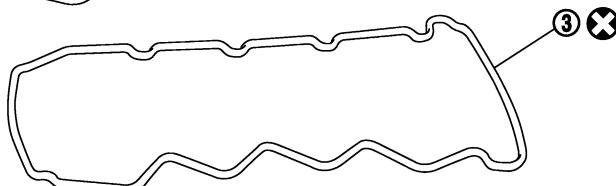
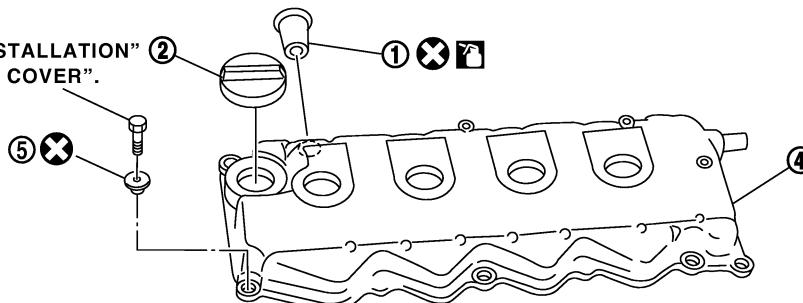
PFP:13264

Removal and Installation

EBS00LRQ

SEC. 111•118

Refer to "INSTALLATION" in "ROCKER COVER".



: Always replace after every disassembly.

: Lubricate with new engine oil.

: Apply Genuine Liquid Gasket or equivalent.

: N•m (kg-m, in-lb)

PBIC2318E

- | | | |
|--------------------|-------------------|-----------|
| 1. Nozzle oil seal | 2. Oil filler cap | 3. Gasket |
| 4. Rocker cover | 5. Washer | |

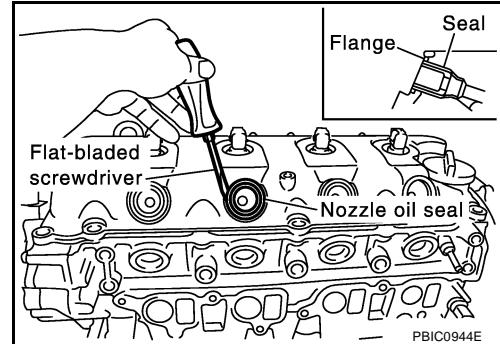
REMOVAL

1. Remove charge air cooler. Refer to [EM-135, "Removal and Installation"](#).
2. Disconnect harness connector from fuel injector. Refer to [EM-157, "INJECTION TUBE AND FUEL INJECTOR"](#).
3. Following steps below, remove injection tube. Refer to [EM-157, "INJECTION TUBE AND FUEL INJECTOR"](#).
 - a. Put a paint mark or tag on injection tubes to identify each cylinder.
 - Use a fuel-resistant method.
 - b. Remove injection tubes in order of 2-1-4-3 individually.

CAUTION:

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

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

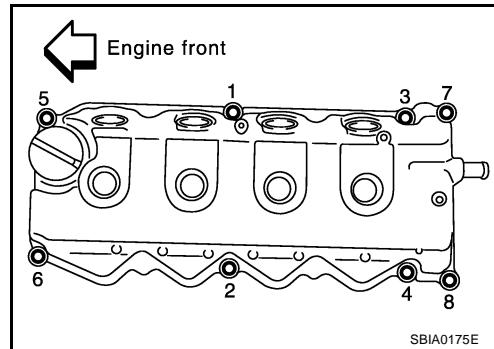


ROCKER COVER

[YD22DDTi]

5. Remove rocker cover.

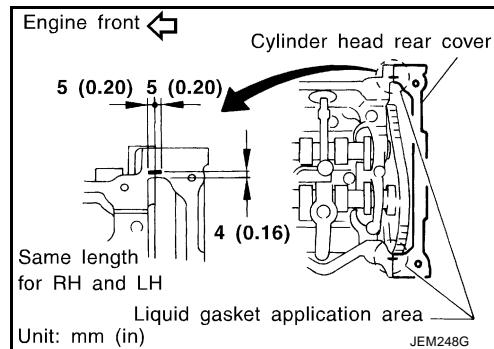
- Loosen holding bolts in reverse order of that shown in the figure and remove.



INSTALLATION

1. Apply 3.0 mm (0.118 in) dia. on locations shown in the figure.

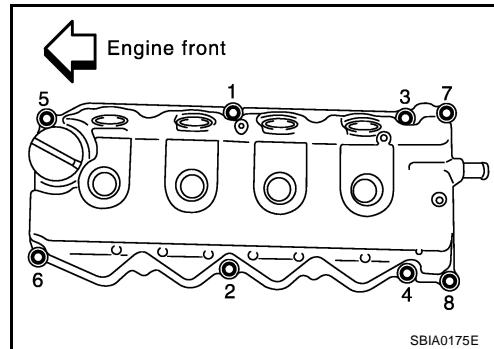
- Use Genuine Liquid Gasket or equivalent.



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

: 7.8 N·m (0.8 kg·m, 69 in-lb)

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



3. Install nozzle oil seal.

- Insert it straight until flange fully contacts rocker cover.

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

5. Before starting engine, bleed air from fuel piping. Refer to [FL-18, "Air Bleeding"](#).

INSPECTION AFTER INSTALLATION

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

CAUTION:

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

NOTE:

Use mirrors for checking at points out of clear sight.

A
EM
C
D
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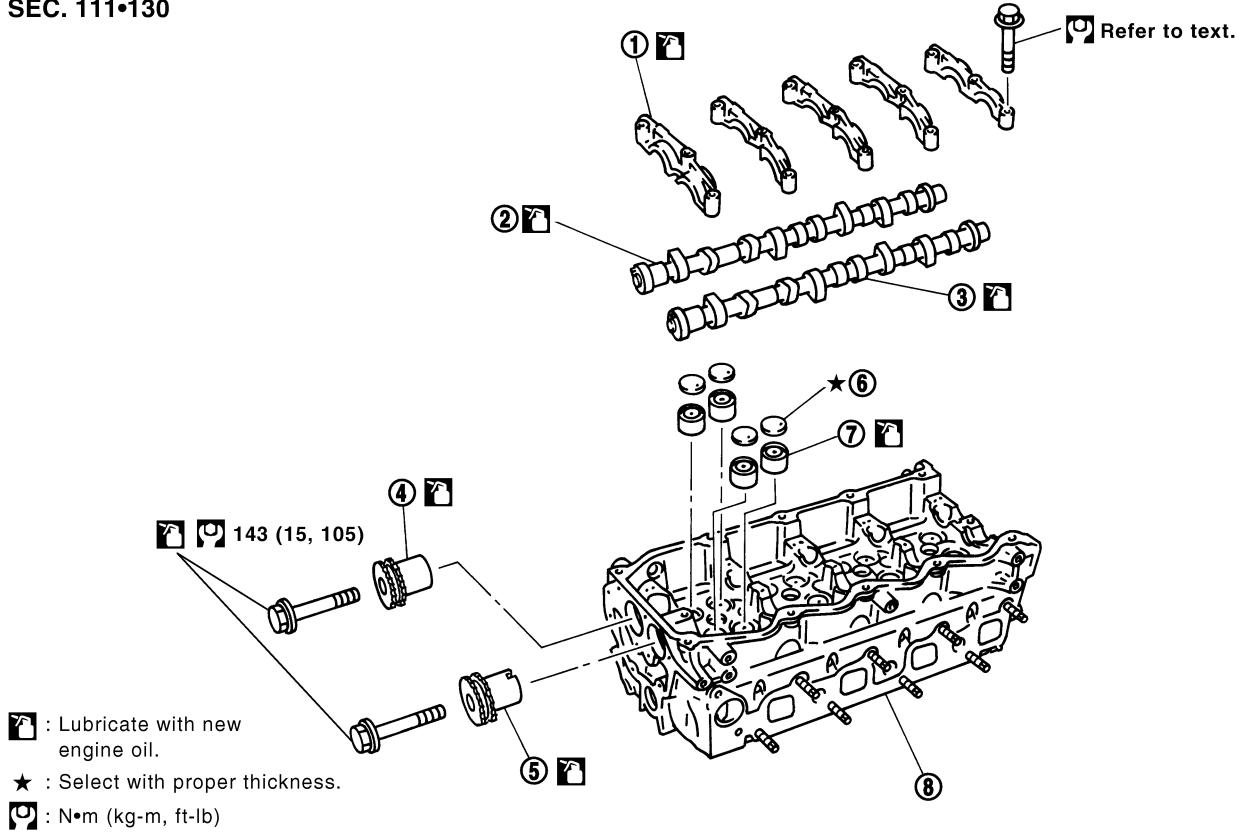
CAMSHAFT

PFP:13001

Removal and Installation

EBS00LRR

SEC. 111•130



PBIC2319E

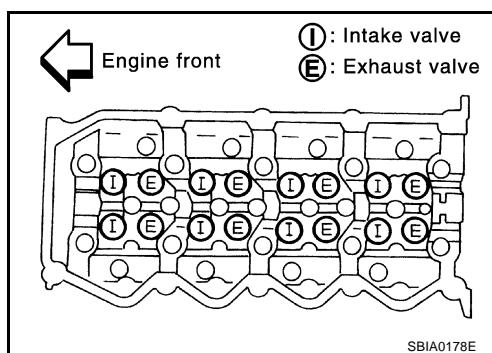
1. Camshaft bracket
2. Camshaft (right side)
3. Camshaft (left side)
4. Camshaft sprocket (right side)
5. Camshaft sprocket (left side)
6. Adjusting shim
7. Valve lifter
8. Cylinder head

CAUTION:

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

Camshaft (right side) : Intake manifold side
Camshaft (left side) : Exhaust manifold side

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

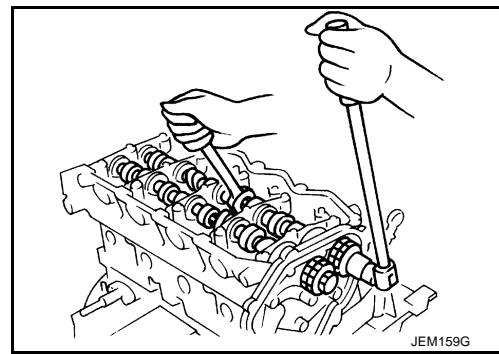
**REMOVAL**

1. Drain engine coolant. Refer to [CO-31, "Changing Engine Coolant"](#).
2. Remove charge air cooler. Refer to [EM-135, "Removal and Installation"](#).
3. Remove air duct. Refer to [EM-133, "Removal and Installation"](#).
4. Remove air inlet pipe. Refer to [EM-141, "EXHAUST MANIFOLD AND TURBOCHARGER"](#).
5. Remove rocker cover. Refer to [EM-168, "Removal and Installation"](#).
6. Remove vacuum pump. Refer to [EM-153, "Removal and Installation"](#).
7. Remove fuel injector. Refer to [EM-157, "Removal and Installation"](#).
8. Remove secondary timing chain. Refer to [EM-180, "Removal and Installation"](#).
9. Remove camshaft sprockets.

CAMSHAFT

[YD22DDTi]

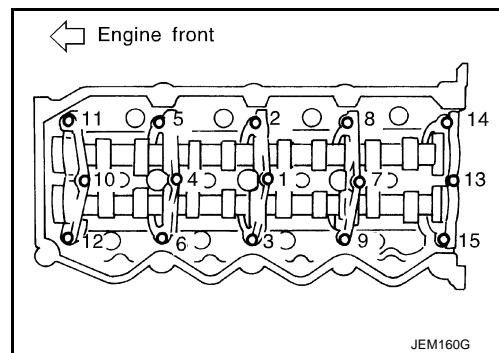
- Loosen the camshaft sprocket mounting bolt by fixing the hexagonal portion of camshaft.



JEM159G

10. Remove camshaft.

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



JEM160G

11. Remove adjusting shim and valve lifter.

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

INSPECTION AFTER REMOVAL

Visual Check of Camshaft

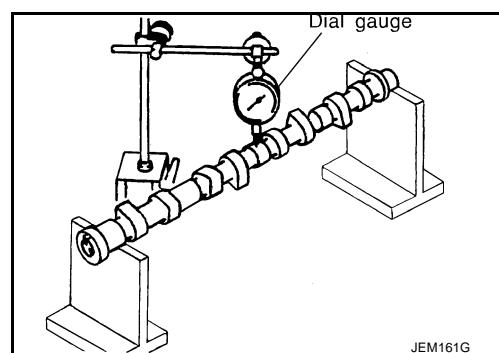
- Check the camshaft for one sided wear or scratches.
- Replace the camshaft if there are abnormalities.

Camshaft Runout

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

Limit : 0.02 mm (0.0008 in)

- If it exceeds the limit, replace camshaft.



JEM161G

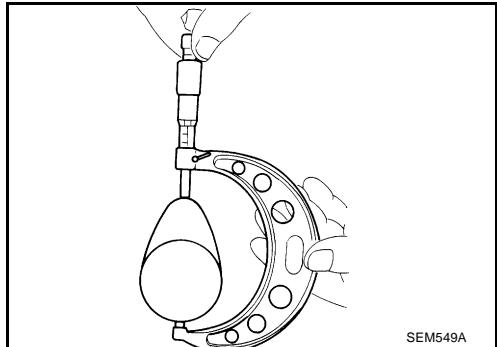
Height of Cam Nose

- Measure the height of cam nose using the micrometer.

Standard:

Intake : 39.505 - 39.695 mm (1.5553 - 1.5628 in)
 Exhaust : 39.905 - 40.095 mm (1.5711 - 1.5785 in)

- If out of the standard, replace camshaft.



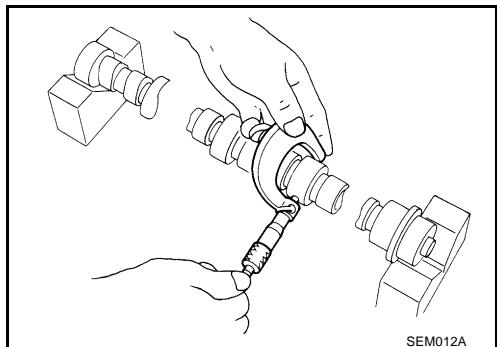
Camshaft Journal Oil Clearance

Camshaft journal outer diameter

- Measure outer diameter of camshaft journal with micrometer.

Standard:

No. 1	: 30.435 - 30.455 mm (1.1982 - 1.1990 in)
No. 2, 3, 4, 5	: 23.935 - 23.955 mm (0.9423 - 0.9431 in)

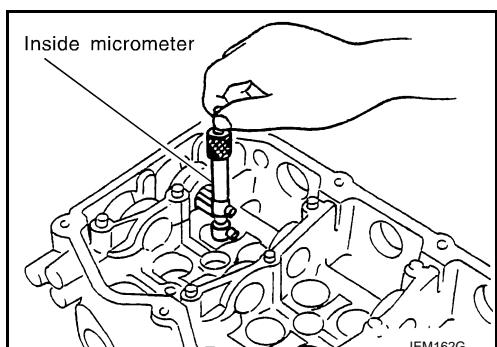


Camshaft Bracket Inner Diameter

- Install camshaft bracket and tighten bolts to the specified torque. Refer to [EM-174, "INSTALLATION"](#) for the tightening procedure.
- Measure inner diameter of camshaft bracket using the inside micrometer.

Standard:

No. 1	: 30.500 - 30.521 mm (1.2008 - 1.2016 in)
No. 2, 3, 4, 5	: 24.000 - 24.021 mm (0.9449 - 0.9457 in)



Camshaft Oil Clearance Calculations

- $(\text{Oil clearance}) = (\text{Camshaft bracket inner diameter}) - (\text{Camshaft journal outer diameter})$

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

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

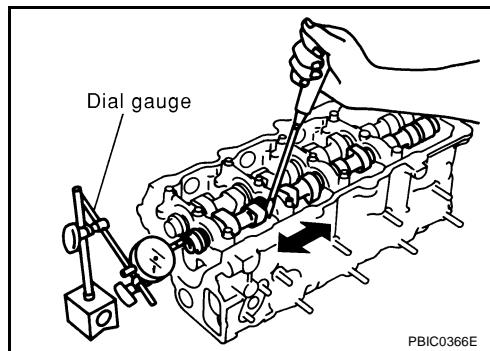
NOTE:

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

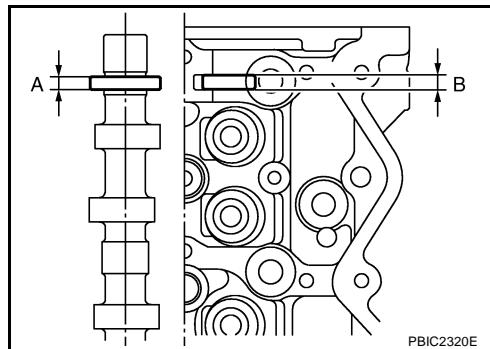
Camshaft End Play

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

Standard : 0.070 - 0.148 mm (0.0028 - 0.0058 in)
Limit : 0.24 mm (0.0094 in)

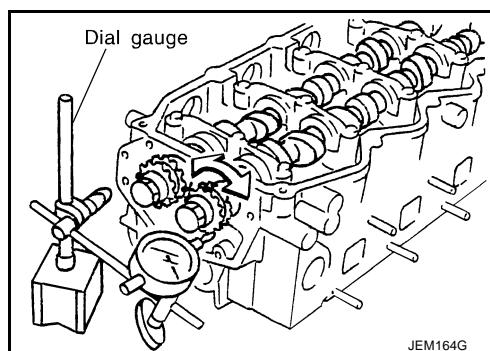


- Measure the following parts if out of the standard.
 - Dimension "A" for camshaft
- Standard : 6.882 - 6.930 mm (0.2709 - 0.2728 in)**
- Dimension "B" for cylinder head
- Standard : 7.000 - 7.030 mm (0.2755 - 0.2767 in)**
- Refer to the standards above, and then replace camshaft and/or cylinder head.



Camshaft Sprocket Runout

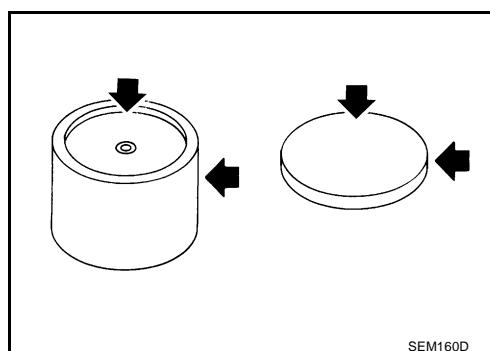
- Install camshaft in cylinder head. Refer to [EM-174, "INSTALLATION"](#) for the tightening procedure.
 - Install sprocket on camshaft. Refer to [EM-174, "INSTALLATION"](#).
 - Measure camshaft sprocket runout. (Total indicator reading)
Limit : 0.15 mm (0.0059 in)
- If it exceeds the limit, replace camshaft sprocket.



Visual Inspection of Valve Lifter and Adjusting Shim

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

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

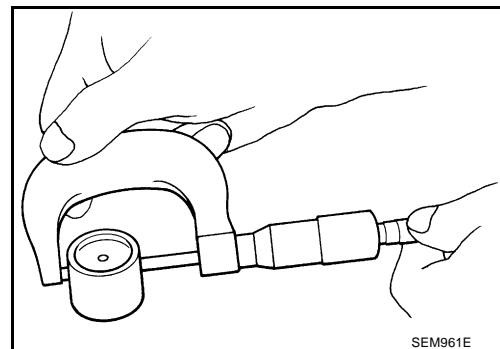


Valve Lifter Clearance

Valve Lifter Outer Diameter

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

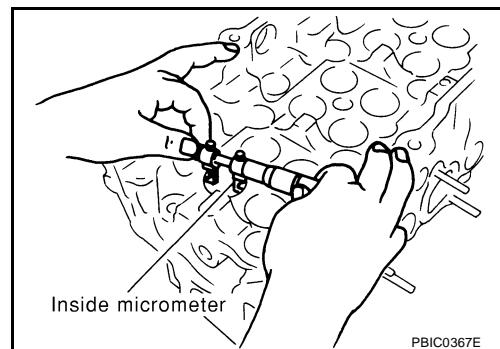
Standard : 29.960 - 29.975 mm (1.1795 - 1.1801 in)



Valve Lifter Bore Diameter

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

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



Valve Lifter Clearance Calculations

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

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

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

INSTALLATION

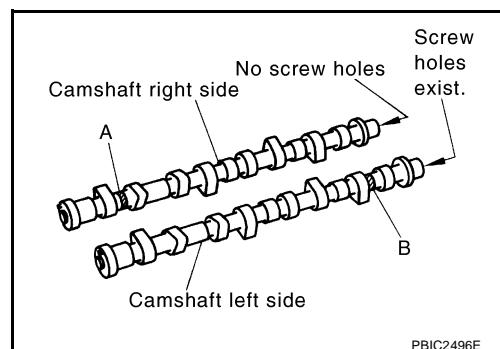
- Install valve lifter and adjusting shim.
 - Make sure that these are installed in the same position as before the removal process.
- Install camshaft.
 - Identify camshafts by the paint position and screw hole at the rear end.

Camshaft (right side) Intake manifold side:

Paint is at position A (Brown) without screw hole.

Camshaft (left side) Exhaust manifold side:

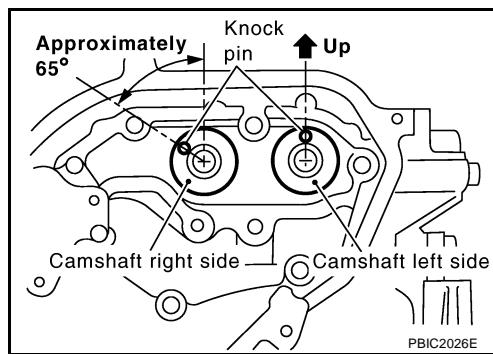
Paint is at position B (Pink) with screw hole.



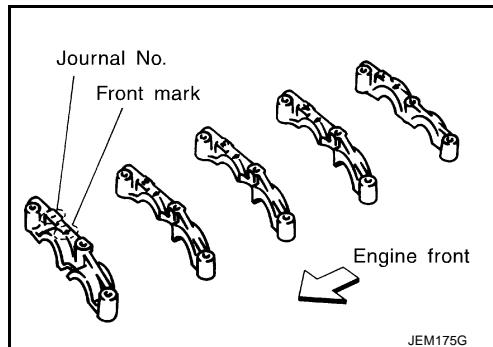
CAMSHAFT

[YD22DDTi]

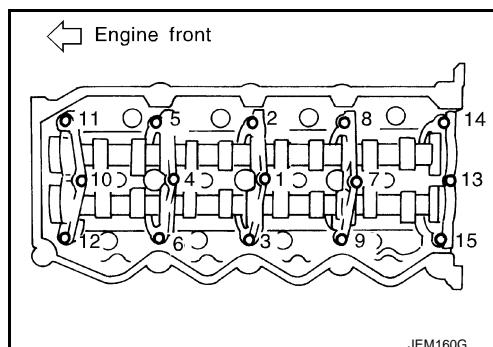
- Install so that knock pins are positioned in the directions shown in the figure.



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



4. Tighten bolts in the order shown in the figure according to the following procedure:
 - a. Tighten all bolts.
扳手 : 2 N·m (0.2 kg·m, 1 ft-lb)
 - Make sure camshaft thrusting parts (on rear side) securely fit in their mating parts on the cylinder head.
 - b. Tighten all bolts.
扳手 : 6 N·m (0.6 kg·m, 4 ft-lb)
 - c. Tighten all bolts.
扳手 : 12 - 13 N·m (1.2 - 1.4 kg·m, 9 - 10 ft-lb)



5. Install camshaft sprockets.
 - Camshaft sprockets are commonly used for right side and left side.
 - Align camshaft sprocket and knock pin on camshaft, and install.
 - Holding the hexagonal part of camshaft with a wrench, tighten bolt securing camshaft sprocket.
6. Before installing spill tube after installing secondary timing chain, check and adjust valve clearance. Refer to [EM-175, "Valve Clearance"](#).
7. Hereafter, install in the reverse order of removal.

Valve Clearance INSPECTION

EBS00LRS

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

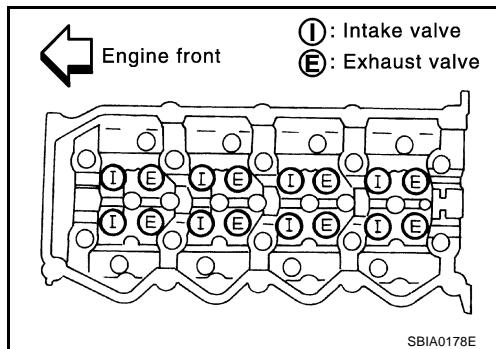
CAMSHAFT

[YD22DDTi]

- Be careful of the intake and exhaust valve arrangement. The valve arrangement is different from that in a normal engine.

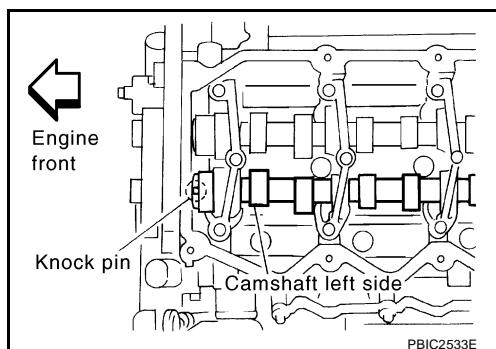
NOTE:

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

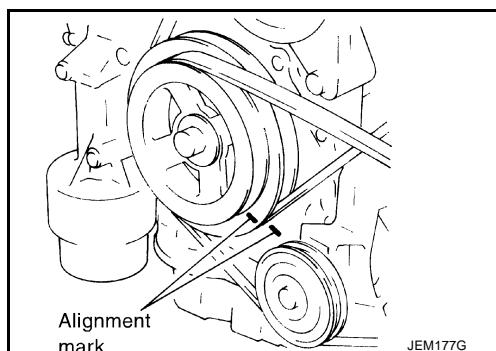


- Remove charge air cooler. Refer to [EM-135, "Removal and Installation"](#).
- Remove air duct. Refer to [EM-133, "Removal and Installation"](#).
- Remove rocker cover. Refer to [EM-168, "Removal and Installation"](#).
- Remove fuel injector. Refer to [EM-157, "Removal and Installation"](#).
- Set the No. 1 piston to TDC on its compression stroke.

- Turn crankshaft pulley clockwise so that the knock pin on camshaft left side faces straight above. (No position indicator, etc. is provided on the crankshaft pulley.)



- Put an alignment mark with paint, etc. on crankshaft pulley and on oil pump housing as an angle indicator.

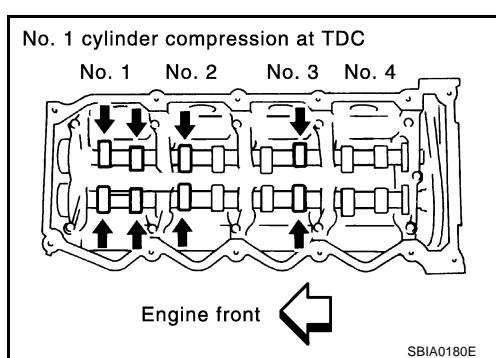


- While referring to the figure, measure the valve clearance marked in the table below.

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

NOTE:

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

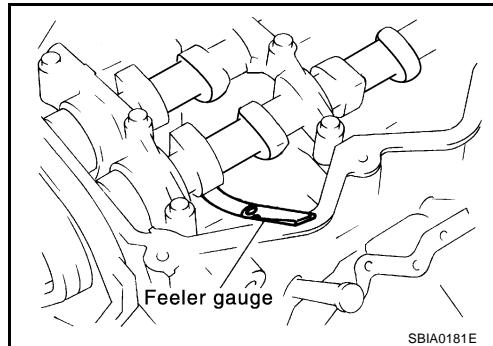


- Measure the valve clearance using the feeler gauge when engine is cool (at normal temperature).

Valve clearance (Cold):

Standard:

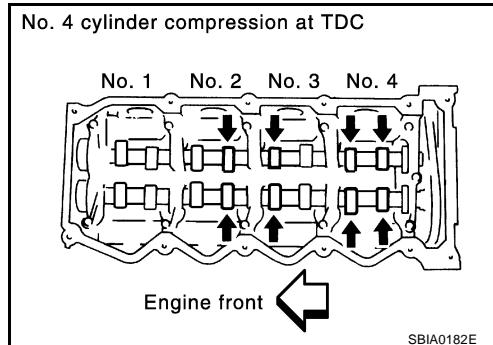
Intake : 0.24 - 0.32 mm (0.0094 - 0.0126 in)
 Exhaust : 0.26 - 0.34 mm (0.0102 - 0.0134 in)



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

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

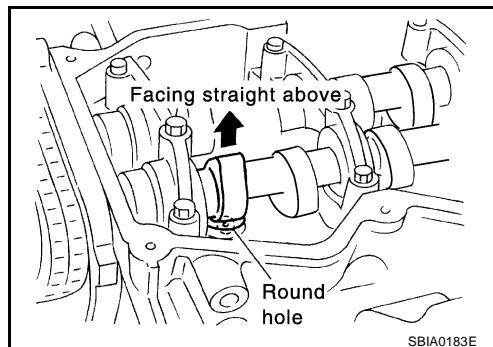
- If the valve clearance is outside the specification, adjust as follows.



ADJUSTMENTS

- Remove adjusting shim for parts which are outside the specified valve clearance.

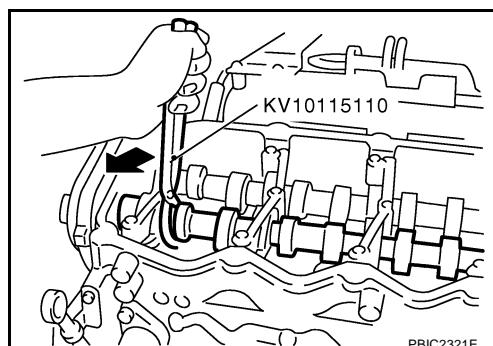
 - Extract engine oil on the upper side of the cylinder head (for the air blowing in step 6).
 - Rotate crankshaft to face the camshaft for adjusting shims that are to be removed upward.



- Grip camshaft with the camshaft pliers (special service tool), then using camshaft as a support point, push adjusting shim downward to compress valve spring.

CAUTION:

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



CAMSHAFT

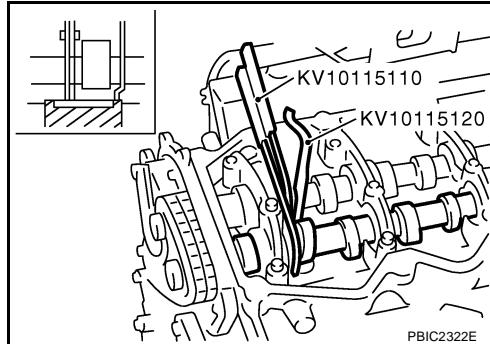
[YD22DDTi]

- With valve spring in a compressed state, remove the camshaft pliers (special service tool) by securely setting the outer circumference of the valve lifter with the end of the lifter stopper (special service tool).

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

CAUTION:

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



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

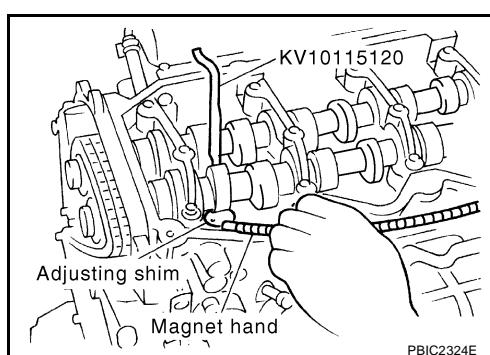
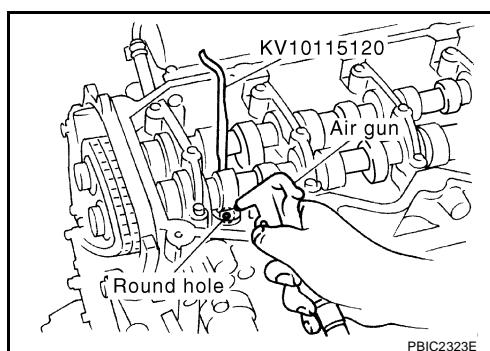
- When adjusting shim on valve lifter will not rotate smoothly, restart from step 3 to release the end of the lifter stopper (special service tool) from touching adjusting shim.

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

CAUTION:

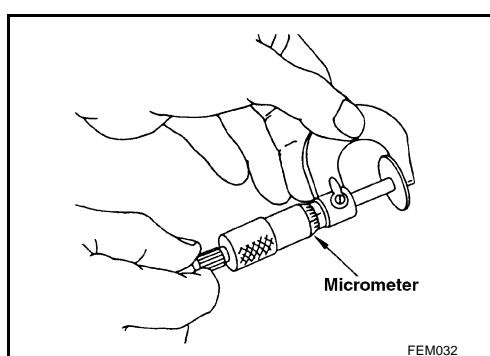
To prevent any remaining engine oil from being blown around, thoroughly wipe the area clean and wear protective goggles.

- Remove adjusting shim by using the magnet hand.



- Measure the thickness of adjusting shim using the micrometer.

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



- Select the new adjusting shim from the following methods.

Calculation method of the adjusting shim thickness:

R = Thickness of removed shim

N = Thickness of new shim

M = Measured valve clearance

Intake

N = R + [M - 0.28 mm (0.0010 in)]

Exhaust

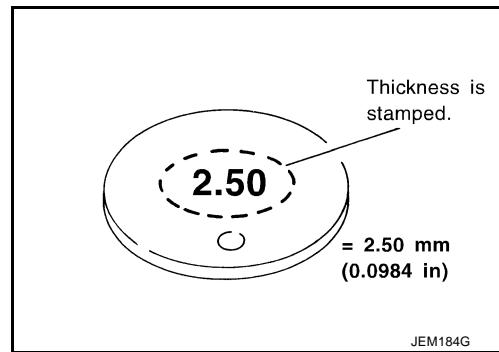
N = R + [M - 0.30 mm (0.0118 in)]

CAMSHAFT

[YD22DDTi]

- New adjusting shims have the thickness stamped on the rear side.

Stamped mark	Shim thickness mm (in)
2.10	2.10 (0.0827)
2.12	2.12 (0.0835)
.	.
.	.
2.74	2.74 (0.1079)

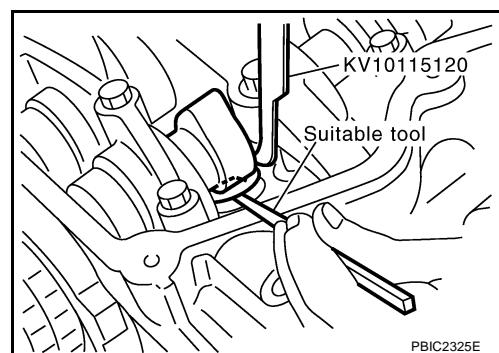


- Shims are available in 33 size from 2.10 mm (0.0827 in) to 2.74 mm (0.1079 in), in steps of 0.02 mm (0.0008 in).

10. Fit the selected adjusting shim to valve lifter.

CAUTION:

Place the stamped side of adjusting shim to valve lifter.



11. Compress valve spring using the camshaft pliers (special service tool: KV10115110) and remove the lifter stopper (special service tool).

12. Rotate crankshaft 2 to 3 turns by hand.

13. Confirm that the valve clearance is within the specification.

Valve clearance:

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

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

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

SECONDARY TIMING CHAIN

[YD22DDTi]

SECONDARY TIMING CHAIN

PFP:13028

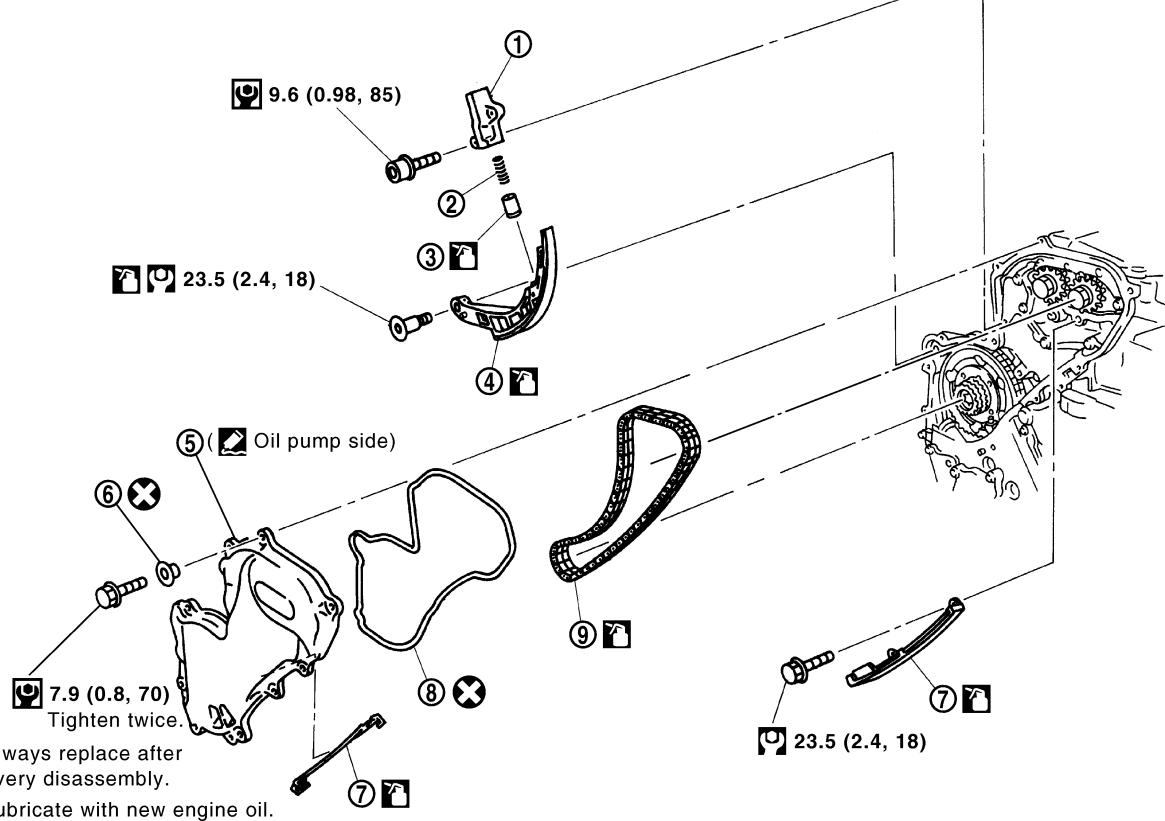
Removal and Installation

EBS001RT

CAUTION:

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

SEC. 130-135



PBIC2326E

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

REMOVAL

- For preparative work for removing/installing secondary timing chain to remove/install fuel pump, refer to [EM-161, "FUEL PUMP"](#).
 - To prepare for removing/installing secondary timing chain to remove/install camshaft, refer to [EM-170, "Removal and Installation"](#).
- Remove engine coolant reservoir tank. Refer to [CO-34, "RADIATOR"](#).
 - Remove RH engine mounting insulator and bracket. Refer to [EM-208, "Removal and Installation"](#).
 - Pull power steering reservoir tank out of brackets to move power steering piping. Refer to [PS-34, "HYDRAULIC LINE"](#).
- CAUTION:**
To avoid removing power steering reservoir tank out of brackets, move it with power steering piping aside.
- Remove front chain case.

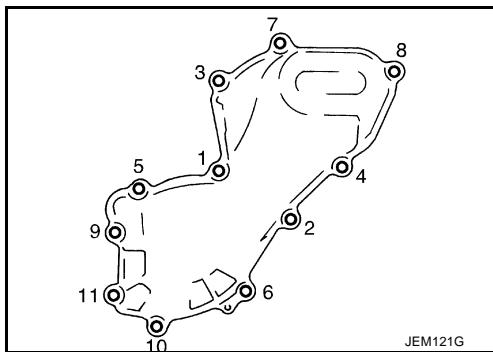
SECONDARY TIMING CHAIN

[YD22DDTi]

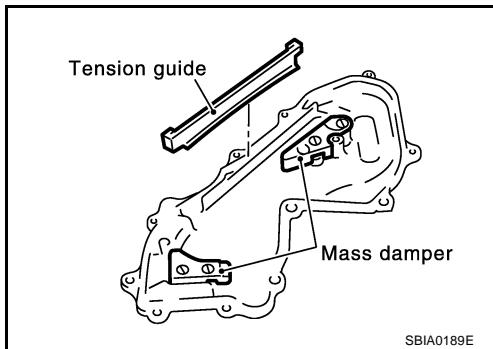
- Loosen fixing bolts in reverse order of that shown in the figure and remove them.
- Remove No. 6, 10 and 11 bolts with the rubber washer as space is limited for pulling them out.

CAUTION:

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

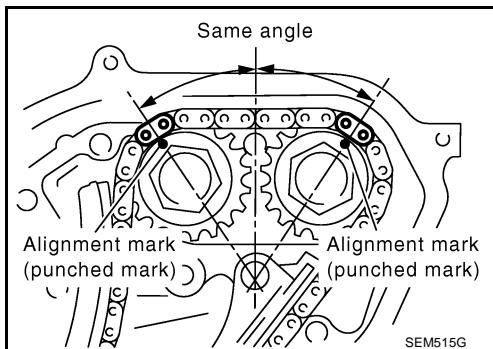


- Do not remove two mass dampers on the back of cover.



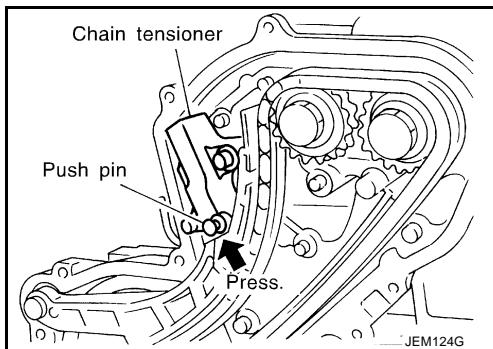
5. Set the No. 1 piston to TDC on its compression stroke.

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



6. Remove chain tensioner.

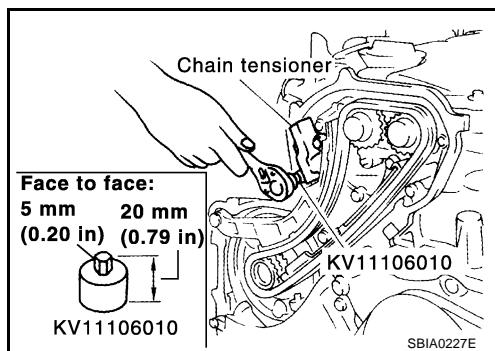
- a. Push the plunger of chain tensioner and keep it pressed with a push pin.



SECONDARY TIMING CHAIN

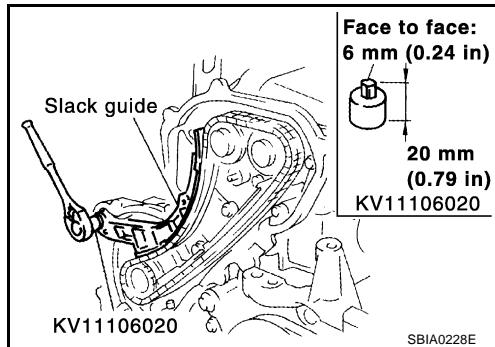
[YD22DDTi]

- b. Using the hexagon wrench (special service tool), remove bolts to remove chain tensioner.



7. Remove slack guide.

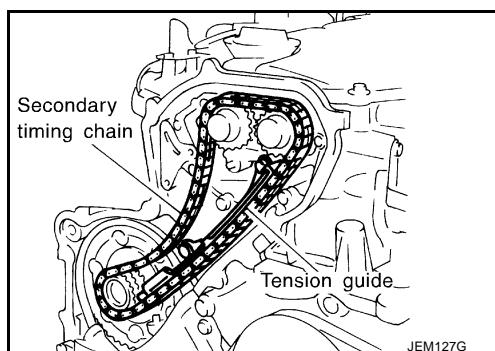
- Using the hexagon wrench (special service tool), remove bolt to remove slack guide.



8. Remove tension guide.

9. Remove secondary timing chain.

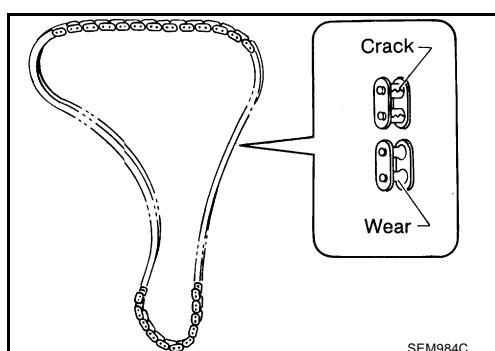
- Timing chain alone can be removed without removing sprockets.



INSPECTION AFTER REMOVAL

Timing Chain

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



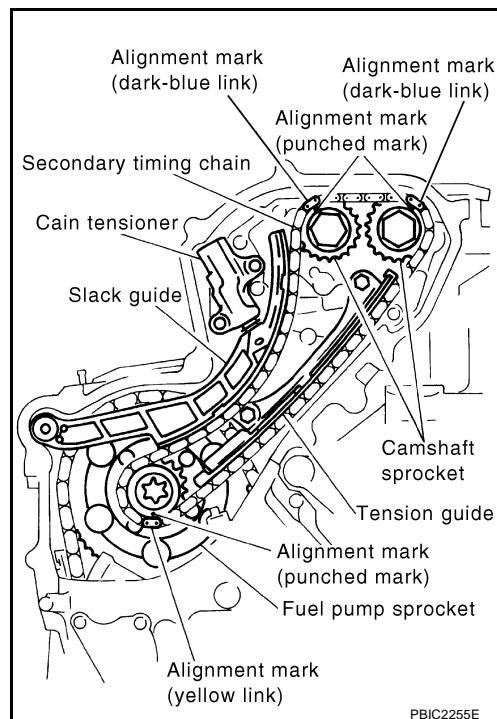
INSTALLATION

- Install secondary timing chain.

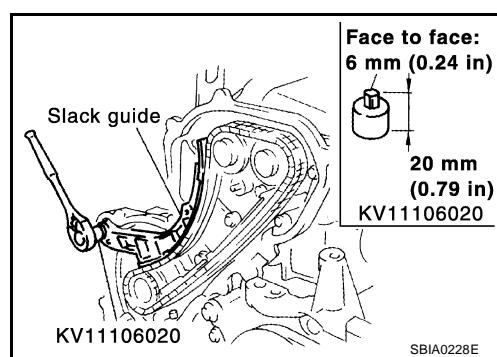
SECONDARY TIMING CHAIN

[YD22DDTi]

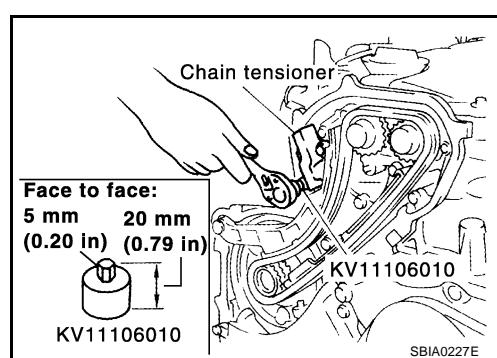
- When installing, match the alignment marks on sprockets with color coded alignment marks (colored links) on the timing chain.
2. Install tension guide.
 - The upper bolt has a longer shank than the lower bolt.



3. Using the hexagon wrench (special service tool), install slack guide.



4. Install chain tensioner.
- a. Push the plunger of chain tensioner. While holding it with a push pin, install chain tensioner.
 - b. Using the hexagon wrench (special service tool), tighten bolts.
 - c. Pull out the push pin, etc. holding the plunger.
- **Make sure again that the alignment marks on the sprockets and the colored alignment marks on the timing chain are aligned.**

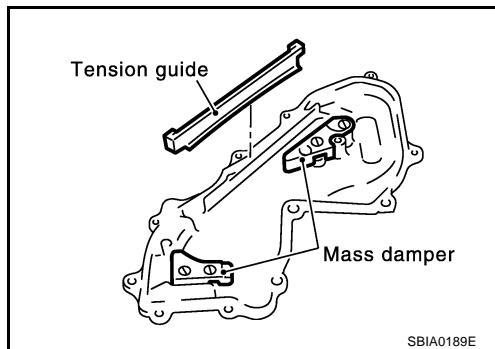


5. Install front chain case.

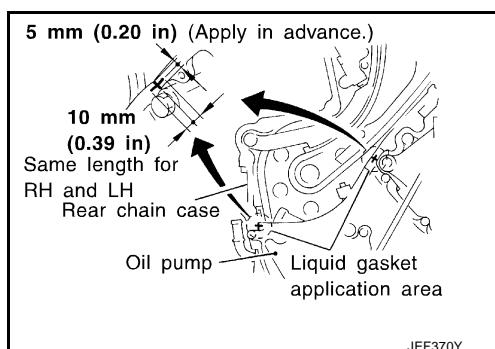
SECONDARY TIMING CHAIN

[YD22DDTi]

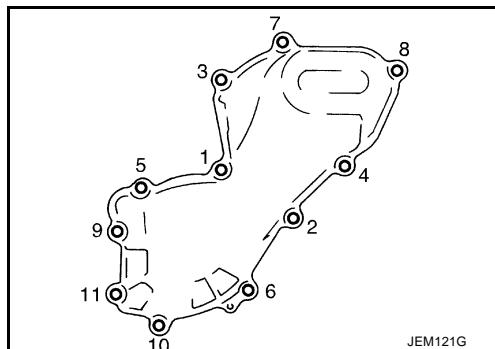
- a. Install tension guide on the back surface of front chain case.
 - Hold front chain case vertically when installing. Tension guide may come off if front chain case is tilted.



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



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



6. Hereafter, install in the reverse order of removal.

PRIMARY TIMING CHAIN

PFP:13028

Removal and Installation

EBS00LRU

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CAUTION:

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

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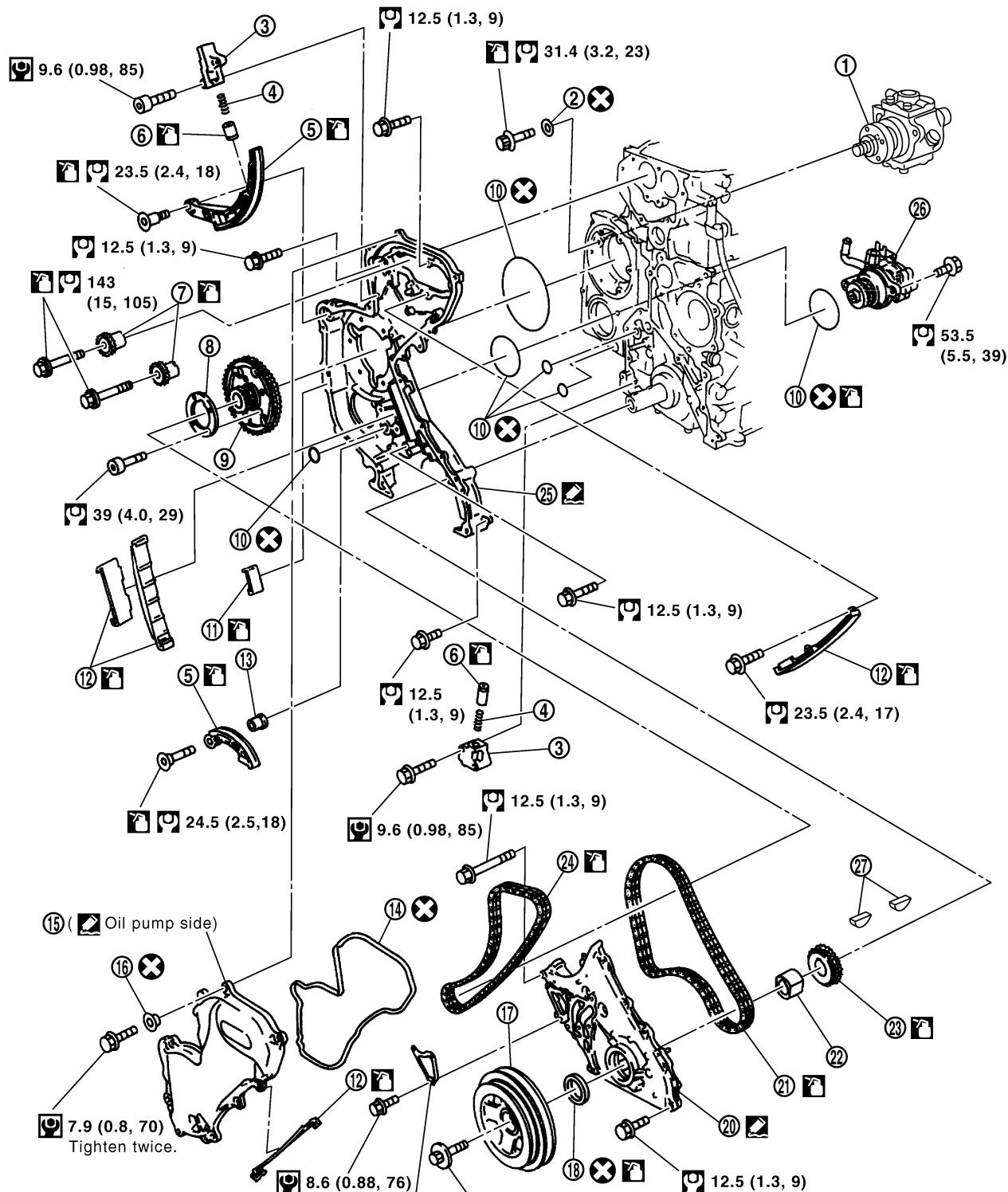
L

M

PRIMARY TIMING CHAIN

[YD22DDTi]

SEC. 120•130•135•186•490



: Lubricate with new engine oil.

: Apply Genuine Liquid Gasket or equivalent.

: N•m (kg-m, in-lb)

: N•m (kg-m, ft-lb)

: Always replace after every disassembly.

Refer to text.

- | | | |
|----------------------|----------------|-----------------------|
| 1. Fuel pump | 2. Seal washer | 3. Chain tensioner |
| 4. Spring | 5. Slack guide | 6. Plunger |
| 7. Camshaft sprocket | 8. Washer | 9. Fuel pump sprocket |

PBIC2327E

PRIMARY TIMING CHAIN

[YD22DDTi]

10. O-ring	11. Chain guide	12. Tension guide
13. Spacer	14. Gasket	15. Front chain case
16. Rubber washer	17. Crankshaft pulley	18. Front oil seal
19. Power steering oil pump cover	20. Oil pump housing	21. Primary timing chain
22. Oil pump drive spacer	23. Crankshaft sprocket	24. Secondary timing chain
25. Rear chain case	26. Power steering oil pump	27. Key

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REMOVAL

1. Remove engine coolant reservoir tank. Refer to [CO-34, "RADIATOR"](#).
2. Remove charge air cooler. Refer to [EM-135, "Removal and Installation"](#).
3. Remove air cleaner and air duct. Refer to [EM-133, "Removal and Installation"](#).
4. Remove rocker cover. Refer to [EM-168, "Removal and Installation"](#).
5. Remove RH engine mounting insulator and bracket. Refer to [EM-208, "Removal and Installation"](#).
6. Pull power steering reservoir tank out of brackets to move power steering piping. Refer to [PS-34, "HYDRAULIC LINE"](#).

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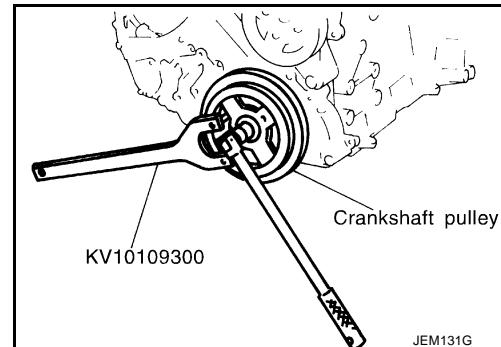
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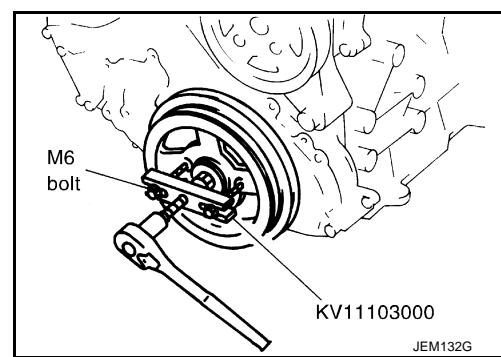
CAUTION:

To avoid removing power steering reservoir tank out of brackets move it with power steering piping aside.

7. Remove oil pan (upper and lower). Refer to [EM-147, "Removal and Installation"](#).
8. Remove oil filter bracket. Refer to [LU-26, "OIL FILTER BRACKET"](#).
9. Remove fuel injector. Refer to [EM-157, "Removal and Installation"](#).
10. Remove secondary timing chain and associated parts. Refer to [EM-180, "Removal and Installation"](#).
11. When removing rear chain case, remove camshaft sprockets. Refer to [EM-170, "Removal and Installation"](#).
12. Remove crankshaft pulley.
 - a. Hold crankshaft pulley with the pulley holder (special service tool).
 - b. Loosen crankshaft pulley fixing bolt and pull out the bolt approximately 10 mm (0.39 in).



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

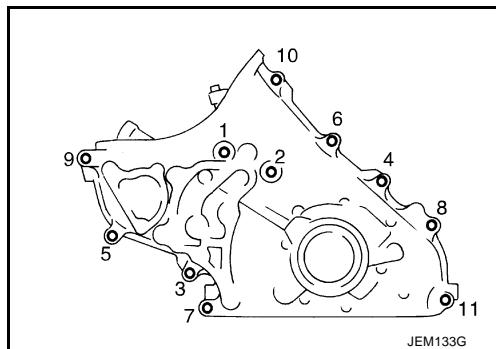


13. Remove oil pump housing.

PRIMARY TIMING CHAIN

[YD22DDTi]

- Loosen bolts in reverse order of that shown in the figure and remove them.
- Use the seal cutter (special service tool: KV10111100) etc. for removal.



14. Remove front oil seal from oil pump housing.

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

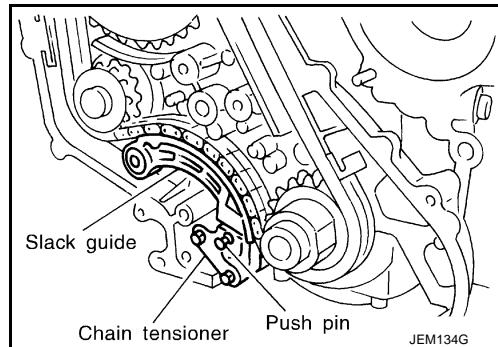
CAUTION:

Be careful not to damage oil pump housing.

15. Remove chain tensioner.

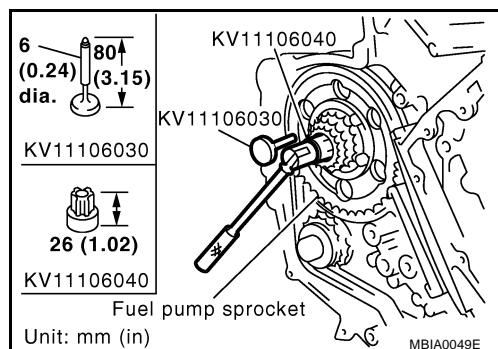
- When removing chain tensioner, push the plunger of chain tensioner and keep it pressed with a push pin, etc.

16. Remove slack guide.

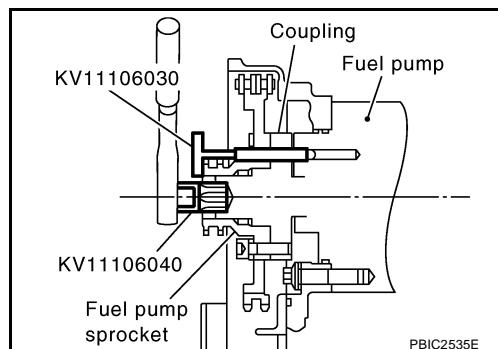


17. Hold fuel pump sprocket and remove bolt.

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



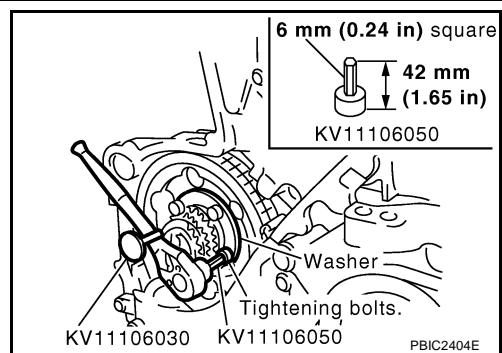
- Insert the positioning stopper pin until its flange contacts fuel pump sprocket.



PRIMARY TIMING CHAIN

[YD22DDTi]

18. Using the hexagon wrench (special service tool) remove tightening bolts to fuel pump sprocket.



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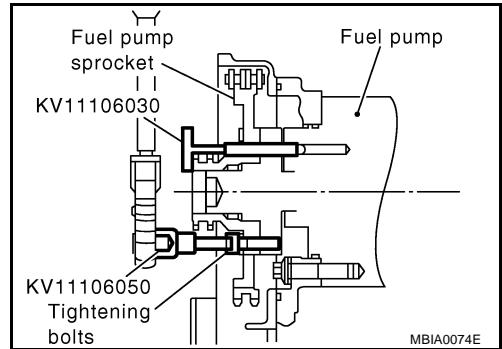
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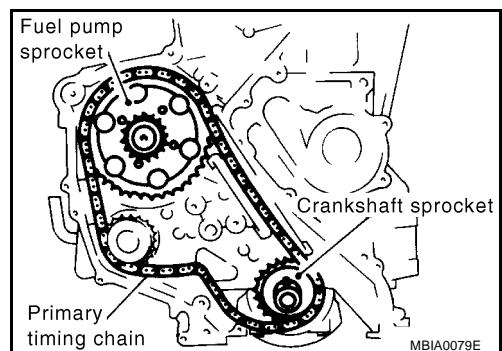
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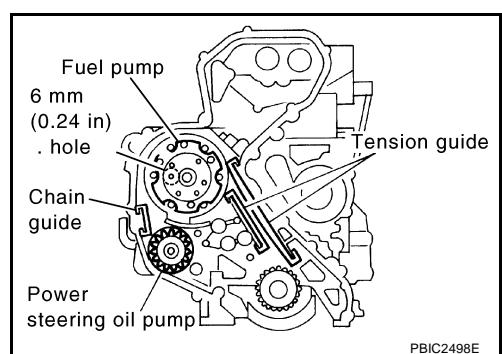
M



19. Remove primary timing chain with fuel pump sprocket and crankshaft sprocket.



20. Remove chain guide and tension guides.



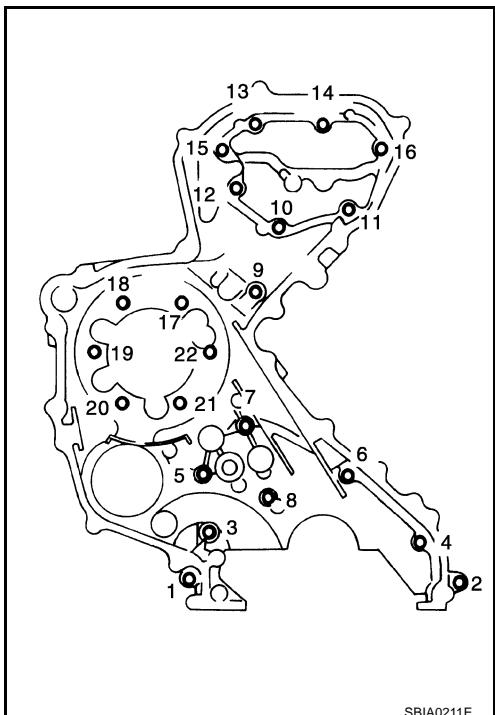
21. Remove fuel pump. Refer to [EM-161, "FUEL PUMP"](#).
22. Remove power steering oil pump.

PRIMARY TIMING CHAIN

[YD22DDTi]

23. Remove rear chain case.

- Loosen fixing bolts in reverse order of that shown in the figure and remove them.
- Use the seal cutter (special service tool: KV10111100) for removal.

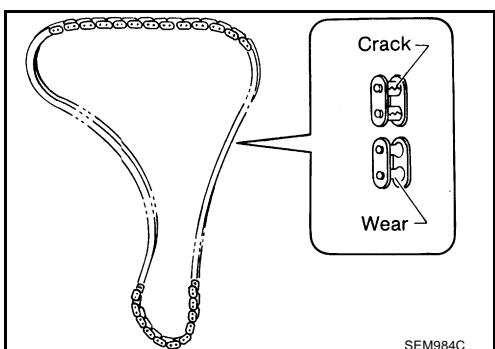


SBIA0211E

INSPECTION AFTER REMOVAL

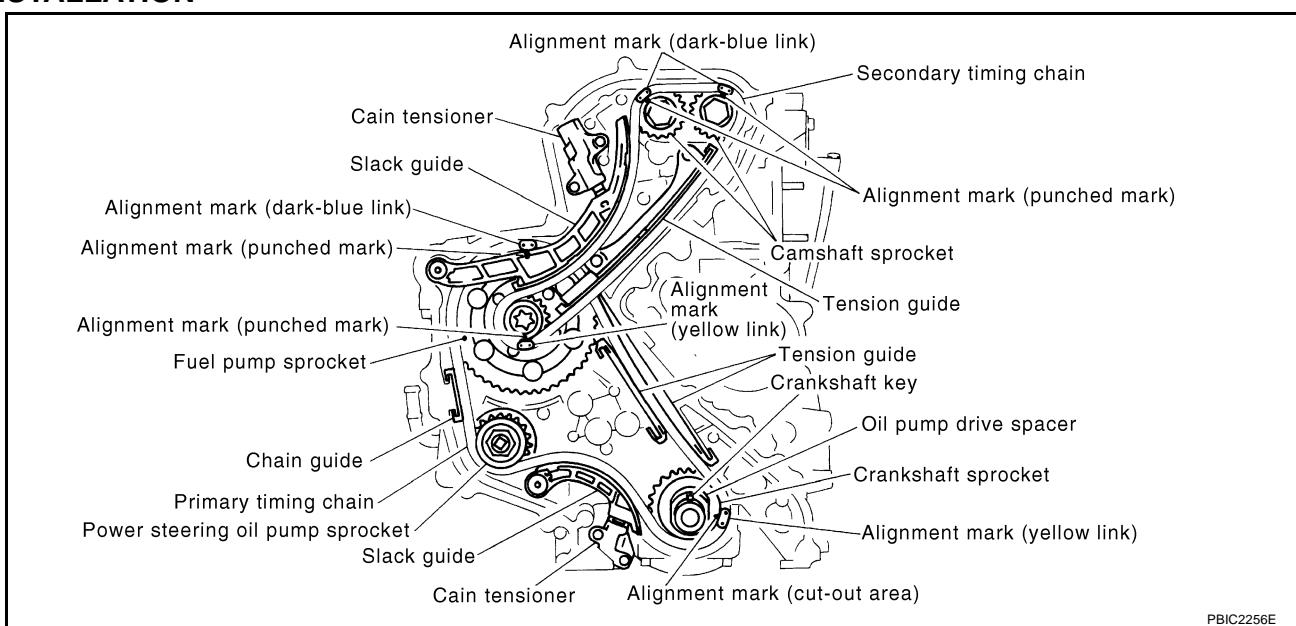
Timing Chain

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



SEM984C

INSTALLATION



PBIC2256E

1. Install rear chain case.

PRIMARY TIMING CHAIN

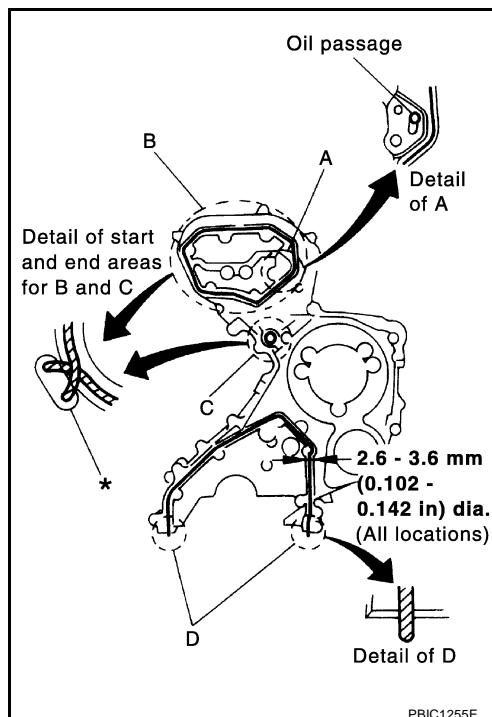
[YD22DDTi]

- a. Apply a continuous bead of liquid gasket with the tube presser (special service tool: WS39930000) on locations shown in the figure.

Use Genuine Liquid Gasket or equivalent.

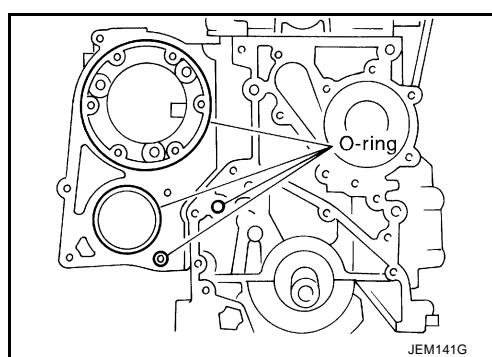
A: Apply bead so that it does not protrude into the oil passage.
B, C: Minimize overlapping area of bead, by starting and ending at areas of bead as shown in the figure. Apply so that the portion marked * comes at an external location but cannot be viewed externally after engine assembly.

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



PBIC1255E

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



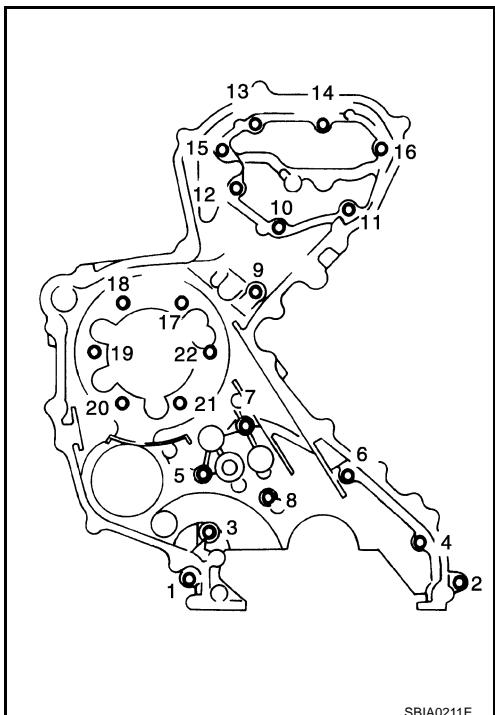
JEM141G

- c. Install rear chain case.
 - When installing, align the dowel pin with the pin hole.

PRIMARY TIMING CHAIN

[YD22DDTi]

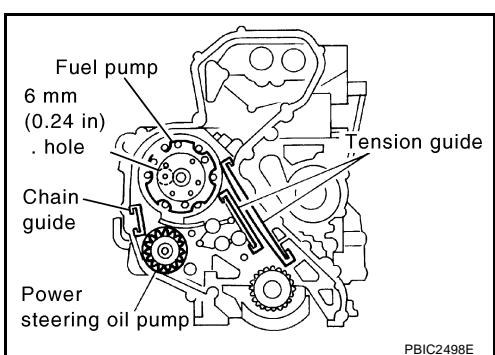
- d. Tighten bolts in numerical order shown in the figure.
- Install the following four types of bolts, referring to the figure.
- | | |
|------------------------|---|
| 16 mm (0.63 in) | : Bolt No. 1, 2, 16, 17, 18, 19, 20, 21, 22 |
| 20 mm (0.79 in) | : Bolt No. 3, 4, 6, 9, 10, 11, 13, 14 |
| 25 mm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



- Install power steering oil pump.
- Install fuel pump. Refer to [EM-161, "FUEL PUMP"](#).

 - Before installing, make sure that spacer and the hole 6 mm (0.24 in) in diameter on coupling are aligned.

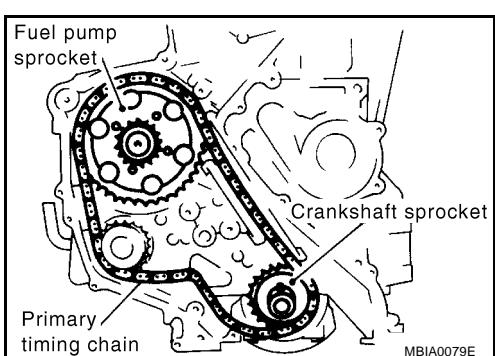
- Install chain guide and tension guides.
- Install crankshaft sprocket, aligning it with crankshaft key on the far side.



- Install primary timing chain with fuel pump sprocket.

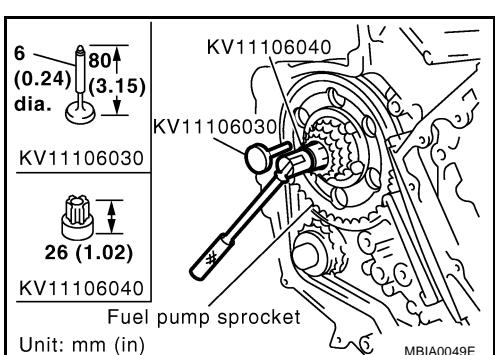
 - When installing, match the alignment marks on sprockets with color coded alignment marks (colored links) on primary timing chain.
 - Install fuel pump sprocket washer with the surface marked "F" (front mark) facing the front of the engine.

- Install timing chain onto power steering oil pump sprocket and through chain guide.



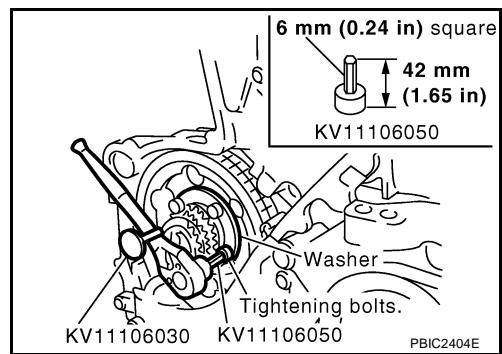
- Use the positioning stopper pin (special service tool) to hold the fuel pump sprocket and install the bolt.

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



PRIMARY TIMING CHAIN

[YD22DDTi]



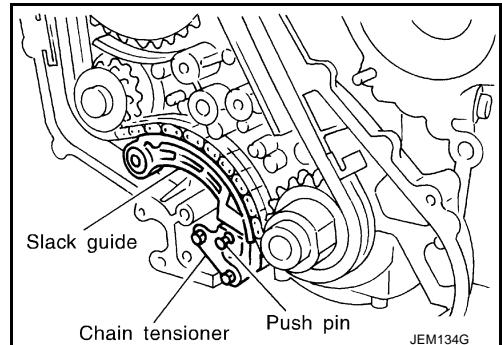
9. Install timing chain slack guide.

10. Install chain tensioner.

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

CAUTION:

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

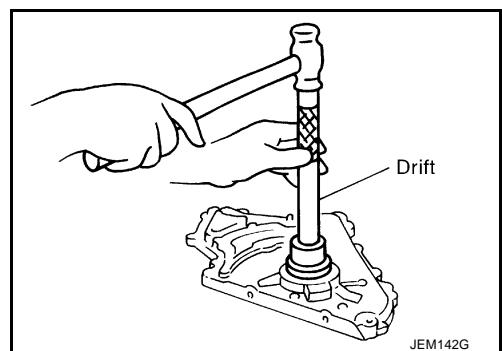


11. Install front oil seal to oil pump housing.

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

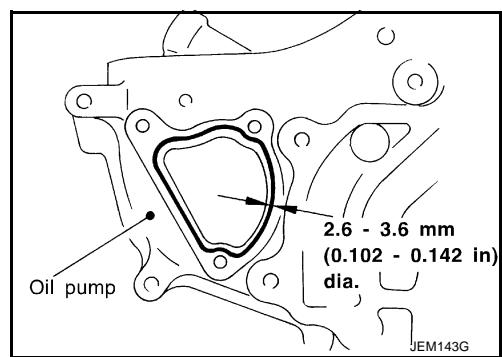
CAUTION:

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



12. Install power steering oil pump cover to oil pump housing.

- Apply a continuous bead of liquid gasket with the tube presser (special service tool: WS39930000) as shown in the figure.
Use Genuine Liquid Gasket or equivalent.
- Apply liquid gasket on oil pump-side surface.

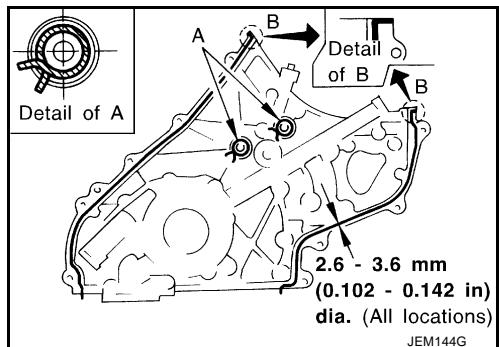


13. Install oil pump housing.

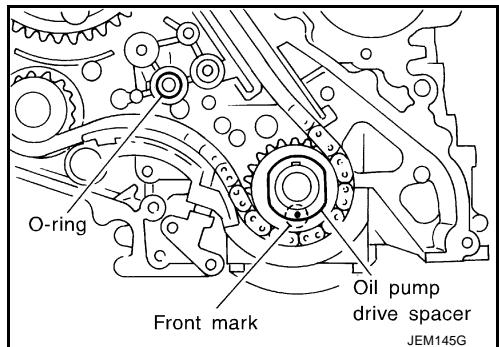
PRIMARY TIMING CHAIN

[YD22DDTi]

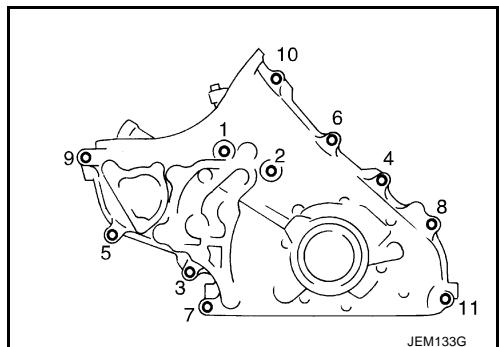
- a. Apply a continuous bead of liquid gasket with the tube presser (special service tool: WS39930000) as shown in the figure.
 A: Leave the start and end areas of the bead slightly protruding from the surface.
 B: Apply liquid gasket along upper end surface of oil pump housing.



- b. Install oil pump drive spacer to crankshaft.
 - Install with the front mark (punched mark) facing the front of the engine.
- c. Install O-ring into the groove of rear chain case.



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



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

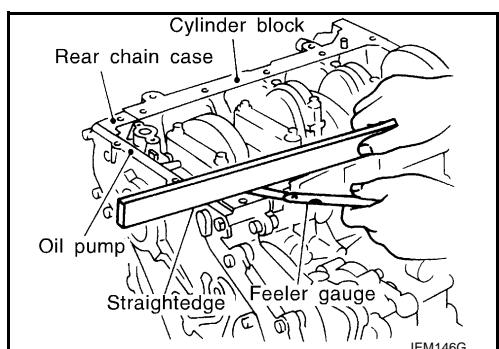
Oil pump housing and rear chain case:

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

Rear chain case and cylinder block:

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

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



15. Install crankshaft pulley.
 - a. Install crankshaft pulley to crankshaft.

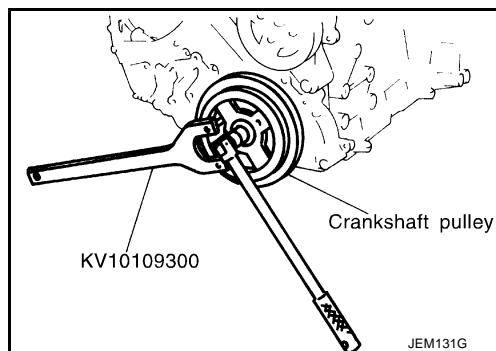
PRIMARY TIMING CHAIN

[YD22DDTi]

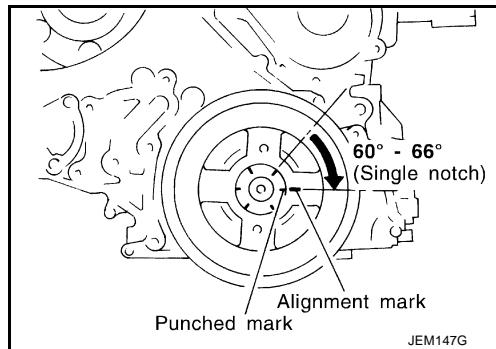
- b. Hold crankshaft pulley with the pulley holder (special service tool).
- c. Tighten crankshaft pulley fixing bolt.

 : 20 - 29 N·m (2.0 - 3.0 kg·m, 15 - 21 ft-lb)

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



- e. Tighten fixing bolt another 60 to 66 degrees [target: 60 degrees (turn by one notch)].



16. Install secondary timing chain and the associated parts.
Refer to [EM-182, "INSTALLATION"](#).

17. Install in the reverse order of removal.

CYLINDER HEAD

PFP:11041

On-Vehicle Service

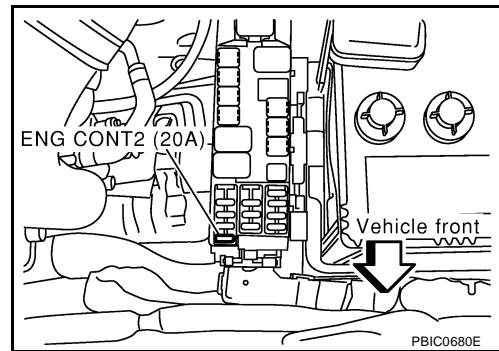
EBS00LRV

CHECKING COMPRESSION PRESSURE

1. Warm up engine thoroughly. Then, stop it.
2. Using CONSULT-II, make sure no error codes are indicated for self-diagnosis items. Refer to [EC-905, "Basic Inspection"](#) (WITH EURO-ODB) or [EC-1231, "Basic Inspection"](#) (WITHOUT EURO-ODB).
 - Do not disconnect CONSULT-II until the end of this operation; it will be used to check engine rpm and for error detection at the end of this operation.
3. Disconnect the negative battery terminal.
4. Remove charge air cooler. Refer to [EM-135, "Removal and Installation"](#)
5. To prevent fuel from being injected during inspection, remove fuel pump fuse [ENG CONT 2 (20A)] from fuse box on the left side of engine room.
 - Among marks on fuse box, [ENG CONT 2 (20A)] is for fuel pump fuse.
6. Remove glow plugs from all the cylinders. Refer to [EM-152, "Removal and Installation"](#).

CAUTION:

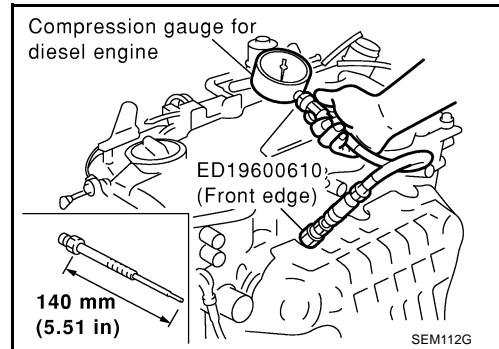
- Before removal, clean the surrounding area to prevent entry of any foreign materials into engine.
- Carefully remove glow plugs to prevent any damage or breakage.
- Handle with care to avoid applying any shock to glow plugs.



7. Install compression gauge adapter (special service tool) to installation holes of glow plugs and connect compression gauge for diesel engine.

: 18 - 22 N·m (1.8 - 2.2 kg-m, 13 - 16 ft-lb)

8. Connect battery negative terminal.
9. With accelerator pedal fully depressed, turn ignition switch to "START" for cranking. When the gauge pointer stabilizes, read the compression pressure and engine rpm. Perform these steps to check each cylinder.
 - Always use a fully-charged battery to obtain specified engine speed.

**Compression pressure**Unit: kPa (bar, kg/cm², psi)/rpm

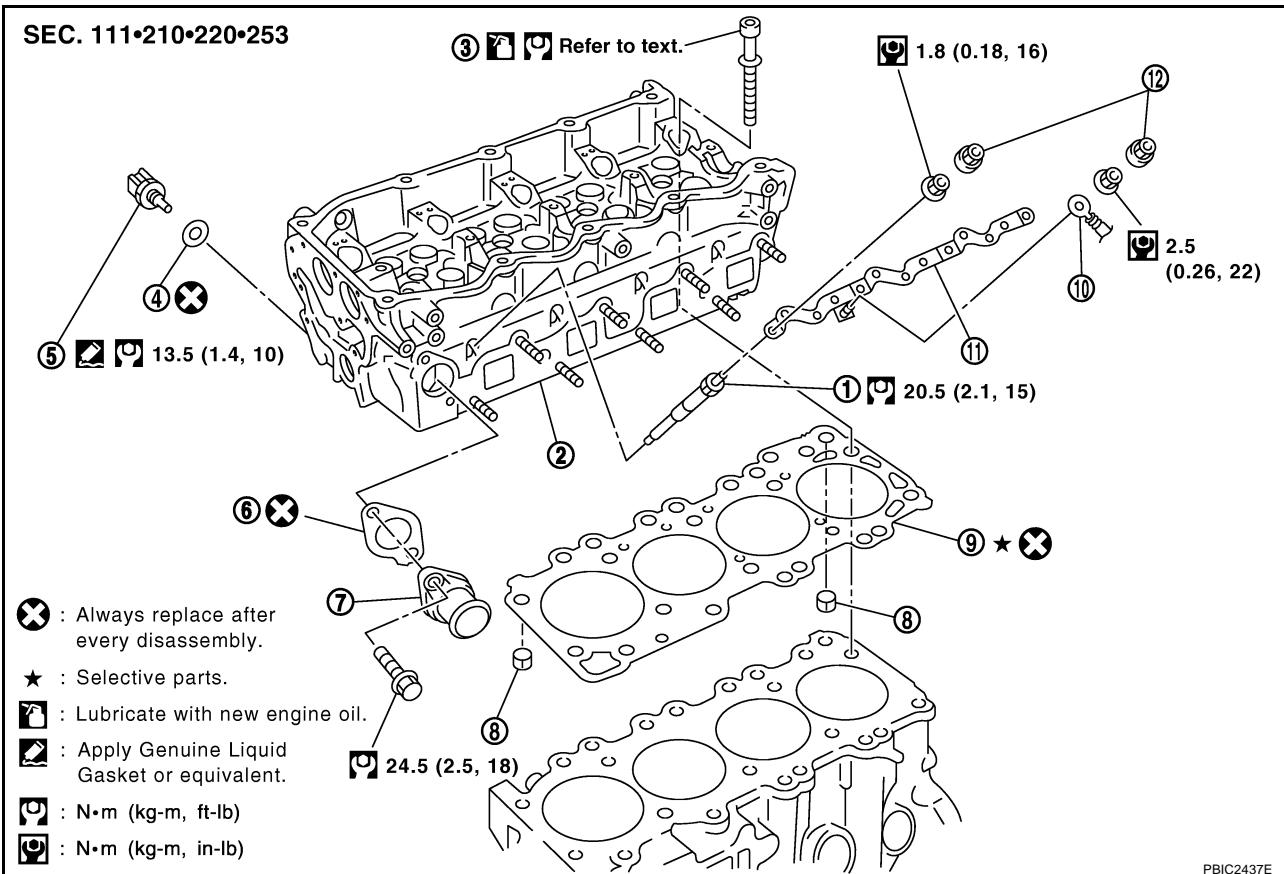
Standard	Minimum	Difference limit between cylinders
2,991 (29.9, 30.5, 434)/200	2,452 (24.5, 25.0, 356)/200	490 (4.9, 5.0, 71)/200

- When engine rpm is out of the specified range, check the specific gravity of battery liquid. Measure again under corrected conditions.
- If engine rpm exceeds the limit, check valve clearance and combustion chamber components (valves, valve seats, cylinder head gaskets, piston rings, pistons, cylinder bores, cylinder block upper and lower surfaces) and measure again.
- If compression pressure is low in some cylinders, apply engine oil from glow plug installation hole. Then check pressure again.
 - If compression pressure becomes normal after applying engine oil, piston ring may be worn or damaged. Check piston ring for malfunction. If any, replace piston ring.
 - If compression pressure is still low after applying engine oil, valve may be malfunctioning. Check valve for malfunction. If contact malfunction is found, replace valve or valve seat.
- If compression pressure in adjacent two cylinders is low after applying engine oil, pressure may be leaking from gasket. In this case, replace cylinder head gasket.

10. Complete this operation as follows:
 - a. Turn the ignition switch to "OFF".
 - b. Disconnect battery negative terminal.
 - c. Install glow plug and install all the parts removed in step 4.
 - d. Install fuel pump fuse [ENG CONT (20A)].
 - e. Connect battery negative terminal.
 - f. Using CONSULT-II make sure no DTC is indicated for items of self-diagnosis.

Removal and Installation

EBS00LRW



- | | | |
|------------------|--------------------------------------|-----------------------|
| 1. Glow plug | 2. Cylinder head assembly | 3. Cylinder head bolt |
| 4. Copper washer | 5. Engine coolant temperature sensor | 6. Gasket |
| 7. Water outlet | 8. Dowel pin | 9. Gasket |
| 10. Glow harness | 11. Glow plate | 12. Cap |

REMOVAL

1. Drain engine coolant. Refer to [CO-31, "Changing Engine Coolant"](#).
2. Remove the following:
 - Charge air cooler (Refer to [EM-135, "Removal and Installation"](#).)
 - Rocker cover (Refer to [EM-168, "Removal and Installation"](#).)
 - Air cleaner and air duct (Refer to [EM-133, "Removal and Installation"](#).)
 - Vacuum pump (Refer to [EM-153, "Removal and Installation"](#).)
 - Spill tube and fuel injector (Refer to [EM-157, "Removal and Installation"](#).)
 - Intake manifold (Refer to [EM-136, "Removal and Installation"](#).)
 - Exhaust manifold and Turbocharger (Refer to [EM-141, "Removal and Installation"](#).)
 - Secondary timing chain (Refer to [EM-180, "Removal and Installation"](#).)
 - Camshaft (Refer to [EM-170, "Removal and Installation"](#).)
3. Remove cylinder head assembly.

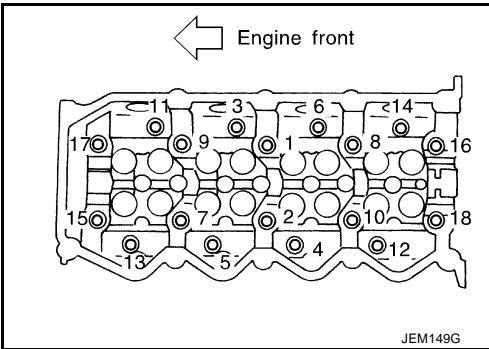
CYLINDER HEAD

[YD22DDTi]

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

CAUTION:

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



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

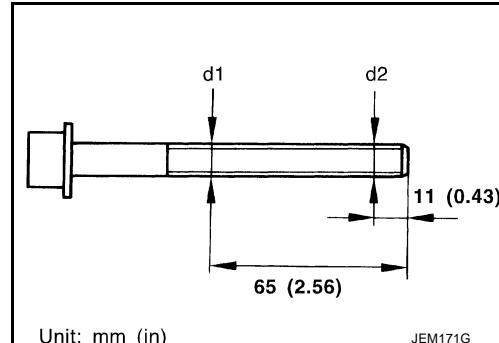
CAUTION:

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

INSPECTION AFTER REMOVAL

Cylinder Head Bolt Deformation

- Using micrometer, measure the outer diameters d₁ and d₂ of bolt thread as shown in the figure.
 - If the necking point can be identified, set it as measuring point d₁.
 - Calculate the difference between d₁ and d₂.
- Limit : 0.15 mm (0.0059 in)**
- If it exceeds the limit, replace cylinder head bolt.



Cylinder Head Distortion

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

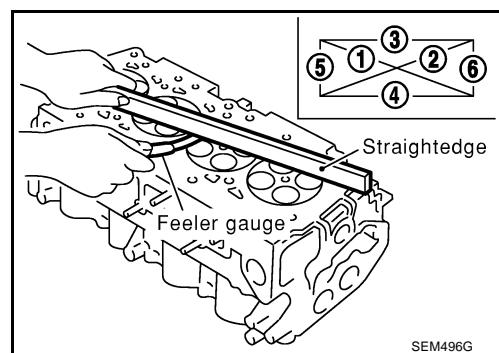
CAUTION:

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

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

Limit : 0.1mm (0.004 in)

- If it exceeds the limit, replace cylinder head.



INSTALLATION

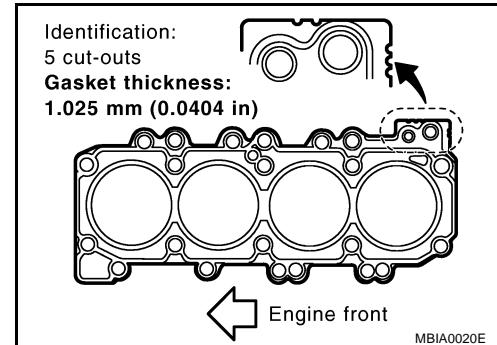
Before installation, remove old liquid gasket from mating surface of all liquid gasket applied parts.

1. Install cylinder head gasket.

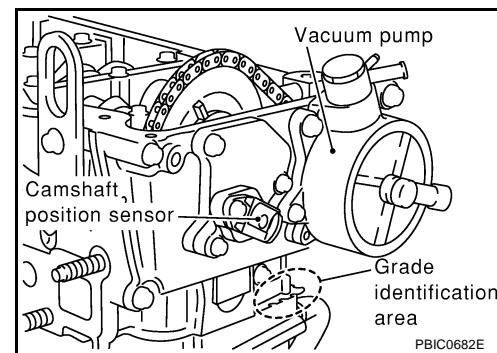
- Cylinder head gasket to be installed is selected by its thickness through the following procedure.
- **When replacing gasket alone**
- Install a gasket with same thickness as that of the one removed.
- Identify the thickness of gasket by the number of cut-outs on the rear RH side.

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

*: Measured with head bolts tightened



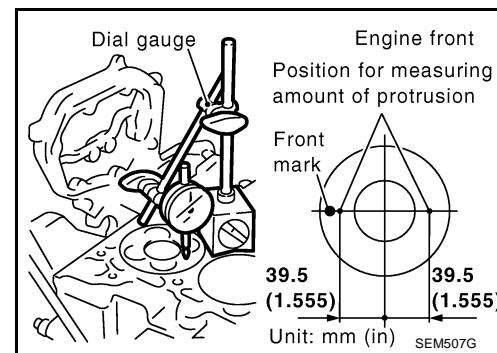
- Gasket thickness can be identified at the location shown in the figure by the numbers of cut-outs before removal.



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

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

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



CYLINDER HEAD

[YD22DDTi]

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

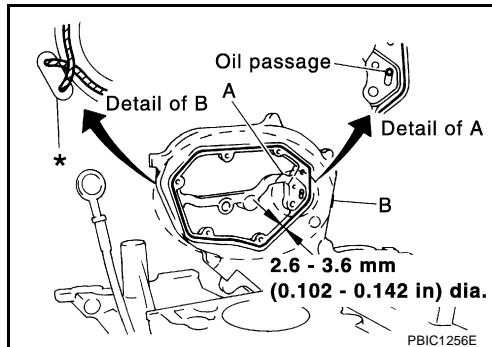
*: Measured with head bolts tightened

2. Apply a continuous bead of liquid gasket with the tube presser (special service tool: WS39930000) as shown in the figure.

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

B: Minimize the overlapping area of the bead, with start and end areas of bead as shown in the figure.

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

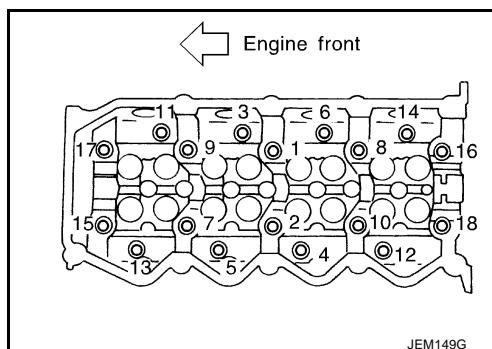


3. Install cylinder head assembly.

- Tighten bolts in numerical order as shown in the figure according to the following procedure:

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

: 35 - 44 N·m (3.5 - 4.5 kg-m, 26 - 32 ft-lb)



- Tighten 180 degrees to 185 degrees [target: 180 degrees] (angle tightening).
- Loosen completely in reverse order of that shown in the figure.

: 0 N·m (0 kg-m, 0 ft-lb)

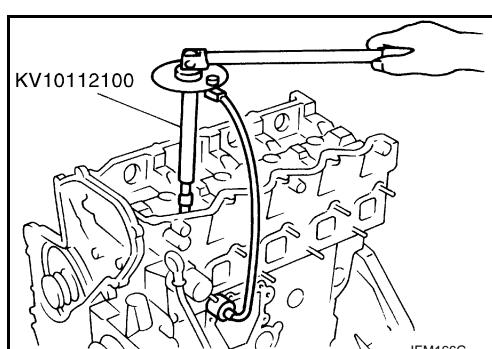
- Tighten all bolts.

: 35 - 44 N·m (3.5 - 4.5 kg-m, 26 - 32 ft-lb)

- Tighten 90 degrees to 95 degrees [target: 90 degrees] (angle tightening).
- Tighten another 90 degrees to 95 degrees [target: 90 degrees] (angular tightening).

CAUTION:

- When the angle wrench (special service tool) is not used, paint an alignment mark on the head of cylinder head bolt and cylinder head surface before tightening. Check the angle with a protractor.



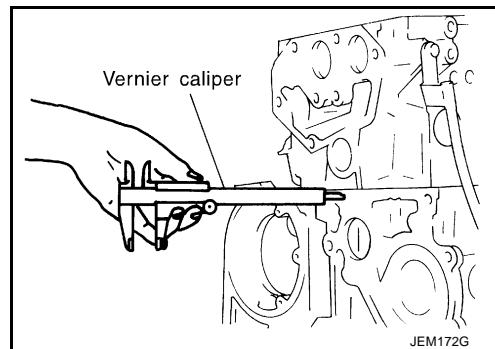
CYLINDER HEAD

[YD22DDTi]

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

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

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



- Install glow plug.

CAUTION:

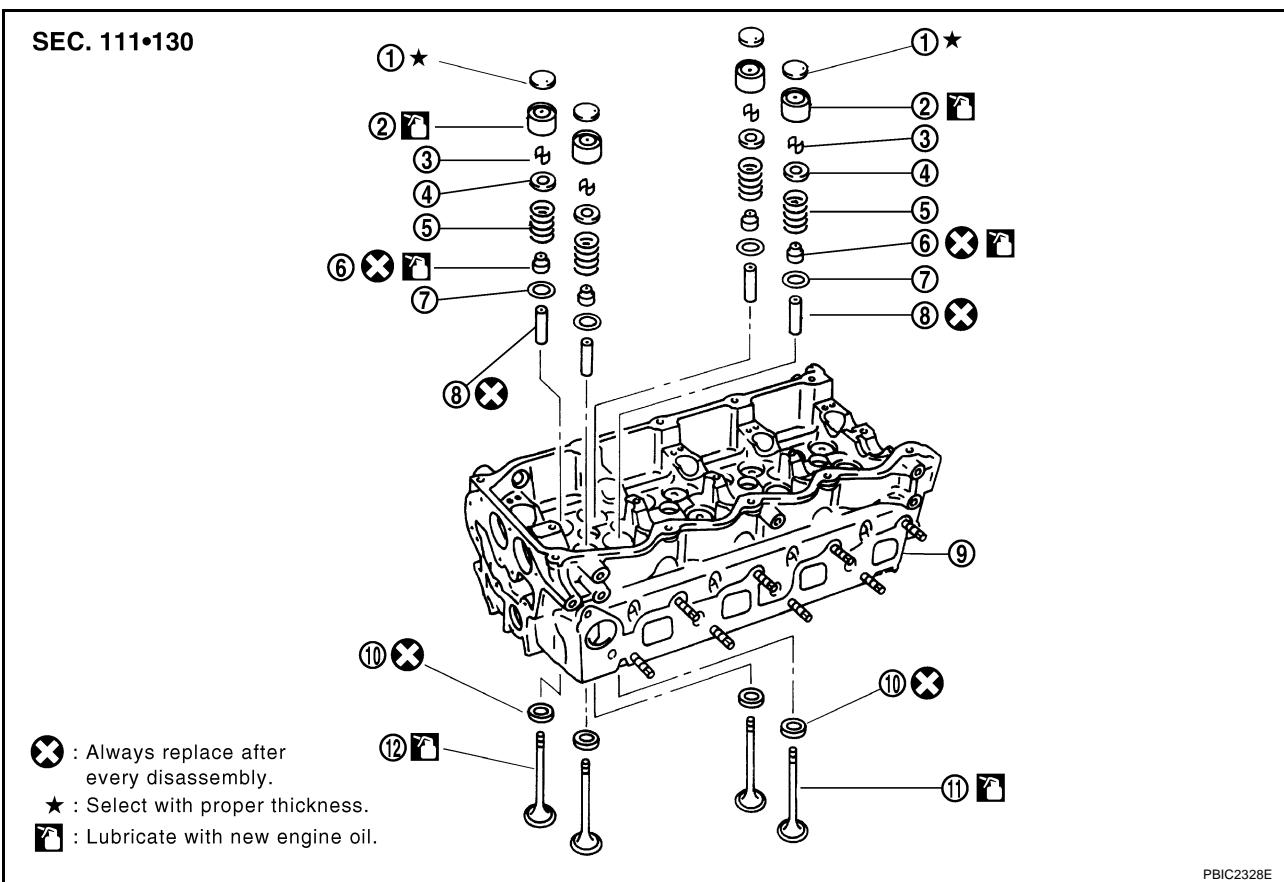
- To avoid damage, glow plugs should be removed only when required.
- Handle with care to avoid applying shock. When dropped from approx. 10 cm (3.94 in) or higher, always replace with a new one.
- Before installing, remove carbon depositing on mounting hole of glow plug with a reamer.

- Install engine coolant temperature sensor.

- Install in the reverse order of removal.

Disassembly and Assembly

EBS00LRX



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

DISASSEMBLY

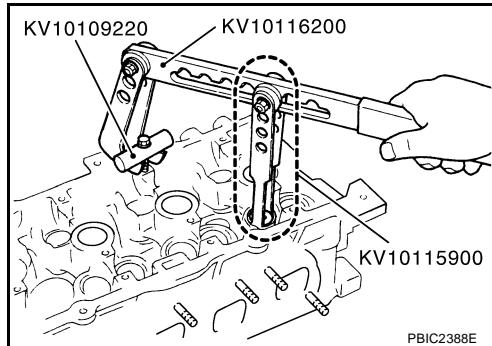
- Remove adjusting shims and valve lifters.
 - Check the installation positions, and keep them to avoid being confused.

CYLINDER HEAD

[YD22DDTi]

2. Remove valve collet.

- Using the valve spring compressor (special service tool), compress valve spring. Using magnet hand, remove valve collets.



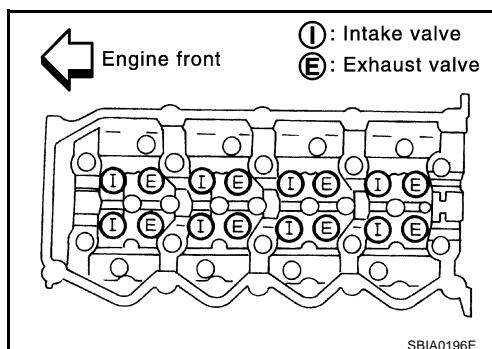
3. Remove valve spring retainers and valve springs.

4. Remove valves as pressing valve stems toward combustion chamber.

- Before removing valve, check the valve guide clearance. Refer to [EM-203, "Valve Guide Clearance"](#).

NOTE:

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

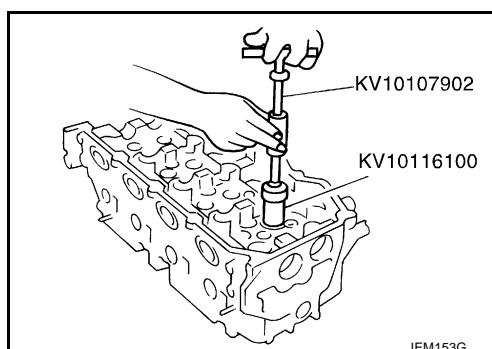


5. Remove valve oil seals using the valve oil seal puller (special service tool).

6. Remove valve spring seats.

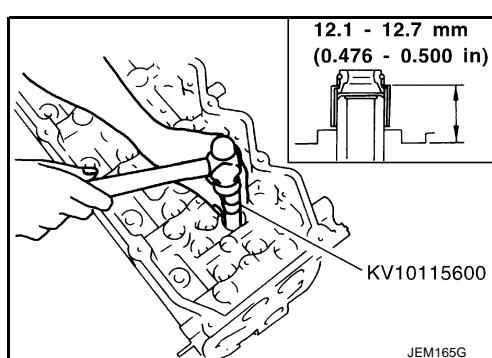
7. Before removing valve seats, perform valve seat contact check. Refer to [EM-205, "Valve Seat Contact"](#).

8. Before removing valve guides, perform valve guide clearance check. Refer to [EM-203, "Valve Guide Clearance"](#).



ASSEMBLY

- Install valve guides. Refer to [EM-204, "Valve Guide Replacement"](#).
- Install valve seats. Refer to [EM-205, "Valve Seat Replacement"](#).
- Using the valve oil seal drift (special service tool), install valve oil seals referring to the dimension shown in the figure.
- Install valve spring seats.

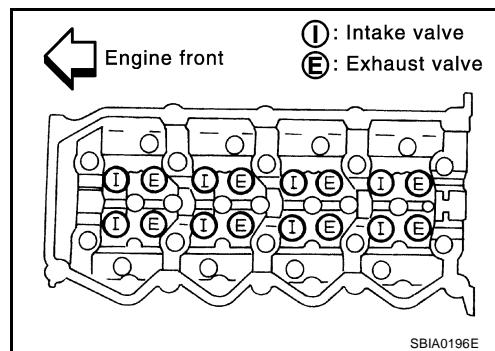


CYLINDER HEAD

[YD22DDTi]

5. Install valves.

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



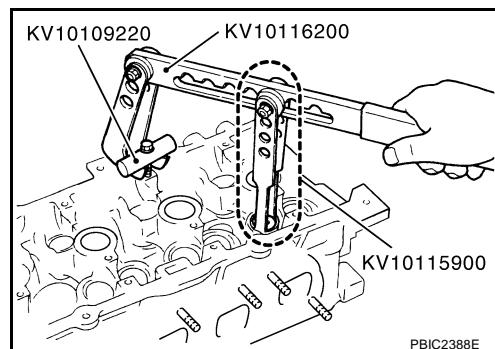
6. Install valve spring.

7. Install valve spring retainers.

8. Using the valve spring compressor (special service tool), compress valve springs.

Then install valve collets using magnet hand.

- After installing valve collets, tap the stem end using the plastic hammer, and check the installation status.

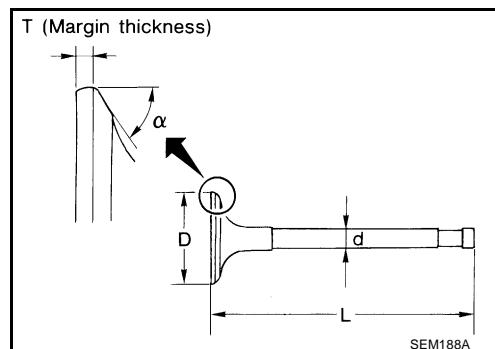


9. Install valve lifters and adjusting shims to the same positions as before.

INSPECTION AFTER DISASSEMBLY

Valve Dimension

- Check dimensions of each valve. For dimensions, refer to [EM-237, "Valve Dimensions"](#).
- If dimensions are out of the standard, replace valve.



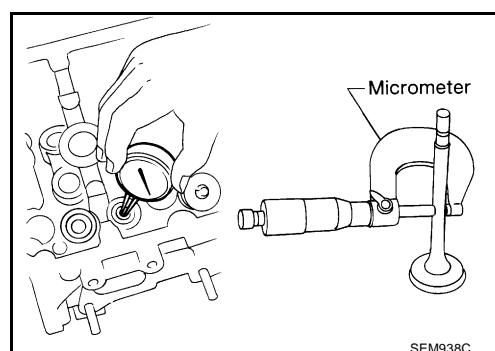
Valve Guide Clearance

Valve Stem Diameter

- Measure diameter of valve stem with micrometer.

Standard

- | | |
|----------------|--|
| Intake | : 5.965 - 5.980 mm (0.2348 - 0.2354 in) |
| Exhaust | : 5.945 - 5.960 mm (0.2341 - 0.2346 in) |



Valve Guide Inner Diameter

- Measure inner diameter of valve guide with inside micrometer.

Standard

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

Valve Guide Clearance

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

Valve guide clearance:**Standard**

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

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

Limit

Intake : 0.08 mm (0.0031 in)

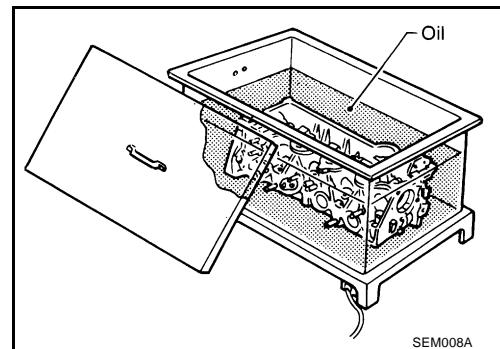
Exhaust : 0.10 mm (0.0039 in)

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

Valve Guide Replacement

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

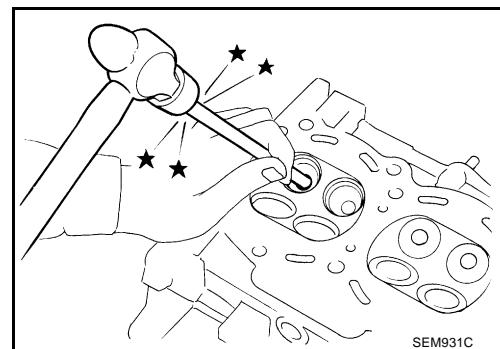
1. Heat cylinder head to 110 to 130°C (230 to 266°F) in oil bath.



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

CAUTION:

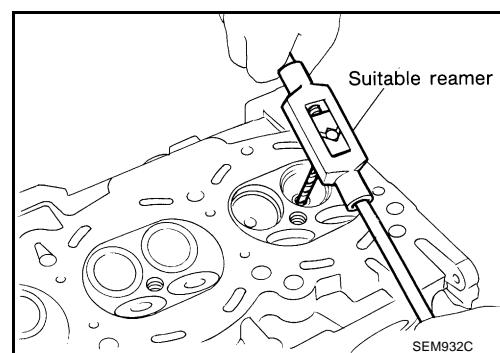
Cylinder head contains heat, when working, wear protective equipment to avoid getting burned.



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

Valve guide hole diameter (for service parts):

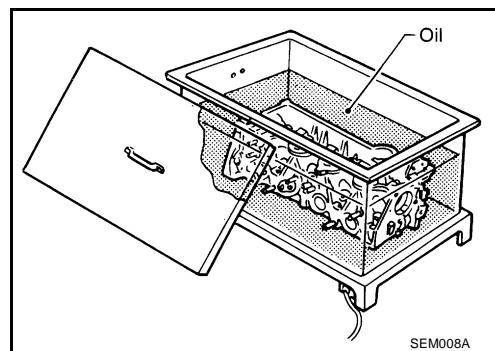
10.175 - 10.196 mm (0.4006 - 0.4014 in)



CYLINDER HEAD

[YD22DDTi]

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

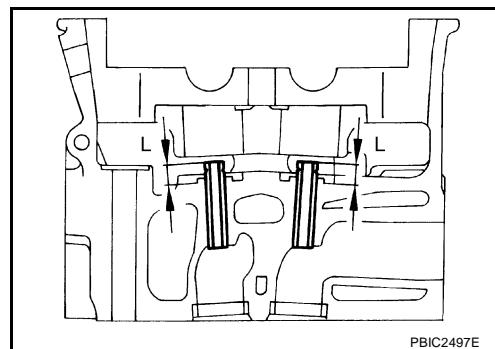


5. Using the valve guide drift (commercial service tool), press fit valve guides from camshaft side, referring to the dimension shown in the figure.

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

CAUTION:

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

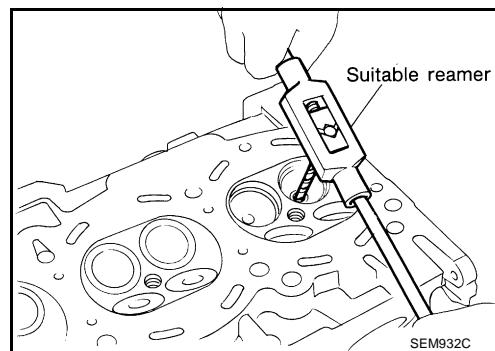


6. Using the valve guide reamer (commercial service tool), perform reaming to the press-fitted valve guides.

Reaming specifications:

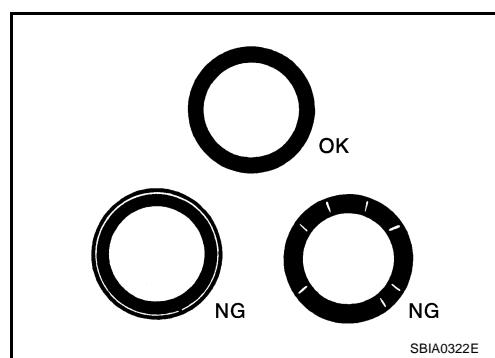
Intake and Exhaust

6.000 - 6.018 mm (0.2362 - 0.2369 in)



Valve Seat Contact

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



Valve Seat Replacement

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

- Bore out old seat until it collapses. Boring should not continue beyond the bottom face of the seat recess in cylinder head. Set the machine depth stop to ensure this. Refer to [EM-240, "Valve Seat"](#).

CYLINDER HEAD

[YD22DDTi]

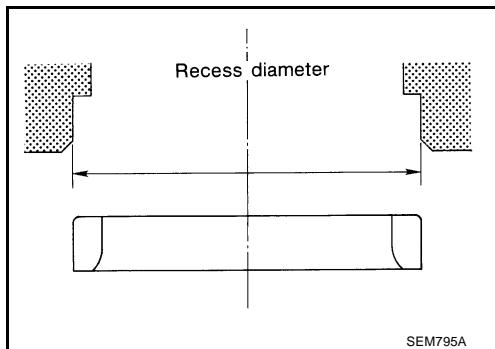
- Ream cylinder head recess diameter for service valve seat.

Oversize [0.5 mm (0.020 in)]:

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

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

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

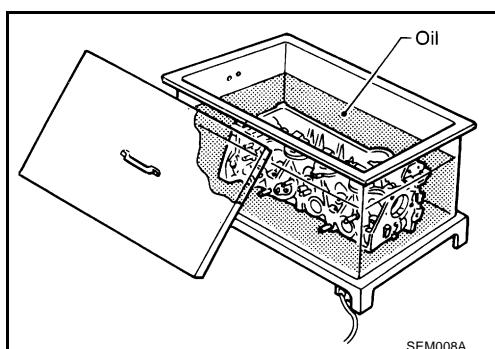


- Heat cylinder head to approximately 110 to 130°C (230 to 266°F) in oil bath.

- After cooling valve seats sufficiently with dry ice, press fit it to cylinder head.

CAUTION:

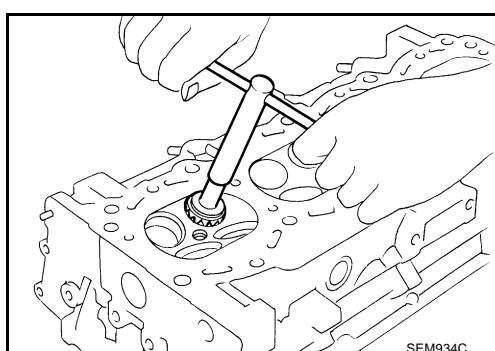
- Do not touch the cooled valve seats directly by hand.
- Cylinder head contains heat, when working, wear protective equipment to avoid getting burned.



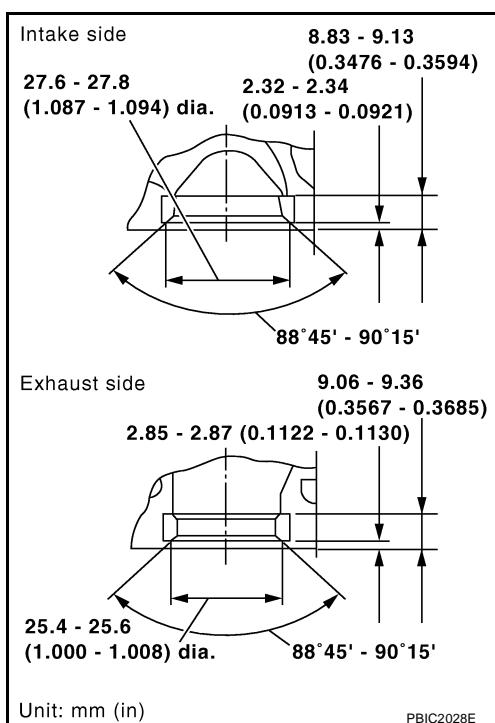
- Using the valve seat cutter set (commercial service tool), finish processing referring to the dimensions shown in the figure.

CAUTION:

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



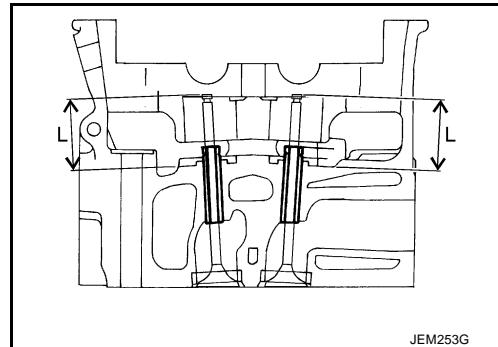
Grind to obtain the dimensions indicated in the figure. Refer to [EM-240, "Valve Seat"](#).



6. Using compound, perform valve fitting.
7. Check again to make sure that contacting status is satisfactory.
For details, Refer to [EM-205, "Valve Seat Contact"](#).
8. Use the depth gauge to measure the distance between the mounting surface of cylinder head spring seat and the valve stem end. If the distance is shorter than specified, repeat step 5 above to adjust it. If it is longer, replace valve seat with a new one.

Valve seat resurface limit "L":

Intake : 36.53 - 36.98 mm (1.4382 - 1.4559 in)
 Exhaust : 36.53 - 37.01 mm (1.4382 - 1.4571 in)

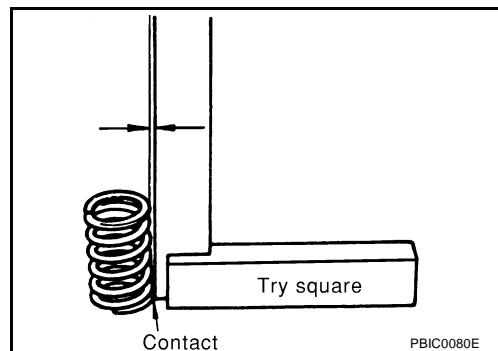


Valve Spring Square

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

Limit : 1.9 mm (0.075 in)

- If it exceeds the limit, replace valve spring.

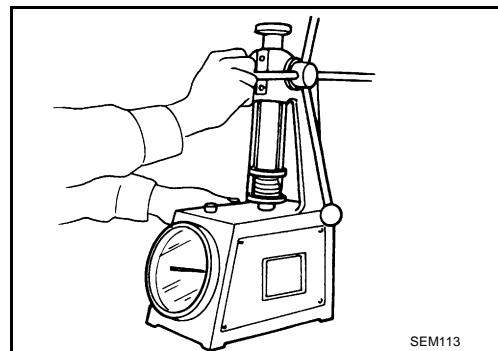


Valve Spring Dimensions and Valve Spring Pressure Load

- Using valve spring tester, check the following.

Standard:

Free height : 43.7 mm (1.720 in)
 Installation height : 32.82 mm (1.2921 in)
 Installation load : 184 - 208 N
 (18.77 - 21.22 kg, 41.4 - 46.8 lb)
 Height during valve open : 24.82 mm (0.9772 in)
 Load with valve open : 320 - 360 N
 (32.65 - 36.73 kg, 71.9 - 80.9 lb)



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

ENGINE ASSEMBLY

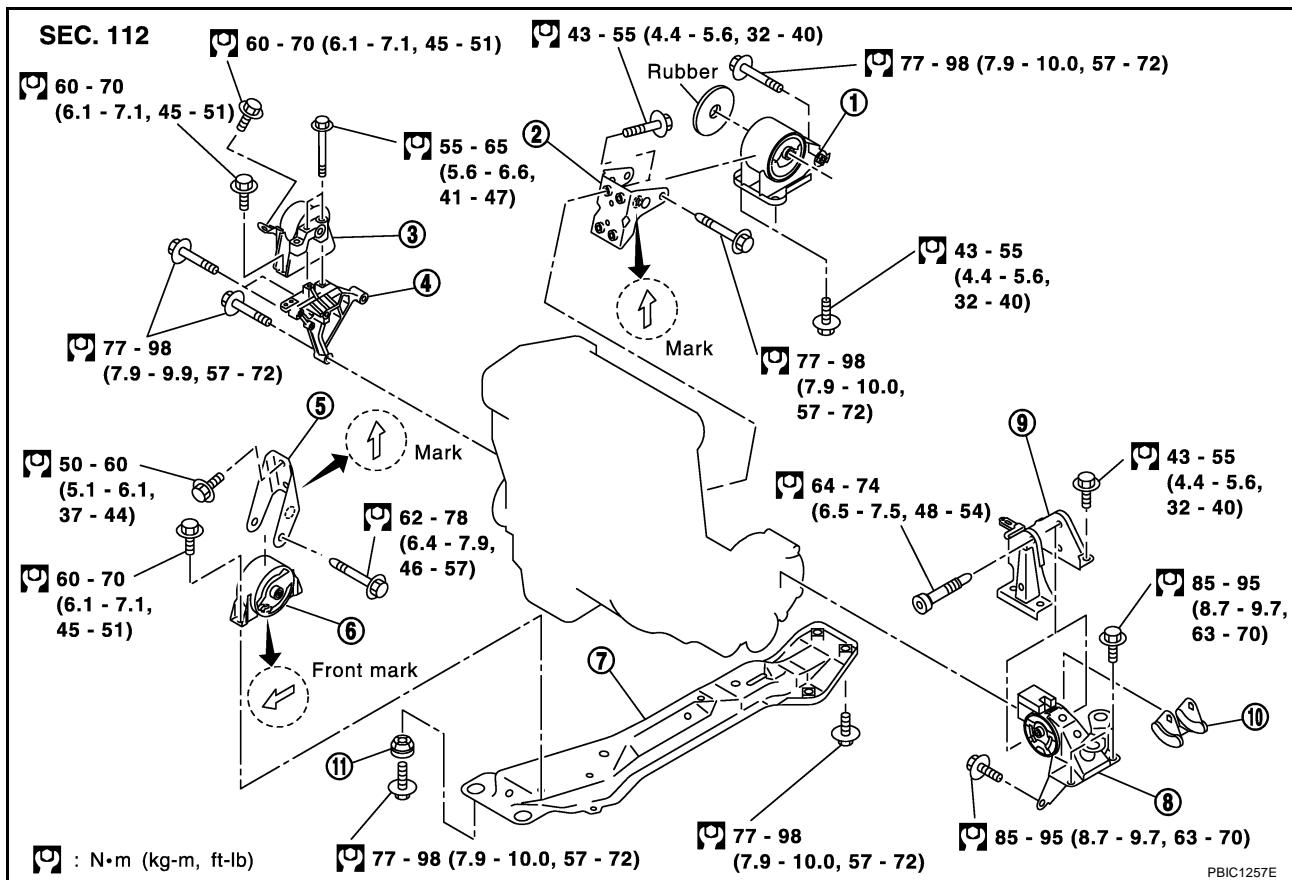
[YD22DDTi]

ENGINE ASSEMBLY

PFP:10001

Removal and Installation

EBS00LRY



PBIC1257E

1. Rear engine mounting insulator
2. Rear engine mounting bracket
3. RH engine mounting insulator
4. RH engine mounting bracket
5. Front engine mounting bracket
6. Front engine mounting insulator
7. Center member
8. LH engine mounting insulator
9. LH engine mounting bracket
10. Stopper
11. Grommet (2pcs)

WARNING:

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

CAUTION:

- Always be careful to work safely, avoid forceful or uninstructed operations.
- Do not start working until exhaust system and engine coolant are cool enough.
- If items or work required are not covered by the engine main body section, refer to the applicable sections.
- Always use the support point specified for lifting.
- Use either 2-pole lift type or separate type lift as best you can. If board-on type is used for unavoidable reasons, support at the rear axle jacking point with transmission jack or similar tool before starting work, in preparation for the backward shift of center of gravity.
- For supporting points for lifting and jacking point at rear axle, refer to [GI-36, "Garage Jack and Safety Stand"](#).

REMOVAL**Description of work**

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

Preparation

1. Remove hood assembly. Refer to [BL-12, "HOOD"](#) .
2. Drain engine coolant from radiator drain plug. Refer to [CO-31, "DRAINING ENGINE COOLANT"](#) .
3. Remove the following parts.
 - LH/RH engine undercover
 - LH/RH front wheels
 - Battery; Refer to [SC-3, "BATTERY"](#) .
 - Drive belts; Refer to [EM-132, "Removal and Installation"](#) .
 - Air duct and air cleaner case assembly; Refer to [EM-133, "Removal and Installation"](#) .
 - Alternator; Refer to [SC-16, "Removal and Installation"](#) .
 - Radiator and cooling fan assembly; Refer to [CO-34, "Removal and Installation"](#) and [CO-36, "COOLING FAN"](#) .
 - Charge air cooler; Refer to [EM-135, "CHARGE AIR COOLER"](#) .
4. Disconnect engine room harness from the engine side and set it aside for easier work.
5. Disconnect all the body-side vacuum hoses and air hoses at engine side.

Engine room LH

1. Disconnect fuel feed hose and return hose, and plug it to prevent fuel from draining. Refer to [EM-136, "INTAKE MANIFOLD"](#) .
2. Disconnect heater hose, and install plug it to prevent engine coolant from draining. Refer to [EM-136, "INTAKE MANIFOLD"](#) .
3. Remove clutch operating cylinder from transaxle, and move it aside. Refer to [MT-17, "TRANSAXLE ASSEMBLY"](#) and [CL-10, "OPERATING CYLINDER"](#) .
4. Disconnect shift cable from transaxle. Refer to [MT-14, "CONTROL LINKAGE"](#) .

Engine room RH

1. Remove engine coolant reservoir tank. Refer to [CO-34, "RADIATOR"](#) .
2. Remove A/C compressor with piping connected from engine. Temporarily secure it on body with a rope to avoid putting load on it. Refer to [ATC-144, "Removal and Installation of Compressor"](#) .

Vehicle underbody

1. Remove exhaust front tube. Refer to [EX-2, "Removal and Installation"](#) .
2. Remove propeller shaft. Refer to [PR-4, "Removal and Installation"](#) .
3. Remove steering shaft from steering gear. Refer to [PS-10, "STEERING COLUMN"](#) .
4. Disconnect power steering fluid cooler piping at a point between body and engine. Refer to [PS-34, "HYDRAULIC LINE"](#) .
5. Remove ABS sensor from brake caliper. Refer to [BRC-45, "WHEEL SENSORS"](#) (ABS), [BRC-116, "WHEEL SENSORS"](#) (ESP/TCS/ABS).
6. Remove brake caliper with piping connected from steering knuckle. Temporarily secure it on body with a rope to avoid load on it. Refer to [BR-27, "FRONT DISC BRAKE"](#) .
7. Remove left and right suspensions from steering knuckle under strut. Refer to [FSU-5, "FRONT SUSPENSION ASSEMBLY"](#) .

ENGINE ASSEMBLY

[YD22DDTi]

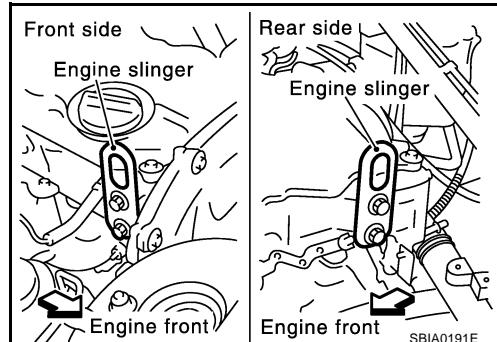
Removal

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

Slinger bolts:

 : 30 - 37 N·m (3.0 - 3.8 kg-m, 22 - 27 ft-lb)

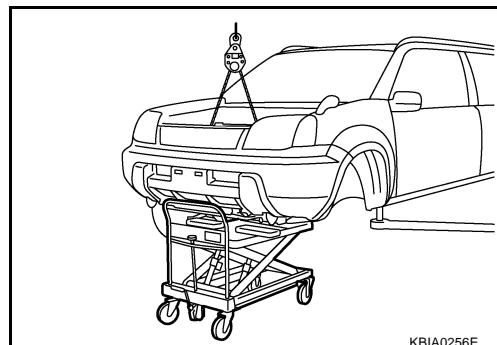
2. Lift with hoist and secure engine in position.



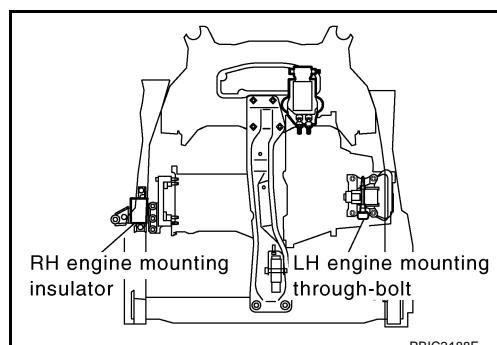
- Use the manual lift table caddy (commercial service tool) or equivalently rigid tool such as a jack or trestle. Securely support bottom of engine and transaxle, and simultaneously adjust hoist tension.

CAUTION:

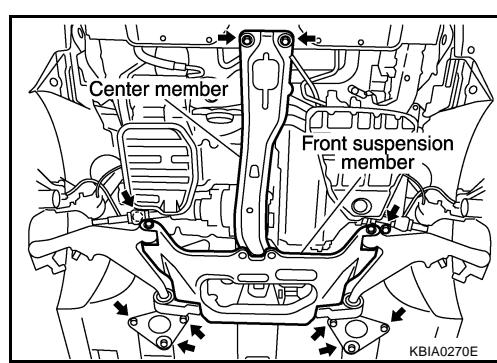
Put a piece of wood or something similar as the supporting surface, secure a completely stable condition.



3. Remove RH engine mounting insulator.
4. Pull LH engine mounting through-bolt out.



5. Remove mounting bolts at front end of center member.
6. Remove front suspension member mounting bolts and nuts. Refer to [FSU-5, "FRONT SUSPENSION ASSEMBLY"](#).



7. Remove engine, transaxle and transfer assembly with suspension member and center member from vehicle downward by carefully operating supporting tools.

CAUTION:

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

ENGINE ASSEMBLY

[YD22DDTi]

8. Remove power steering oil pump with piping connected from engine. Move it aside on suspension member. Refer to [PS-34, "HYDRAULIC LINE"](#).
9. Remove front engine mounting and rear engine mounting through-bolts to remove suspension member.
10. Remove starter motor. Refer to [SC-21, "STARTING SYSTEM"](#).
11. Separate engine and transaxle. Refer to [MT-17, "TRANSAXLE ASSEMBLY"](#).

A

EM

INSTALLATION

Install in the reverse order of removal.

- Do not allow engine oil to get on mounting insulator. Be careful not to damage mounting insulator.
- When installation directions are specified, install parts according to the direction marks on them referring to figure of components. Refer to [EM-208, "ENGINE ASSEMBLY"](#).
- Make sure that each mounting insulator is seated properly, and tighten mounting bolts and nuts.

C

D

INSPECTION AFTER INSTALLATION

- Before starting engine, check the levels of engine coolant, engine oil and working fluid. If less than required quantity, fill to the specified level.
- Before starting engine, bleed air from fuel piping. Refer to [FL-18, "Air Bleeding"](#).
- Run engine to check for unusual noise and vibration.
- Warm up engine thoroughly to make sure there is no leakage of engine coolant, lubricants, working engine oil, fuel and exhaust gas.
- Bleed air from passages in pipes and tubes of applicable lines, such as in cooling system.
- After cooling down engine, again check amounts of engine coolant, engine oil and working fluid. Refill to specified level, if necessary.

E

F

G

H

Summary of the inspection items:

Item	Before starting engine	Engine running	After engine stopped
Engine coolant	Level	Leakage	Level
Engine oil	Level	Leakage	Level
Working fluid	Level	Leakage	Level
Fuel	—	Leakage	—
Exhaust gas	—	Leakage	—

I

J

K

L

M

CYLINDER BLOCK

[YD22DDTi]

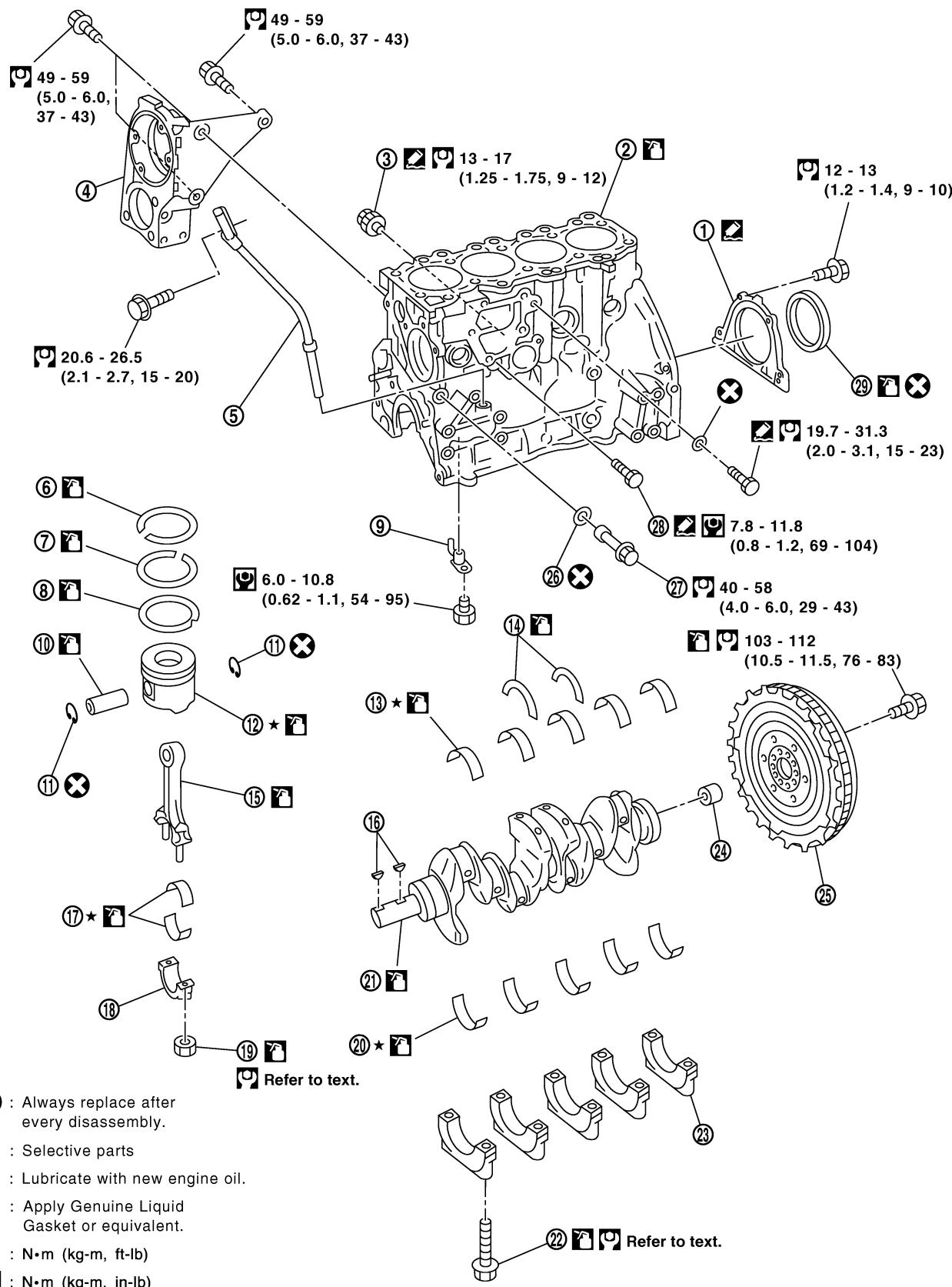
CYLINDER BLOCK

PFP:11010

Disassembly and Assembly

EBS000DX

SEC. 110•120•144•186



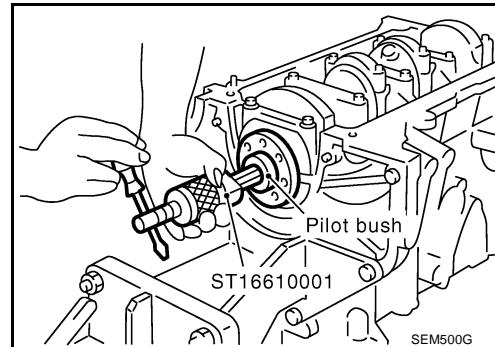
CYLINDER BLOCK

[YD22DDTi]

- | | | |
|---------------------------|----------------------------|--------------------------|
| 1. Rear oil seal retainer | 2. Cylinder block | 3. Oil pressure switch |
| 4. Fuel pump bracket | 5. Oil level gauge guide | 6. Top ring |
| 7. Second ring | 8. Oil ring | 9. Oil jet |
| 10. Piston pin | 11. Snap ring | 12. Piston |
| 13. Main bearing upper | 14. Thrust bearing | 15. Connecting rod |
| 16. Key | 17. Connecting rod bearing | 18. Connecting rod cap |
| 19. Connecting rod nut | 20. Main bearing lower | 21. Crankshaft |
| 22. Main bearing cap bolt | 23. Main bearing cap | 24. Pilot bush |
| 25. Flywheel | 26. Copper washer | 27. Oil jet relief valve |
| 28. Drain plug | 29. Rear oil seal | |

DISASSEMBLY

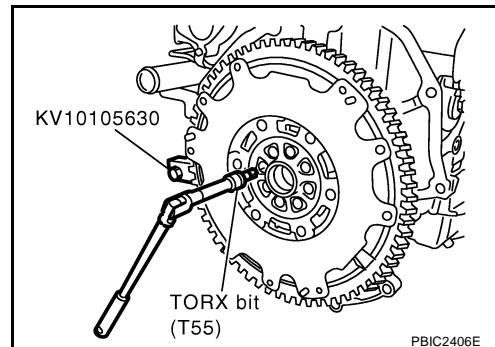
1. Remove engine, transaxle and transfer assembly from the vehicle, then separate engine and transaxle and transfer assembly. Refer to [EM-208, "ENGINE ASSEMBLY"](#).
2. Remove clutch cover and disk. Refer to [CL-14, "CLUTCH DISC, CLUTCH COVER AND FLYWHEEL"](#).
3. If they need to be replaced, replace pilot bush.
 - Using the pilot bushing puller (special service tool), remove the pilot bush from rear end of crankshaft.



4. Install engine to engine stand as follows.
- a. Remove flywheel.
- b. Secure ring gear with the ring gear stopper (special service tool), then loosen mounting bolts with TORX socket (size: T55, Commercial Service Tools) and remove them. As an alternative method hold crankshaft pulley with the pulley holder (special service tool: KV10109300) to remove flywheel.

CAUTION:

- Do not disassemble flywheel.
- Do not place flywheel 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.



- c. Install the engine sub-attachment (special service tool) to the rear side of cylinder block.
- Align knock pins on cylinder block with pin holes on attachment to install.

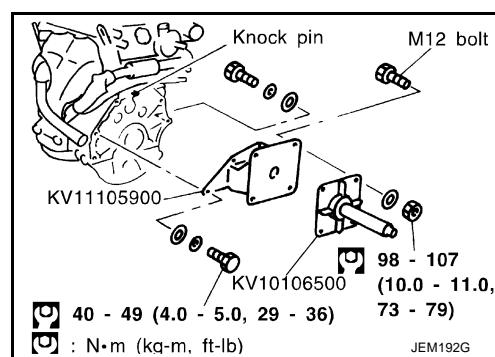
NOTE:

Installation bolts are part of engine sub-attachment.

- d. Install the engine stand shaft (special service tool).

NOTE:

Use commercially available M12 (0.47 in) mounting bolts and nuts (4 sets) with strength grade of 9T (minimum).



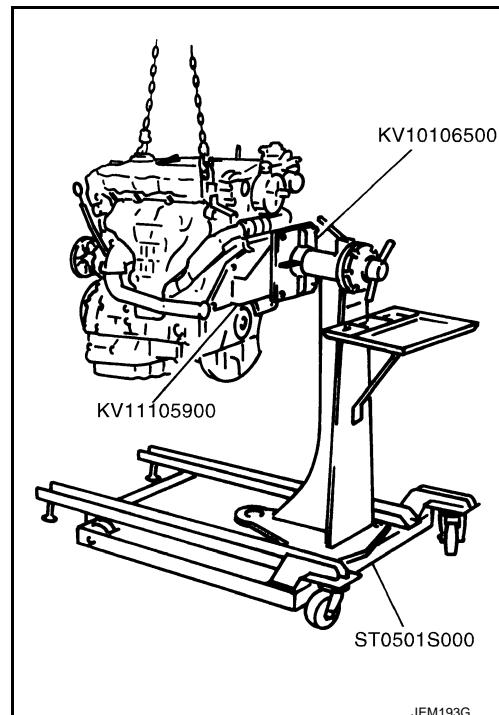
CYLINDER BLOCK

[YD22DDTi]

- e. Hoist engine and install it to the engine stand (special service tool).

NOTE:

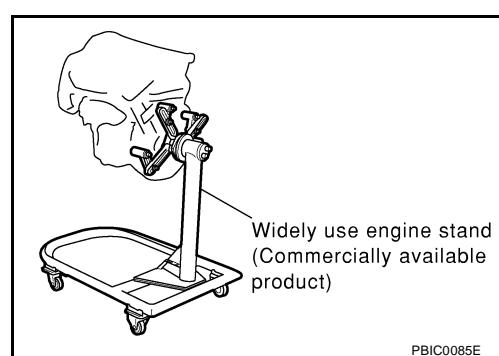
It is possible to set engine sub-attachment and engine stand shaft to the engine stand at first, then install engine later.



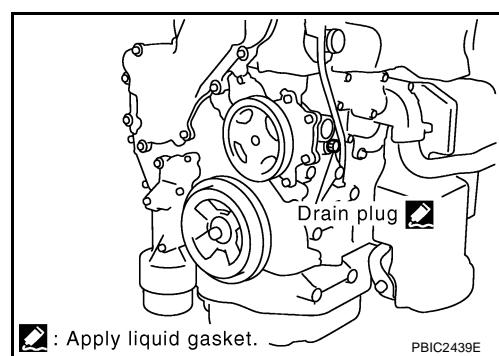
- Widely use engine stand can be used.

NOTE:

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



5. Drain engine oil and engine coolant from inside engine. Refer to [LU-21, "Changing Engine Oil"](#).
6. Drain engine coolant by removing drain plug from inside of engine.



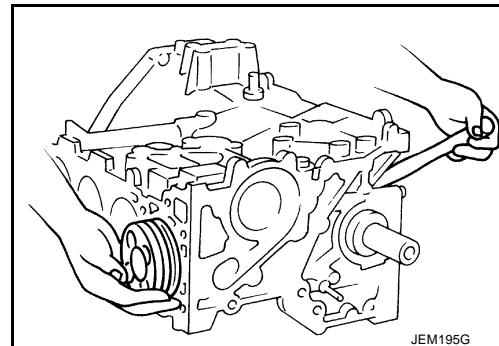
7. Remove the following parts and related parts. (Only major parts are listed.)
 - Intake manifold (Refer to [EM-136, "Removal and Installation"](#).)
 - Exhaust manifold and turbocharger (Refer to [EM-141, "Removal and Installation"](#).)
 - Rocker cover (Refer to [EM-168, "Removal and Installation"](#).)
 - Fuel injector (Refer to [EM-157, "Removal and Installation"](#).)
 - Oil pan and oil strainer (Refer to [EM-147, "Removal and Installation"](#).)
 - Water pump (Refer to [CO-42, "WATER PUMP"](#).)
 - Thermostat and water piping (Refer to [CO-44, "THERMOSTAT AND WATER PIPING"](#).)

- Vacuum pump (Refer to [EM-153, "Removal and Installation"](#) .)
 - Secondary timing chain (Refer to [EM-180, "Removal and Installation"](#) .)
 - Primary timing chain (Refer to [EM-185, "Removal and Installation"](#) .)
 - Fuel pump (Refer to [EM-161, "Removal and Installation"](#) .)
 - Camshaft (Refer to [EM-170, "Removal and Installation"](#) .)
 - Cylinder head (Refer to [EM-197, "Removal and Installation"](#) .)
 - Oil cooler (Refer to [LU-28, "OIL COOLER"](#) .)
 - Accessory, accessory bracket and mount brackets
8. Remove fuel pump bracket.
 9. Remove rear oil seal retainer.
 - Insert a flat-bladed screwdriver between main bearing cap and rear oil seal retainer to remove retainer.
 10. Remove rear oil seal from rear oil seal retainer.
 - Punch out with a flat-bladed screwdriver.

CAUTION:

Be careful not to damage rear oil seal retainer.

11. Remove piston and connecting rod assembly.
 - Before removing piston and connecting rod assembly, check connecting rod side clearance. Refer to [EM-226, "CONNECTING ROD SIDE CLEARANCE"](#) .
- a. Move crankshaft pin to be removed to approximately BDC.
- b. Remove connecting rod caps.
- c. Using the grip of a hammer, press the piston and connecting rod assembly out to cylinder head side.

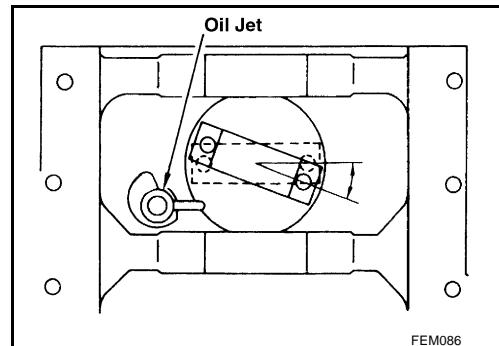


JEM195G

CAUTION:

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

12. Remove connecting rod bearings from connecting rods and caps.
 - Keep them by cylinder to avoid confusion.

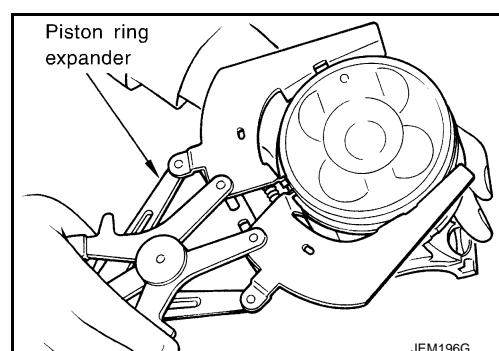


FEM086

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

CAUTION:

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

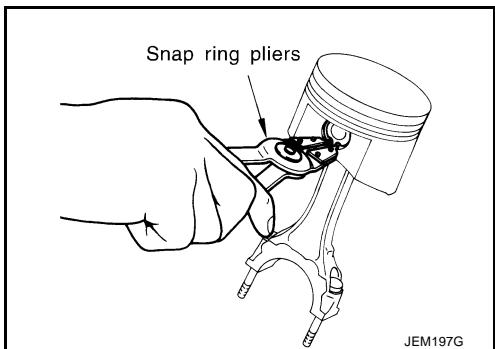


JEM196G

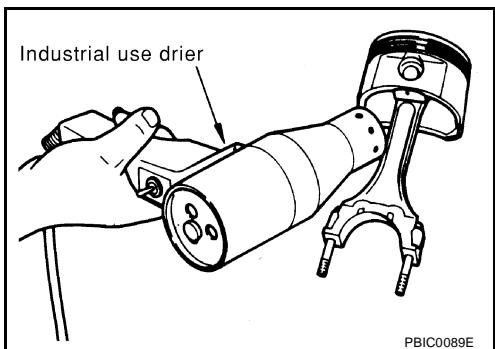
CYLINDER BLOCK

[YD22DDTi]

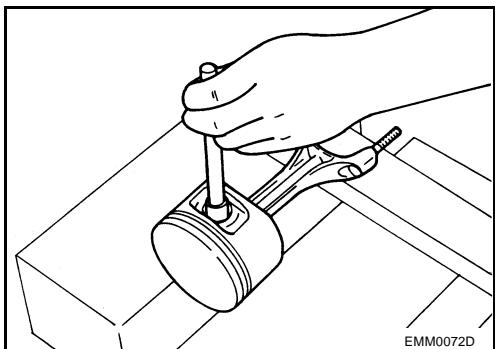
14. Remove pistons from connecting rods.
- Using the snap ring pliers, remove snap rings.



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

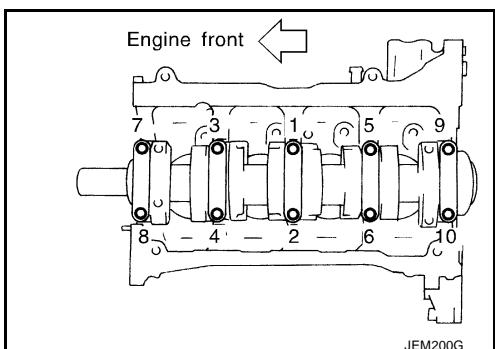


- Using rod with outer diameter of 26 mm (1.02 in), press piston pins out.



15. Remove main bearing cap bolts.

- With a TORX socket (size: E14, Commercial Service Tool), loosen main bearing cap bolts in several stages in reverse order of that shown in the figure and remove them.
- Before loosening main bearing cap bolts, measure crankshaft end play. Refer to [EM-226, "CRANKSHAFT END PLAY"](#).



16. Remove main bearing caps.

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

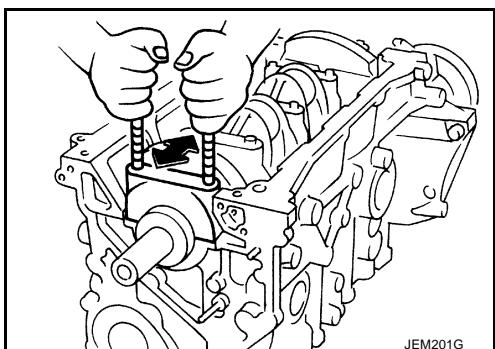
17. Remove crankshaft.

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

CAUTION:

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

19. Remove oil jet.



20. Remove oil jet relief valve.

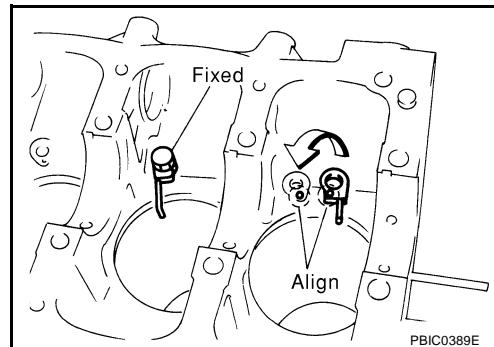
ASSEMBLY

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

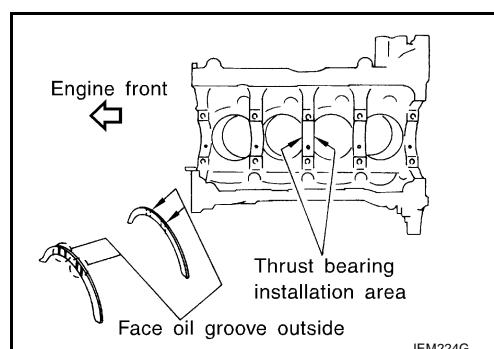
CAUTION:

Use a goggles to protect your eye.

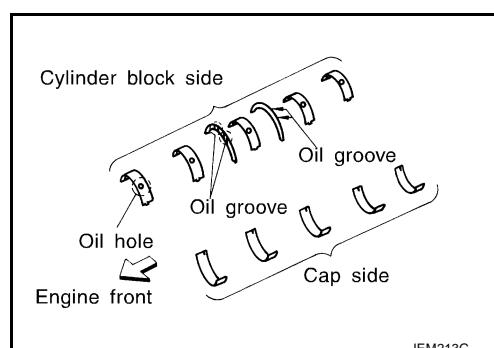
- Install oil jet relief valve.
- Install oil jet.
- Align knock pin on back of oil jet with hole on block when installing oil jet.



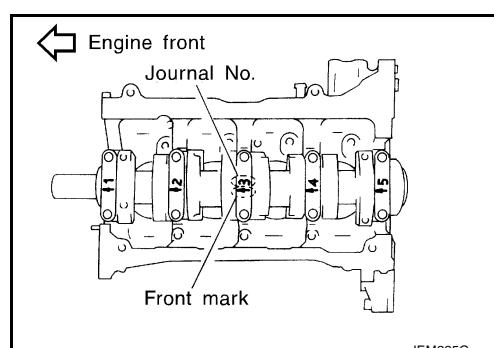
- Install main bearings and thrust bearings.
- Remove contamination, dust and engine oil from bearing mounting positions on cylinder block and main bearing caps.
- Install thrust bearings on both sides of No. 3 housing on cylinder block.
- Install thrust bearings with oil groove facing to crankshaft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



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



- Install crankshaft to cylinder block.
- Make sure crankshaft rotates smoothly by hand.
- Install main bearing caps.
- Identify main bearing caps by the punched mark. Install correctly matching the journal No. on the bearing cap and the journal with the front mark facing forward.
- Main bearing caps are commonly processed with the cylinder block. Therefore, caps and cylinder block should be replaced as a set.
- Check the main bearing cap bolts for deformation. Refer to [EM-234, "MAIN BEARING CAP BOLT DEFORMATION"](#).



CYLINDER BLOCK

[YD22DDTi]

8. With the TORX socket (size: E14, commercial service tool), tighten the main bearing cap bolts according to the following procedure:
 - a. Apply engine oil to the threaded part and seat surface of each bolt.
 - b. Tighten all bolts in numerical order shown in the figure.

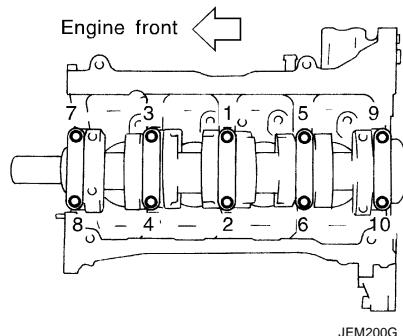
 : 25 - 30 N·m (2.5 - 3.1 kg·m, 18 - 22 ft-lb)

- c. Put alignment marks (with paint) on each bolt and the main bearing cap, all in the same direction. (When using a protractor)
- d. Then, tighten 90 degrees to 95 degrees [target: 90 degrees]. (angle tightening)

CAUTION:

Always use either the angle wrench (special service tool) or protractor during angular tightening. Avoid tightening based on visual checks alone.

- After tightening bolts to specified torque, make sure that crankshaft rotates smoothly.
- Check crankshaft end play. Refer to [EM-226, "CRANKSHAFT END PLAY"](#).



9. Check the outer diameter of connecting rod bolts. Refer to [EM-234, "CONNECTING ROD BOLT DEFORMATION"](#).

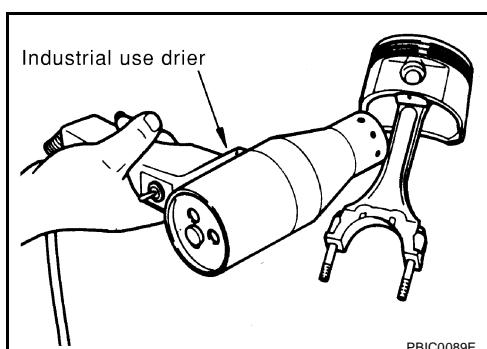
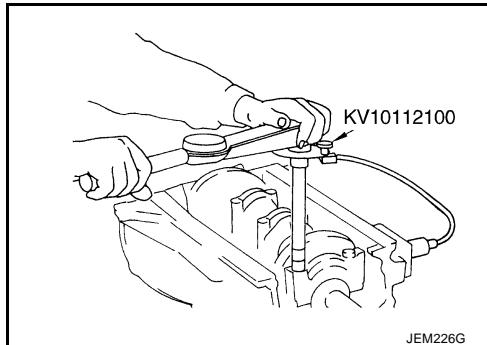
10. Install piston to connecting rod.

- a. Using the snap ring pliers, install snap rings to groove on piston rear side.

- Fit snap ring correctly into grooves.

- b. Install pistons to connecting rods.

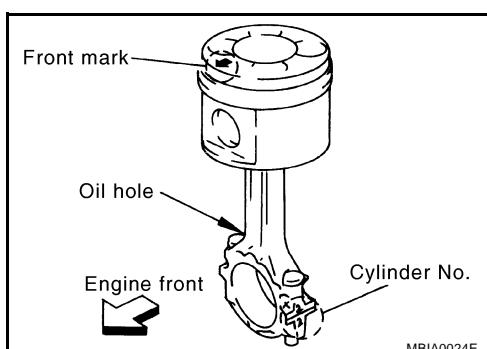
- Using the industrial use dryer, heat pistons up to approx. 60 to 70°C (140 to 158°F) until piston pin can be pressed down by finger touch. Then insert piston pin into piston and connecting rod from front side of piston toward rear.



- Assemble piston and connecting rod with front mark of piston head and cylinder No. stamped on connecting rod being positioned as shown in the figure.
- c. Install snap ring to front side of piston.

- Refer to above step a for precaution on snap ring installation.

- After installation, check connecting rods for smooth movement.



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

CAUTION:

When installing, prevent piston from being damaged.

CYLINDER BLOCK

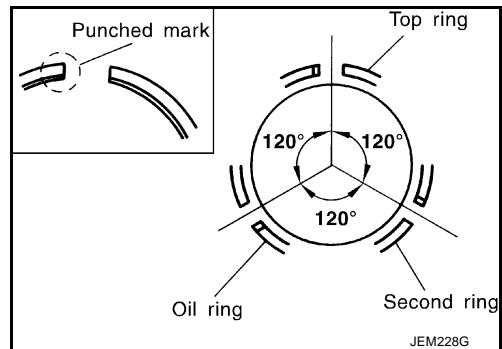
[YD22DDTi]

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

Punched mark:

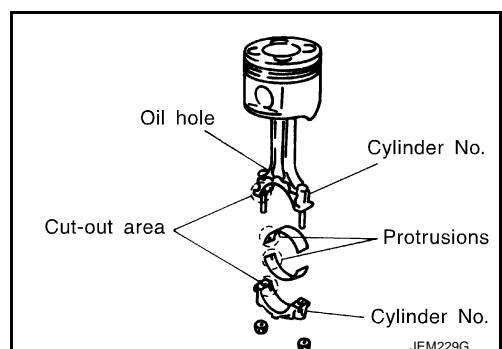
Top ring : RTop
Second ring : R2nd

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



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

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

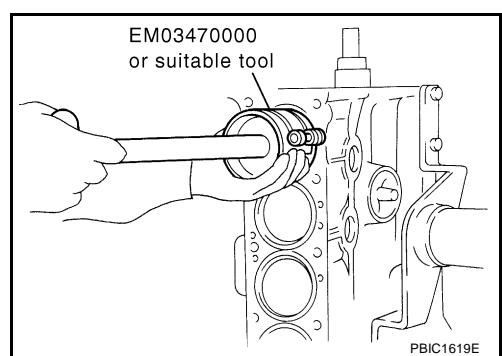


13. Install piston and connecting rod assembly to crankshaft.

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

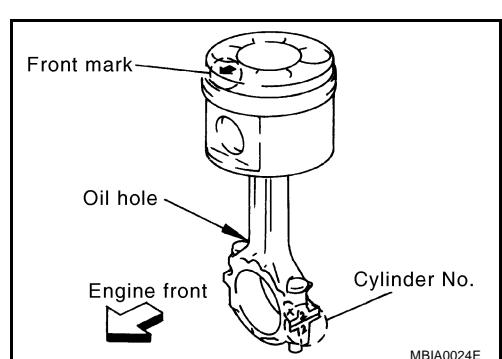
CAUTION:

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



14. Install connecting rod caps and mounting nuts.

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



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

- Apply engine oil on bolt threads and seat surface of nuts.
- Tighten bolts.

: 29 - 30 N·m (2.9 - 3.1 kg-m, 21 - 22 ft-lb)

- Loosen completely.

: 0 N·m (0 kg-m, 0 in-lb)

CYLINDER BLOCK

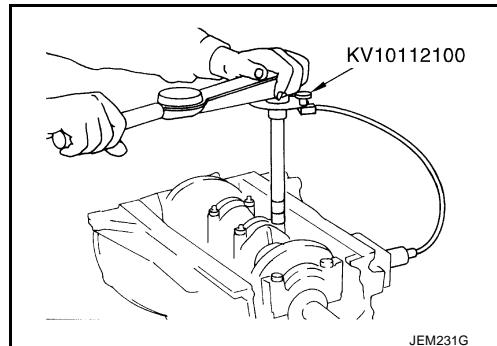
[YD22DDTi]

- d. Tighten bolts.

 : 19 - 20 N·m (1.9 - 2.1 kg·m, 14 - 15 ft-lb)

- e. Tighten 120 degrees to 125 degrees [target: 120 degrees].
(angle tightening)

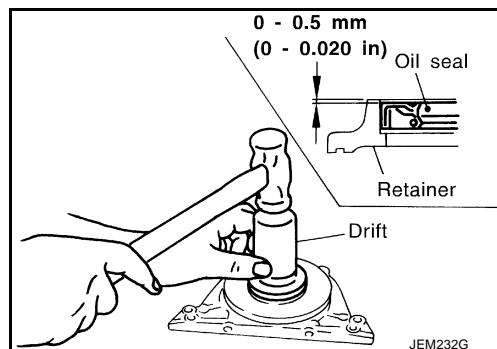
- Always use either the angle wrench (special service tool) or protractor during angular tightening. Avoid tightening based on visual checks alone.
- After tightening nuts, make sure that crankshaft rotates smoothly.
- Check connecting rod side clearance. Refer to [EM-226, "CONNECTING ROD SIDE CLEARANCE"](#).



JEM231G

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

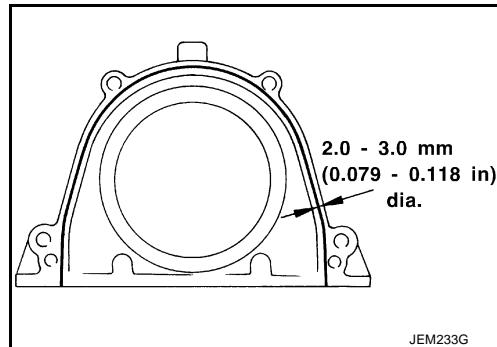
- Using the drift [105 mm (4.13 in) dia.], press fit so that the dimension is as specified in the figure.
- Avoid inclined fitting. Force fit perpendicularly.



JEM232G

17. Install rear oil seal retainer to cylinder block.

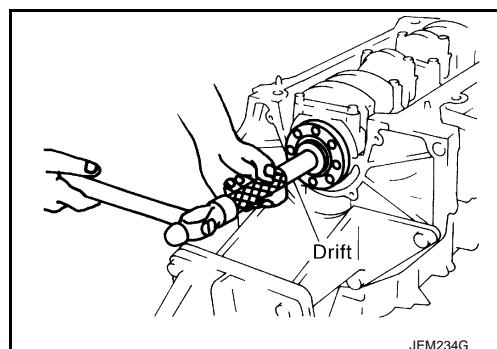
- Apply new engine oil to the oil and dust seal lips.
- Apply liquid gasket to rear oil seal retainer using the tube presser (special service tool: WS39930000) as shown in the figure.
Use Genuine Liquid Gasket or equivalent.



JEM233G

18. Press fit pilot bush into flywheel.

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



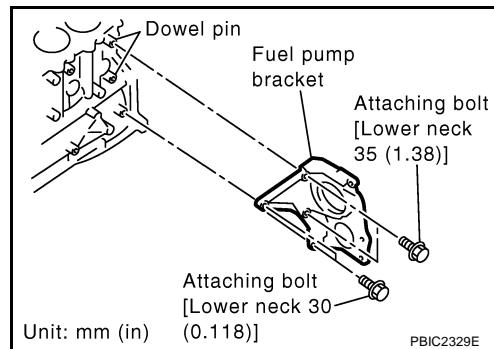
JEM234G

CYLINDER BLOCK

[YD22DDTi]

19. Install fuel pump bracket.

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

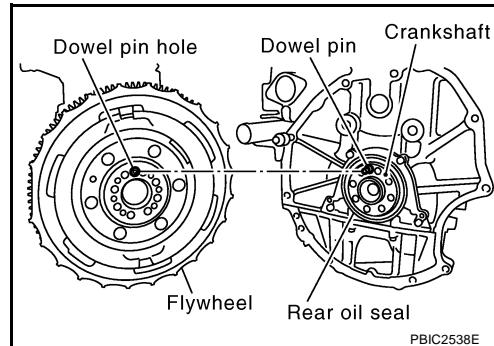


20. Install parts to engine in the reverse order of disassembly.

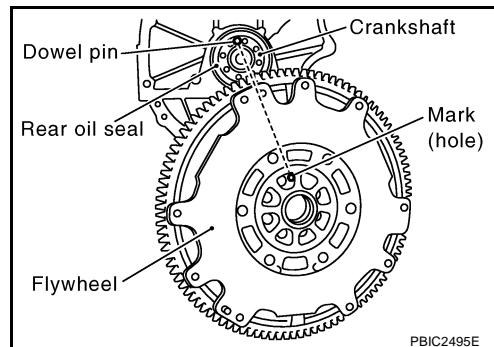
21. Remove engine from engine stand in the reverse order of assembly.

22. Install flywheel.

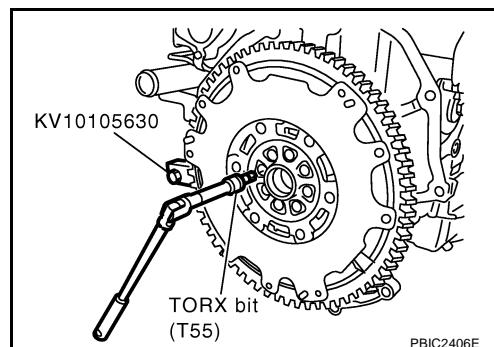
- When installing flywheel to crankshaft, be sure to correctly align crankshaft side dowel pin and flywheel side dowel pin-hole.



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



- Holding ring gear with the ring stopper (special service tool), tighten securing bolts with TORX bit (size: T55, Commercial Service Tool).
- Tighten bolts uniformly in a crisscross manner.



How to Select Piston and Bearing DESCRIPTION

EBS000DY

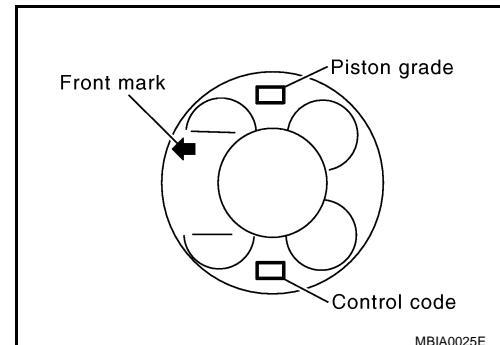
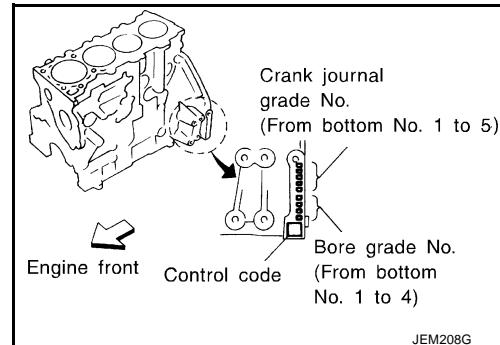
Selection points	Selection parts	Selection items	Selection methods
Between cylinder block to crankshaft	Main bearing	Main bearing grade (bearing thickness)	Determined by match of cylinder block bearing housing grade (inner diameter of housing) and crankshaft journal grade (outer diameter of journal)
Between crankshaft to connecting rod	Connecting rod bearing	Connecting rod bearing grade (bearing thickness)	Combining service grades for connecting rod big end diameter and crankshaft pin outer diameter determine connecting rod bearing selection.
Between cylinder block to piston	Piston and piston pin assembly The piston is available together with piston pin as an assembly.	Piston grade (piston outer diameter)	Piston grade = cylinder bore grade (inner diameter of bore)

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

HOW TO SELECT PISTON

When Using New Cylinder Block

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



When Re-using an Old Cylinder Block

1. Measure cylinder bore inner diameter. Refer to [EM-230, "Cylinder Bore Inner Diameter"](#).
2. Referring to "Cylinder bore inner diameter" in "Piston Selection Table", determine the bore grade.
3. Select piston of the same grade.

CYLINDER BLOCK

[YD22DDTi]

Piston Selection Table

Unit: mm (in)

Grade (punched)	1	2	3
Cylinder bore inner diameter	86.000 - 86.010(3.3858 - 3.3862)	86.010 - 86.020(3.3862 - 3.3866)	86.020 - 86.030(3.3866 - 3.3870)
Piston outer diameter	85.928 - 85.942(3.3830 - 3.3835)	85.938 - 85.952(3.3834 - 3.3839)	85.948 - 85.962(3.3838 - 3.3843)

NOTE:

Piston is available together with piston pin as an assembly.

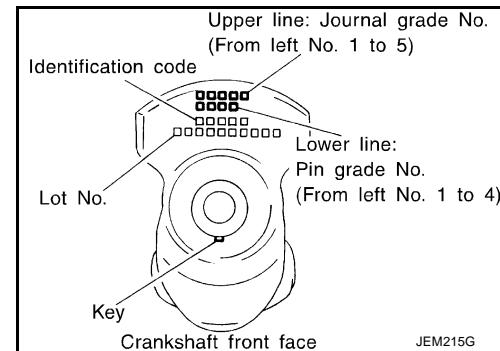
HOW TO SELECT CONNECTING ROD BEARING

When Using New Crankshaft and Connecting Rod

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

NOTE:

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



When Re-using the Removed Crankshaft and Connecting Rod

- Measure the inner diameter of the big end of connecting rod and make sure it is within the specified range. Refer to [EM-228, "CONNECTING ROD BIG END INNER DIAMETER"](#).
- Measure the outer diameter of the crankshaft pin. Refer to [EM-231, "CRANKSHAFT PIN OUTER DIAMETER"](#).
- Determine the crankshaft pin grade by comparing the measurement with the values under the column "Crankshaft pin outer diameter" in "Selection Table of connecting Rod Bearing".
- Choose bearings of the same grade.

Selection Table of connecting Rod Bearing

Unit: mm (in)

Connecting rod big end inner diameter	55.000 - 55.013 (2.1654 - 2.1659)			
Unit: mm (in)				
Crankshaft pin outer diameter	Grade (Mark)	Dimension (Bearing thickness range)	Bearing grade No.	Color
51.968 - 51.974 (2.0460 - 2.0462)	0	1.492 - 1.496 (0.0587 - 0.0589)	STD 0	Black
51.961 - 51.968 (2.0457 - 2.0460)	1	1.496 - 1.500 (0.0589 - 0.0591)	STD 1	Brown
51.954 - 51.961 (2.0454 - 2.0457)	2	1.500 - 1.504 (0.0591 - 0.0592)	STD 2	Green

Under Size Bearing Usage

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

CYLINDER BLOCK

[YD22DDTi]

Connecting Rod Bearing Under Size List

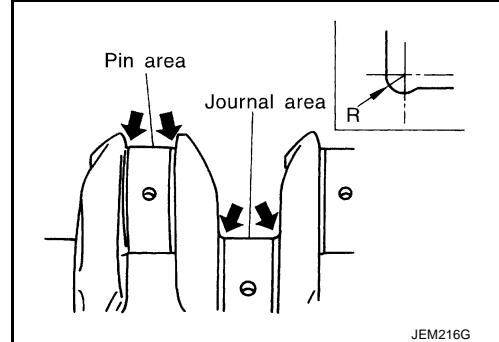
Unit: mm (in)

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

CAUTION:

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

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

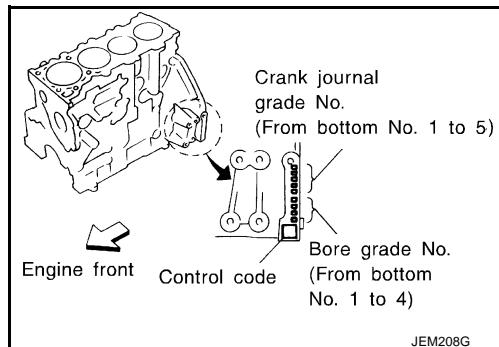


JEM216G

HOW TO SELECT MAIN BEARING

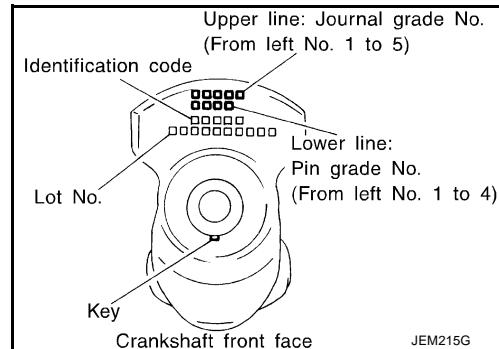
When Using New Cylinder Block and Crankshaft

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



JEM208G

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



JEM215G

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

When Re-using Removed Cylinder Block and Crankshaft

- Measure the inner diameter of cylinder block main bearing housing. Refer to [EM-229, "MAIN BEARING HOUSING INNER DIAMETER"](#).
- Locate the applicable cell where the measurement falls, on "Inner diameter of Cylinder block main bearing housing" row in the "Main Bearing Grade Table".
- Measure the outer diameter of crankshaft journal. Refer to [EM-231, "CRANKSHAFT JOURNAL OUTER DIAMETER"](#).
- Locate the applicable cell where the measurement falls, under "Crankshaft journal outer diameter" column in the "Main Bearing Grade Table".
- The main bearing to be used (STD 0 to STD 4) can be located in the cell where the row and column cross.

CYLINDER BLOCK

[YD22DDTi]

Main Bearing Grade Table

Unit: mm (in)

Inner diameter of Cylinder block main bearing housing			66.654 - 66.663 (2.6242 - 2.6245)	66.663 - 66.672 (2.6245 - 2.6249)	66.672 - 66.681 (2.6249 - 2.6252)
Crankshaft journal outer diameter	Grade (punched)		0	1	2
62.967 - 62.975 (2.4790 - 2.4793)	0	<ul style="list-style-type: none"> ● Bearing grade No. 1.816 - 1.820 (0.0715 - 0.0717) ● Bearing thickness 0.039 - 0.066 (0.0015 - 0.0026) ● Oil clearance Black ● Identification color 	STD 0 1.820 - 1.824 (0.0717 - 0.0718) 0.039 - 0.066 (0.0015 - 0.0026) Black	STD 1 1.820 - 1.824 (0.0717 - 0.0718) 0.039 - 0.066 (0.0015 - 0.0026) Brown	STD 2 1.824 - 1.828 (0.0718 - 0.0720) 0.039 - 0.066 (0.0015 - 0.0026) Green
62.959 - 62.967 (2.4787 - 2.6790)	1	<ul style="list-style-type: none"> ● Bearing grade No. 1.820 - 1.824 (0.0717 - 0.0718) ● Bearing thickness 0.039 - 0.066 (0.0015 - 0.0026) ● Oil clearance Brown ● Identification color 	STD 1 1.820 - 1.824 (0.0717 - 0.0718) 0.039 - 0.066 (0.0015 - 0.0026) Brown	STD 2 1.824 - 1.828 (0.0718 - 0.0720) 0.039 - 0.066 (0.0015 - 0.0026) Green	STD 3 1.828 - 1.832 (0.0720 - 0.0721) 0.039 - 0.066 (0.0015 - 0.0026) Yellow
62.951 - 62.959 (2.4784 - 2.4787)	2	<ul style="list-style-type: none"> ● Bearing grade No. 1.824 - 1.828 (0.0718 - 0.0720) ● Bearing thickness 0.039 - 0.066 (0.0015 - 0.0026) ● Oil clearance Green ● Identification color 	STD 2 1.824 - 1.828 (0.0718 - 0.0720) 0.039 - 0.066 (0.0015 - 0.0026) Green	STD 3 1.828 - 1.832 (0.0720 - 0.0721) 0.039 - 0.066 (0.0015 - 0.0026) Yellow	STD 4 1.832 - 1.836 (0.0721 - 0.0723) 0.039 - 0.066 (0.0015 - 0.0026) Blue

Under Size Bearing Usage

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

Main Bearing Under Size List

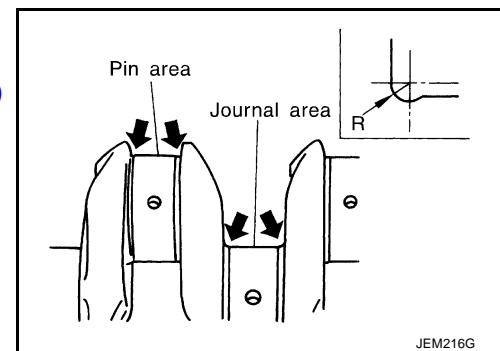
Unit: mm (in)

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

CAUTION:

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

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



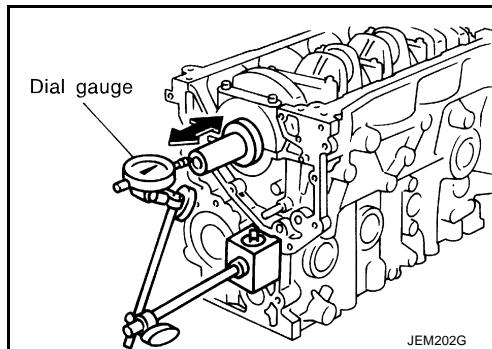
Inspection After Disassembly**CRANKSHAFT END PLAY**

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

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

Limit : 0.30 mm (0.0118 in)

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

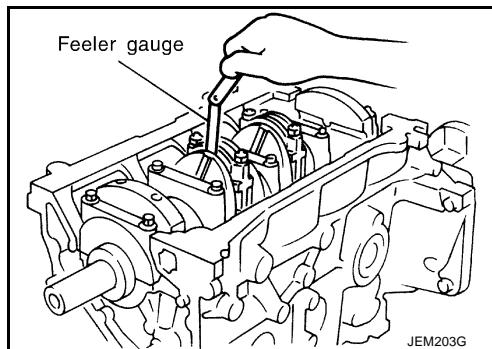
**CONNECTING ROD SIDE CLEARANCE**

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

Standard : 0.20 - 0.35 (0.0079 - 0.0138 in)

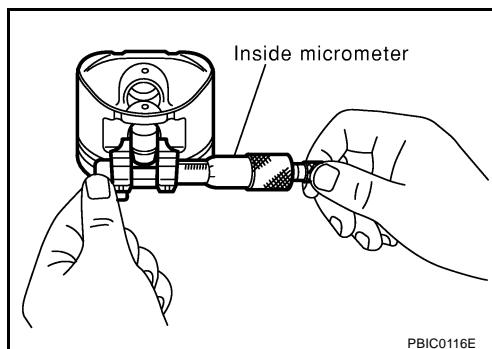
Limit : 0.40 mm (0.0157 in)

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

**PISTON TO PISTON PIN CLEARANCE****Piston Pin Bore Diameter**

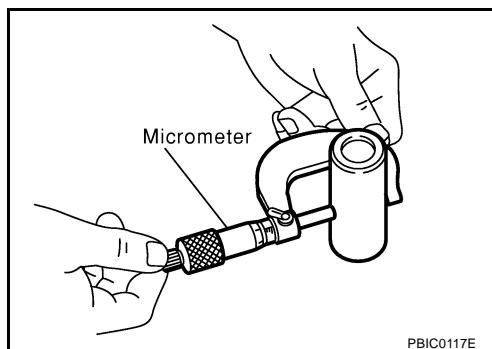
Using inside micrometer, measure piston pin bore diameter.

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

**Piston Pin Outer Diameter**

Using micrometer, measure piston pin outer diameter.

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

**Calculation of Piston to Piston Pin Clearance**

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

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

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

CYLINDER BLOCK

[YD22DDTi]

NOTE:

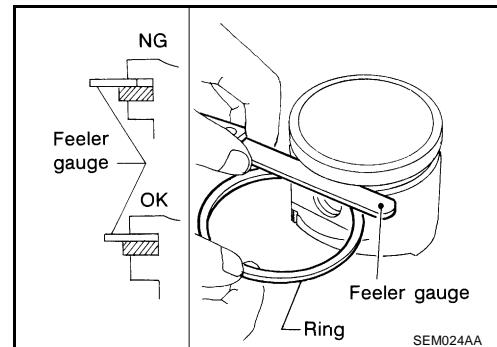
Piston is available together with piston pin as assembly.

PISTON RING SIDE CLEARANCE

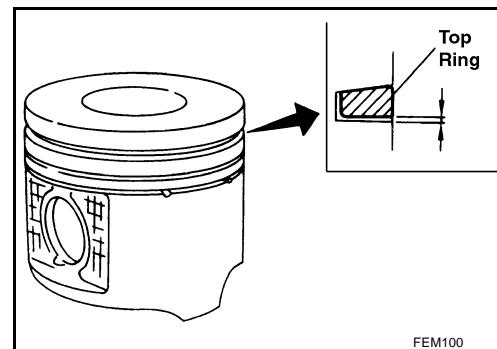
- Using feeler gauge, measure the side clearance between piston ring and piston ring groove.

Unit: mm (in)

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



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

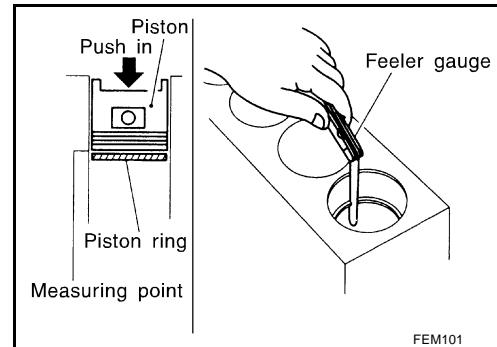


PISTON RING END GAP

- Make sure that cylinder bore diameter is within the specifications. Refer to [EM-230, "PISTON TO CYLINDER BORE CLEARANCE"](#).
- Lubricate with new engine oil to piston and piston ring, and then insert piston ring until middle of cylinder with piston, and measure piston ring end gap with feeler gauge.

Unit: mm (in)

Item	Standard	Limit
Top ring	0.20 - 0.30 (0.0079 - 0.0118)	1.0 (0.039)
2nd ring	0.31 - 0.51 (0.0122 - 0.0201)	
Oil ring	0.30 - 0.55 (0.0118 - 0.0217)	



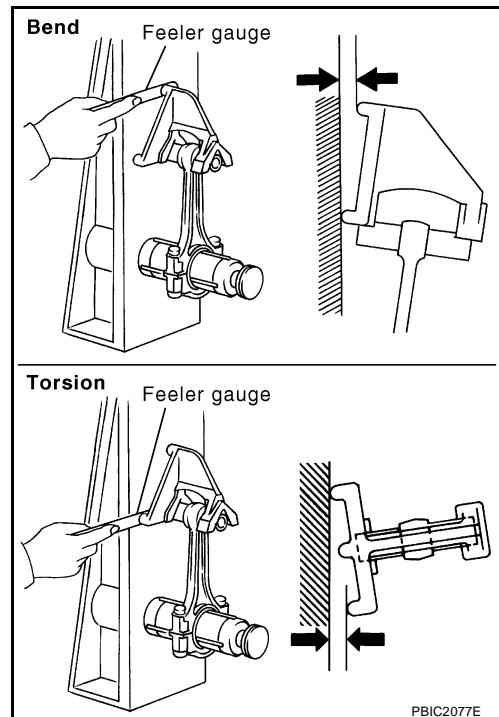
- If out of the limit, replace piston ring. If gap still exceeds the limit even with a new ring, re-bore cylinder and use oversized piston and piston ring. Refer to [EM-230, "PISTON TO CYLINDER BORE CLEARANCE"](#).

CONNECTING ROD BEND AND TORSION

- Use connecting rod aligner to check bend and torsion.

Bend limit : 0.12 mm (0.0047 in)/100 mm (3.94 in)

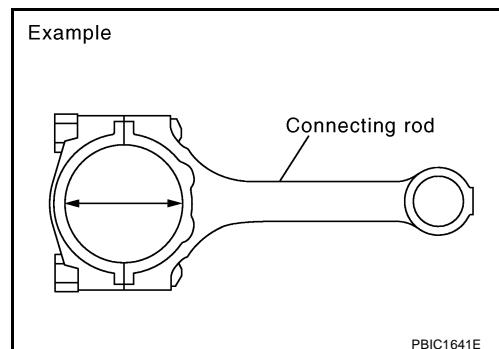
Torsion limit : 0.12 mm (0.0047 in)/100 mm (3.94 in)
- If it exceeds the limit, replace connecting rod assembly.



CONNECTING ROD BIG END INNER DIAMETER

- Install connecting rod caps without connecting rod bearings and tighten connecting rod nuts to the specified torque. Refer to [EM-217, "ASSEMBLY"](#).
- Using inside micrometer, measure connecting rod big end inner diameter.

Standard : 55.000 - 55.013 mm (2.1654 - 2.1659 in)
- If out of the standard, replace connecting rod.

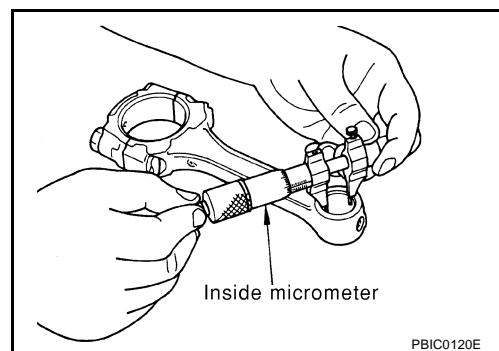


CONNECTING ROD BUSHING OIL CLEARANCE

Connecting Rod Bushing Inner Diameter

Use inside micrometer to measure bushing inner diameter.

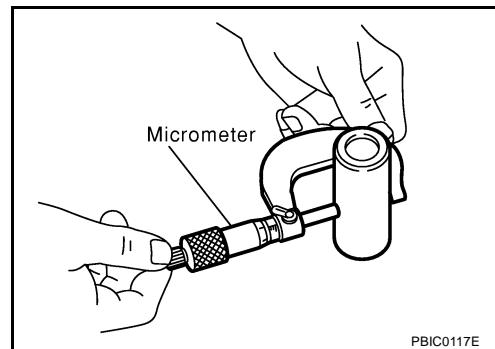
Standard : 28.026 - 28.038 mm (1.1034 - 1.1039 in)



Piston Pin Outer Diameter

Use micrometer to measure piston pin outer diameter.

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

**Calculation of Connecting Rod Bushing Clearance**

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

Standard : 0.026 - 0.044 mm (0.0010 - 0.0017 in)

Limit : 0.057 mm (0.0022 in)

- If it exceeds the limit, replace connecting rod and/or piston and piston pin assembly. Refer to [EM-223, "HOW TO SELECT CONNECTING ROD BEARING"](#) and/or [EM-222, "HOW TO SELECT PISTON"](#).

CYLINDER BLOCK TOP SURFACE DISTORTION

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

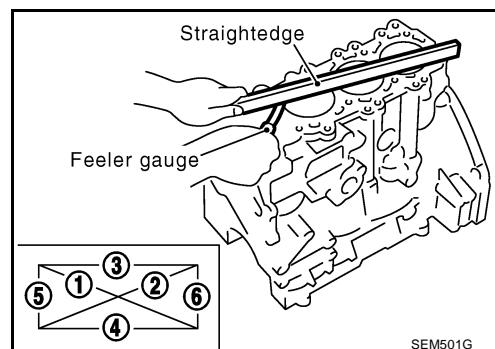
CAUTION:

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

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

Limit : 0.1 mm (0.004 in)

- If it exceeds the limit, replace cylinder block.

**MAIN BEARING HOUSING INNER DIAMETER**

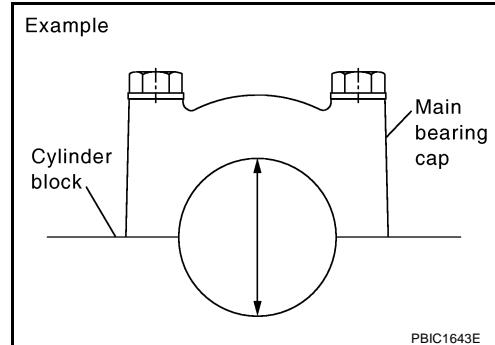
- Without installing main bearings, install main bearing caps, and tighten bolts to the specified torque. Refer to [EM-217, "ASSEMBLY"](#).
- Measure the inner diameter of main bearing housing with a bore gauge.

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

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

NOTE:

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



PISTON TO CYLINDER BORE CLEARANCE

Cylinder Bore Inner Diameter

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

Cylinder bore inner diameter

: 86.000 - 86.030 mm (3.3858 - 3.5870 in)

Wear limit

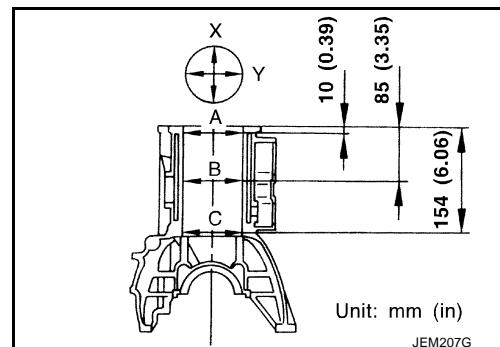
: 0.20 mm (0.008 in)

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

: 0.015 mm (0.0006 in)

Taper limit (Difference between A and C)

: 0.010 mm (0.0004 in)



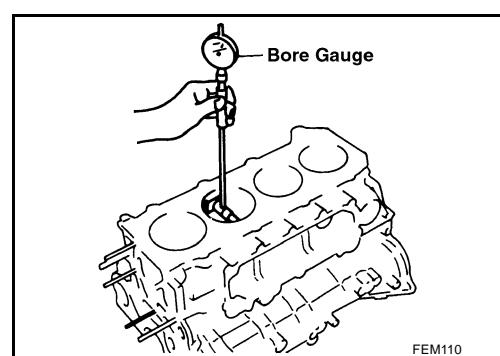
- If the measured value exceeds the limit, or if there are scratches and/or seizure on the cylinder inner wall, hone or bore the inner wall.
- Oversize piston is provided. When using oversize piston, hone the cylinder so that the clearance between piston and cylinder satisfies the standard.

CAUTION:

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

Oversize (OS) : 0.25 mm (0.0098 in)

: 0.50 mm (0.0197 in)



Piston Outer Diameter

Use micrometer to measure piston outer diameter.

Piston outer diameter

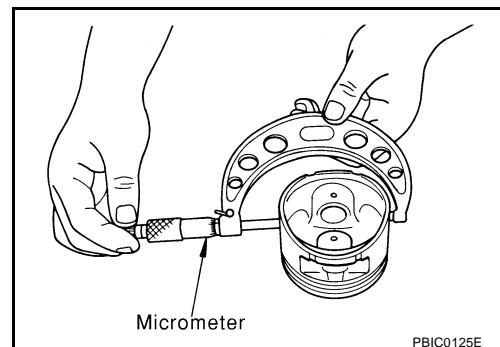
Measurement position : 11.0 mm (0.43 in)

Distance from the bottom

Standard : 85.928 - 85.962 mm
(3.3830 - 3.3843 in)

0.25 (0.0098) O/S : 86.188 - 86.202
(3.3932 - 3.3938 in)

0.50 (0.0197) O/S : 86.438 - 86.452
(3.4031 - 3.4036 in)



Calculation of Piston to Cylinder Bore Clearance

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

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

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

- If it exceeds the limit, replace piston and piston pin assembly. Refer to [EM-222, "HOW TO SELECT PISTON"](#).

Reboring Cylinder Bore

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

Rebore size calculation:

$$D = A + B - C$$

Where,

D: Bored diameter

- A: Piston outer diameter as measured
- B: Piston-to-cylinder bore clearance
- C: Honing allowance 0.02 mm (0.0008 in)

2. install main bearing caps and tighten bolts to the specified torque. Refer to [EM-217, "ASSEMBLY"](#). This will prevent distortion of cylinder bores.

3. Cut cylinder bore.

NOTE:

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

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

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

NOTE:

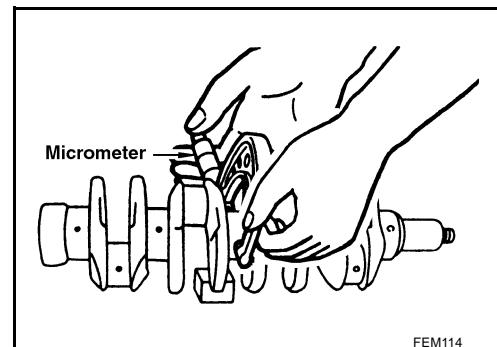
- Measurement should be done after cylinder bore cools down.

CRANKSHAFT JOURNAL OUTER DIAMETER

- Use micrometer to measure journal outer diameter.

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

- If out of the standard, measure the main bearing oil clearance, then use the undersize bearing. Refer to [EM-233, "MAIN BEARING OIL CLEARANCE"](#).



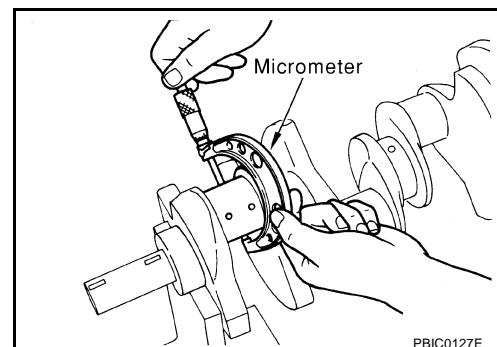
FEM114

CRANKSHAFT PIN OUTER DIAMETER

- Use micrometer to measure crankshaft pin outer diameter.

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

- If out of the standard, measure the connecting rod bearing oil clearance, then use the undersize bearing. Refer to [EM-232, "CONNECTING ROD BEARING OIL CLEARANCE"](#).



PBIC0127E

CRANKSHAFT OUT-OF-ROUND AND TAPER

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

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

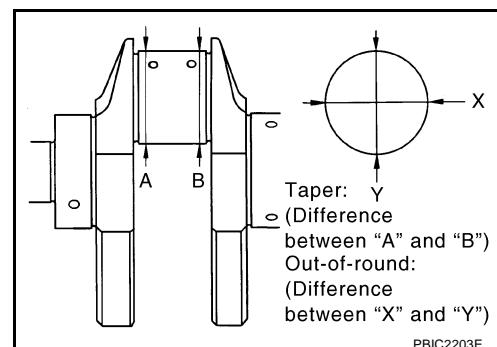
Standard : 0.003 mm (0.0001 in)

Limit : 0.005 mm (0.0002 in)

Taper: (Difference between A and B)

Standard : 0.003 mm (0.0001 in)

Limit : 0.005 mm (0.0002 in)



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

- If corrected, measure the bearing oil clearance of the corrected journal and/or pin. Then select the main bearing or connecting rod bearing. Refer to [EM-233, "MAIN BEARING OIL CLEARANCE"](#) and/or [EM-232, "CONNECTING ROD BEARING OIL CLEARANCE"](#).

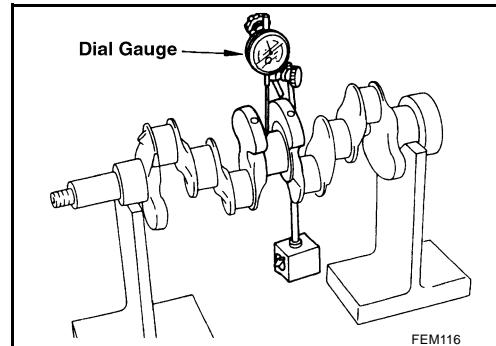
CRANKSHAFT RUNOUT

- Place V-block onto surface plate to support journals at both ends of crankshaft.
- Position dial gauge vertically onto No. 3 journal.
- Rotate crankshaft to read needle movement on dial gauge. (Total indicator reading)

Standard : 0.05 mm (0.0020 in)

Limit : 0.10 mm (0.0039 in)

- If it exceeds the limit, replace crankshaft.



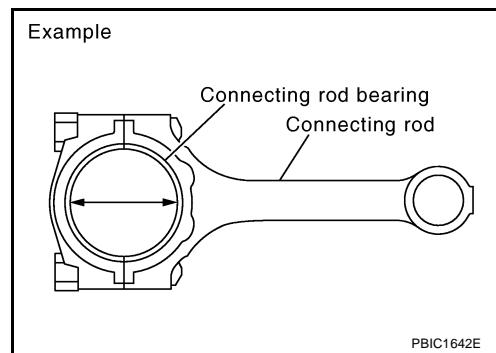
CONNECTING ROD BEARING OIL CLEARANCE

Method by Measurement

- Install connecting rod bearings to connecting rod and cap, and tighten connecting nuts to the specified torque. Refer to [EM-217, "ASSEMBLY"](#). Use inside micrometer to measure connecting rod bearing inner diameter.
(Bearing clearance) = (Connecting rod bearing inner diameter) – (Crankshaft pin outer diameter)

Standard : 0.031 - 0.061 mm (0.0012 - 0.0024 in)

- If clearance exceeds the standard, select proper connecting rod bearing according to connecting rod big end diameter and crankshaft pin outer diameter to obtain specified bearing oil clearance. Refer to [EM-223, "HOW TO SELECT CONNECTING ROD BEARING"](#).



Method of Using Plastigage

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

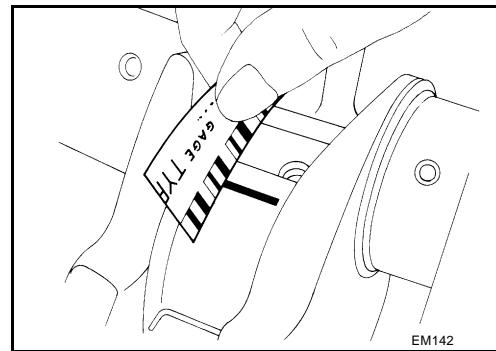
CAUTION:

Do not rotate crankshaft.

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

NOTE:

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



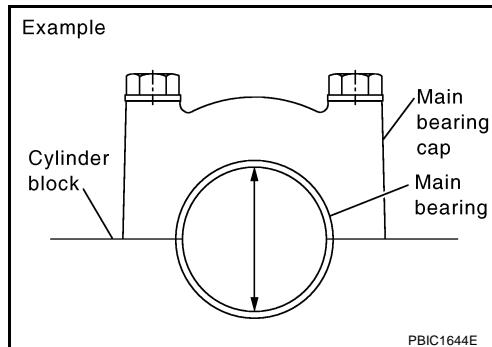
MAIN BEARING OIL CLEARANCE

Method by Measurement

- Install main bearings to cylinder block and bearing cap, and tighten the bolts to the specified torque. Refer to [EM-217, "ASSEMBLY"](#). Then, measure the inner diameter of main bearings.
(Bearing clearance) = (Bearing inner diameter) – (Crankshaft journal outer diameter)

Standard : 0.039 - 0.066 mm (0.0015 - 0.0026 in)

- If out of the standard, check main bearing housing inner diameter and crankshaft journal outer diameter, and select appropriate main bearing to adjust clearance to specifications. Refer to [EM-224, "HOW TO SELECT MAIN BEARING"](#).



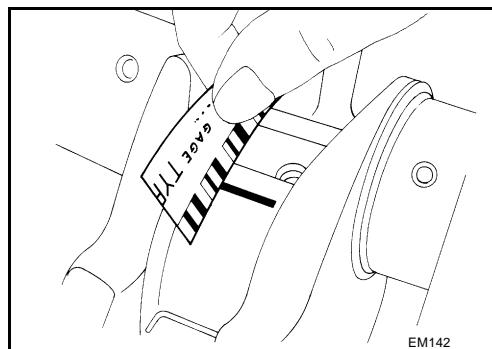
Method of Using Plastigage

- Remove contamination such as engine oil and dust completely from crankshaft journals and each bearing surface.
- Cut plastigage slightly shorter than bearing width. Place it in crankshaft turning direction, avoiding oil holes.
- Install main bearings and bearing cap and tighten to the specified torque. Refer to [EM-217, "ASSEMBLY"](#) for the tightening procedure.

CAUTION:

Do not rotate crankshaft.

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



NOTE:

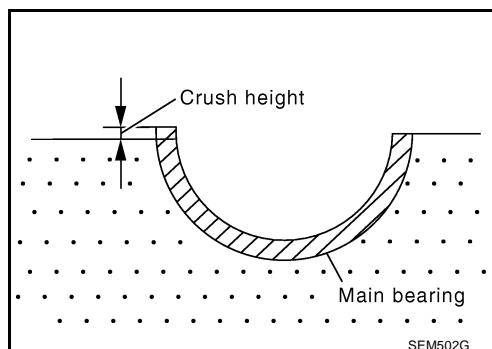
If out of specification, take same action mentioned in "Method by Measurement".

CRUSH HEIGHT OF MAIN BEARING

- When bearing cap is removed after being tightened to the specified torque with main bearings installed, the tip end of bearing must protrude. Refer to [EM-217, "ASSEMBLY"](#).

Standard : There must be crush height.

- If out of the standard, replace main bearings.

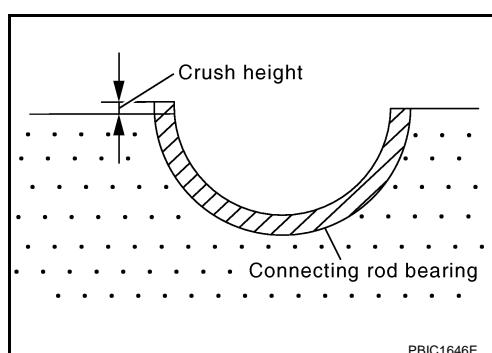


CRUSH HEIGHT OF CONNECTING ROD BEARING

- When connecting rod bearing cap is removed after being tightened to the specified torque with connecting rod bearings installed, the tip end of bearing must protrude. Refer to [EM-217, "ASSEMBLY"](#).

Standard : There must be crush height.

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

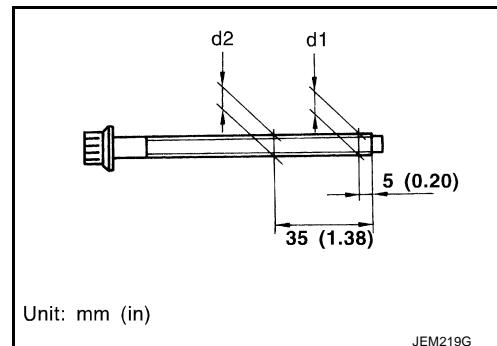


CYLINDER BLOCK

[YD22DDTi]

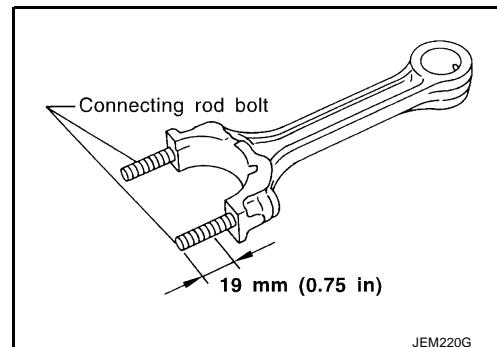
MAIN BEARING CAP BOLT DEFORMATION

- Measure the outer diameter of threaded area, d1 and d2, at the points specified in the figure.
- When the necked point is identified at a point other than where specified, measure at the point as d2.
- Calculate the difference between d1 and d2.
Limit : 0.13 mm (0.0051 in)
- If it exceeds the limit, replace main bearing cap bolt.



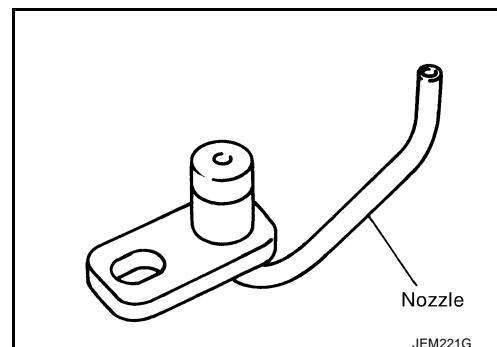
CONNECTING ROD BOLT DEFORMATION

- Install nuts to connecting rod bolts. Make sure that the nut can be screwed smoothly on bolt threads by hand to the last thread on the bolt.
- If the nut does not screw in smoothly, measure the outer diameter of the bolt thread at the point specified in the figure.
- If a necked point is identified, measure at that point.
Standard : 8.90 - 9.00 mm (0.3504 - 0.3543 in) dia.
Limit : 8.75 mm (0.3445 in) dia.
- If it exceeds the limit, replace connecting rod bolts and nuts.



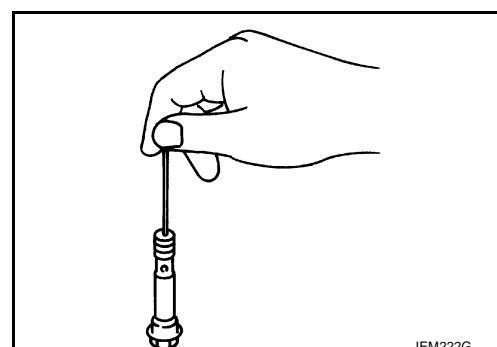
OIL JET

- Check nozzle for deformation and damage.
- Blow compressed air from nozzle, and check for clogs.
Standard : No deformation and no damage.
- If out of the standard, replace oil jet.



OIL JET RELIEF VALVE

- Using clean plastic stick, press check valve in oil jet relief valve. Make sure that valve moves smoothly with proper reaction force.
Standard:
Valve moves smoothly with proper reaction force.
- If out of the standard, replace oil jet relief valve.



FLYWHEEL DEFLECTION

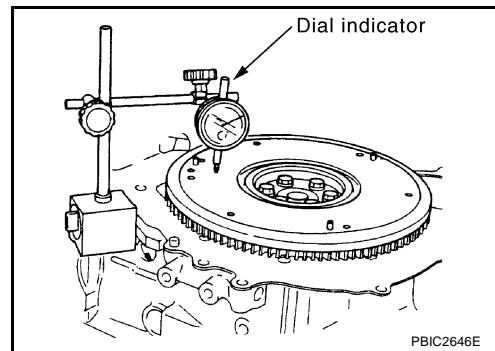
- Measure the deflection of flywheel contact surface to clutch with a dial indicator.
- Measure the deflection at 210 mm (8.27 in) dia.

Standard : 0.45 mm (0.0177 in) or less.

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

CAUTION:

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

**MOVEMENT AMOUNT OF FLYWHEEL****CAUTION:**

Do not disassemble double mass flywheel.

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

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

Standard : 1.3 mm (0.051 in) or less

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

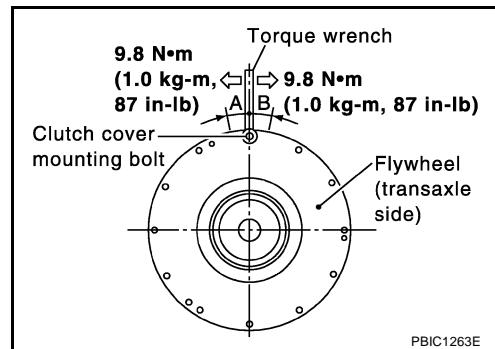
Movement Amount in Radial (Rotation) Direction

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

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

Standard: 26.2 mm (1.031 in) or less.

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



SERVICE DATA AND SPECIFICATIONS (SDS)

[YD22DDTi]

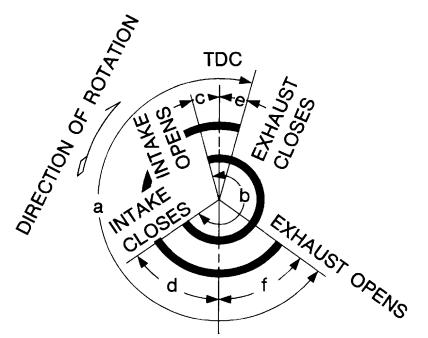
SERVICE DATA AND SPECIFICATIONS (SDS)

PFP:00030

Standard and Limit

GENERAL SPECIFICATIONS

EBS000DZ

Cylinder arrangement	In-line 4
Displacement	Unit: cm ³ (cu in) 2,184 (133.27)
Bore and stroke	Unit: mm (in) 86 x 94 (3.39 x 3.70)
Valve arrangement	DOHC
Firing order	1-3-4-2
Number of piston rings	Compression 2 Oil 1
Number of main bearings	5
Compression ratio	16.7
Compression pressure Unit: kPa (bar, kg/cm ² , psi)/200 rpm	Standard 2,991 (29.9, 30.5, 434) Minimum 2,452 (24.5, 25.0, 356) Differential limit between cylinders 490 (4.9, 5.0, 71)
Valve timing	 <p>EM120</p>

Unit: degree

a	b	c	d	e	f
224	212	2	30	-2	46

INTAKE MANIFOLD AND EXHAUST MANIFOLD

Unit: mm (in)

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

DRIVE BELTS

Belt Deflection:

Unit: mm (in)

Applied belt	Belt deflection with 98 N (10 kg, 22 lb) force applied*		
	New	Adjusted	Limit for re-adjusting
A/C compressor belt	4 - 5 (0.16 - 0.20)	6 - 7 (0.24 - 0.28)	8.5 (0.335)
Alternator and water pump belt	9.0 - 10.5 (0.354 - 0.413)	11.0 - 12.5 (0.433 - 0.492)	16.5 (0.650)

*: When engine is cold.

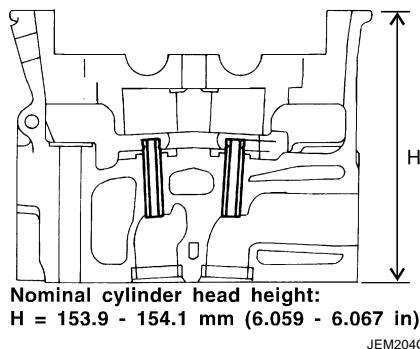
SERVICE DATA AND SPECIFICATIONS (SDS)

[YD22DDTi]

CYLINDER HEAD

Unit: mm (in)

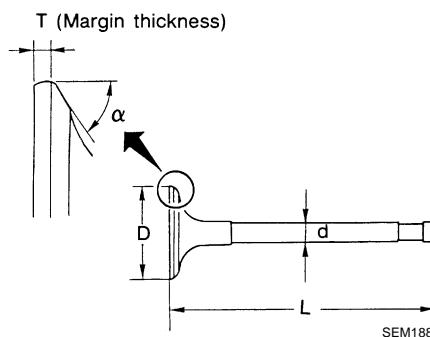
Item	Standard	Limit
Cylinder head distortion	Less than 0.03 (0.0012)	0.1 (0.004)



VALVE

Valve Dimensions

Unit: mm (in)



Valve head diameter "D"	Intake	28.0 - 28.3 (1.102 - 1.114)
	Exhaust	26.0 - 26.3 (1.024 - 1.035)
Valve length "L"	Intake	106.72 (4.2016)
	Exhaust	106.36 (4.1874)
Valve stem diameter "d"	Intake	5.965 - 5.980 (0.2348 - 0.2354)
	Exhaust	5.945 - 5.960 (0.2341 - 0.2346)
Valve seat angle "α"	Intake	45 degrees 15' - 45 degrees 45'
	Exhaust	
Valve margin "T"	Intake	1.38 (0.0543)
	Exhaust	1.48 (0.0583)
Valve margin "T" limit		More than 1.0 (0.039)
Valve stem end surface grinding limit		Less than 0.2 (0.008)

Valve Clearance

Unit: mm (in)

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

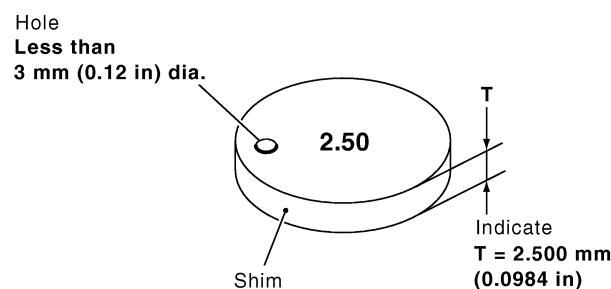
*: Approximately 80°C (176°F)

SERVICE DATA AND SPECIFICATIONS (SDS)

[YD22DDTi]

Available Shims

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



SEM512G

SERVICE DATA AND SPECIFICATIONS (SDS)

[YD22DDTi]

Valve Spring

Valve spring square	mm (in)	1.9 (0.075)
Free height	mm (in)	43.7 (1.720)
Pressure	N (kg, lb) at height mm (in)	184 - 208 (18.77 - 21.22, 41.4 - 46.8) at 32.82 (1.2921)
Height during valve open	mm (in)	24.82 (0.9772)
Load with valve open	N (kg, lb)	320 - 360 (32.65 - 36.73, 71.9 - 80.9)

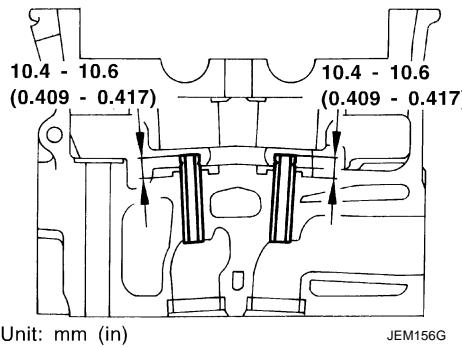
Valve Lifter

Unit: mm (in)

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

Valve Guide

Unit: mm (in)



Unit: mm (in)

JEM156G

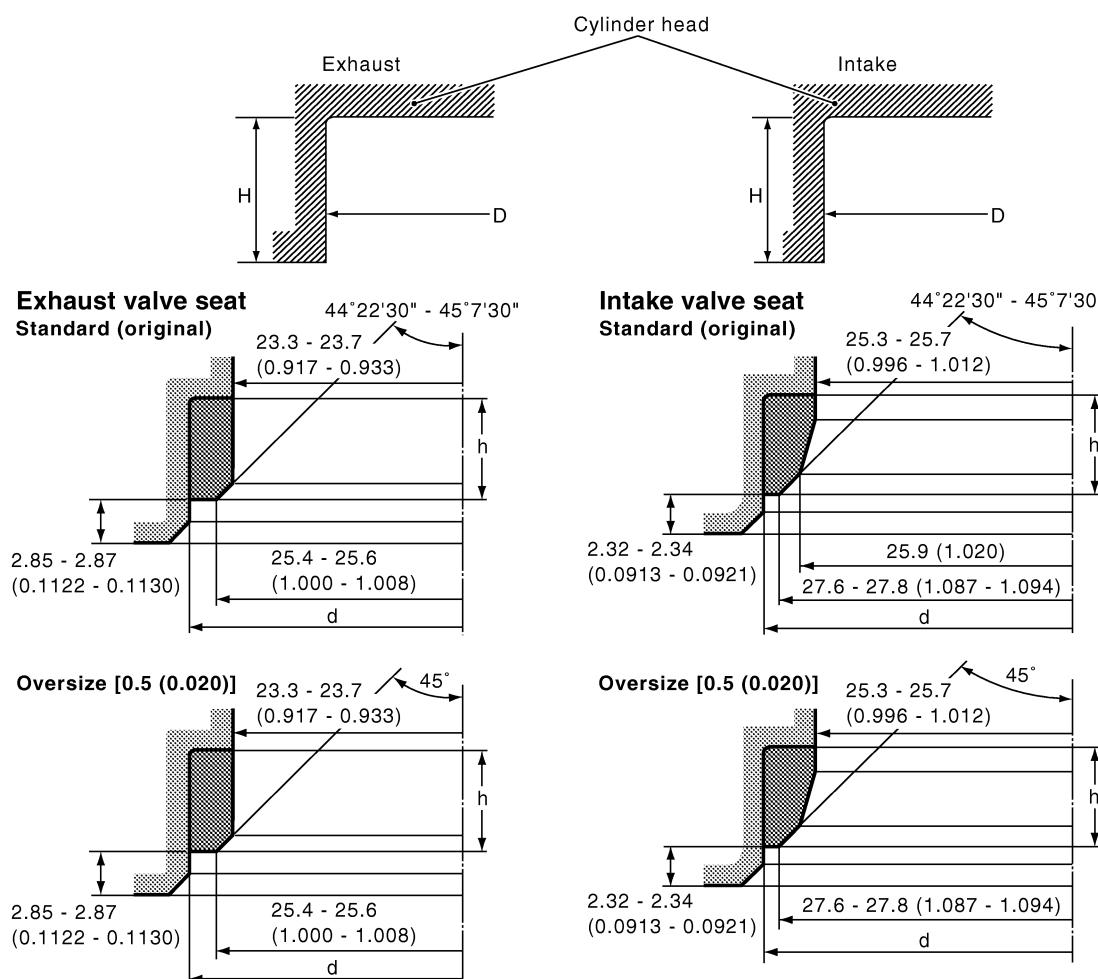
Item		Standard	Service
Valve guide	Outer diameter	10.023 - 10.034 (0.3946 - 0.3950)	10.223 - 10.234 (0.4025 - 0.4029)
Valve guide	Inner diameter (Finished size)	6.000 - 6.018 (0.2362 - 0.2369)	
Cylinder head valve guide hole diameter		9.975 - 9.996 (0.3927 - 0.3935)	10.175 - 10.196 (0.4006 - 0.4014)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

SERVICE DATA AND SPECIFICATIONS (SDS)

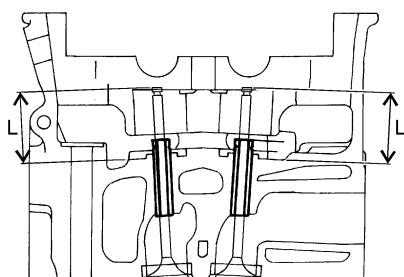
[YD22DDTi]

Valve Seat

Unit: mm (in)



SEM546G



JEM253G

Item		Standard	Service
Cylinder head seat recess diameter (D)	Intake	30.000 - 30.016 (1.1811 - 1.1817)	30.500 - 30.516 (1.2008 - 1.2014)
	Exhaust	29.000 - 29.016 (1.1417 - 1.1424)	29.500 - 29.516 (1.1614 - 1.1620)
Valve seat interference fit	Intake	0.064 - 0.100 (0.0025 - 0.0039)	
	Exhaust	0.064 - 0.096 (0.0025 - 0.0038)	
Valve seat outer diameter (d)	Intake	30.080 - 30.100 (1.1842 - 1.1850)	30.580 - 30.600 (1.2039 - 1.2047)
	Exhaust	29.080 - 29.096 (1.1449 - 1.1455)	29.580 - 29.596 (1.1646 - 1.1652)
Height (h)	Intake	7.0 - 7.1 (0.276 - 0.280)	6.60 - 6.70 (0.2598 - 0.2638)
	Exhaust	6.7 - 6.8 (0.264 - 0.268)	6.3 - 6.4 (0.248 - 0.252)

SERVICE DATA AND SPECIFICATIONS (SDS)

[YD22DDTi]

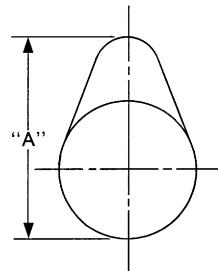
Depth (H)	Intake	8.83 - 9.13 (0.3476 - 0.3594)
	Exhaust	9.06 - 9.36 (0.3567 - 0.3685)
Projection (L)	Intake	36.53 - 36.98 (1.4382 - 1.4559)
	Exhaust	36.53 - 37.01 (1.4382 - 1.4571)

A
EM

CAMSHAFT

Unit: mm (in)

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



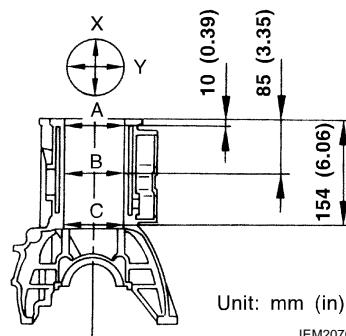
SEM671

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

*: Total indicator reading

CYLINDER BLOCK

Unit: mm (in)



Unit: mm (in)

JEM207G

Top surface distortion	Standard			Less than 0.03 (0.0012)
	Limit			0.1 (0.004)
Cylinder bore	Inner diameter	Standard	Grade No. 1	86.000 - 86.010 (3.3858 - 3.3862)
			Grade No. 2	86.010 - 86.020 (3.3862 - 3.3866)
			Grade No. 3	86.020 - 86.030 (3.3866 - 3.3870)
		Wear limit		0.20 (0.008)

SERVICE DATA AND SPECIFICATIONS (SDS)

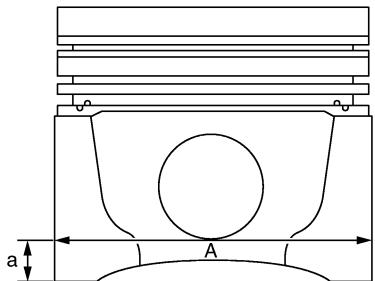
[YD22DDTi]

Out-of-round (X - Y)	Limit	Less than 0.015 (0.0006)
Taper (A - B - C)		Less than 0.010 (0.0004)
Main bearing housing inner diameter (Without bearing)		66.654 - 66.681 (2.6242 - 2.6252)
Difference in inner diameter between cylinders	Limit	Less than 0.05 (0.0020)

PISTON, PISTON RING AND PISTON PIN

Available Piston

Unit: mm (in)



MBIA0026E

Piston outer diameter "A"	Standard	Grade No. 1	85.928 - 85.942 (3.3830 - 3.3835)	
		Grade No. 2	85.938 - 85.952 (3.3834 - 3.3839)	
		Grade No. 3	85.948 - 85.962 (3.3838 - 3.3843)	
		0.25 (0.0098) O/S (Service)	86.188 - 86.202 (3.3932 - 3.3938)	
		0.50 (0.0197) O/S (Service)	86.438 - 86.452 (3.4031 - 3.4036)	
"a" dimension			11.0 (0.43)	
Piston pin bore diameter			28.003 - 28.009 (1.1025 - 1.1027)	
Piston to cylinder bore clearance			0.058 - 0.082 (0.0023 - 0.0032)	

Piston Ring

Unit: mm (in)

Item		Standard	Limit
Side clearance	Top	0.050 - 0.090 (0.0020 - 0.0035)	0.2 (0.008)
	2nd	0.050 - 0.090 (0.0020 - 0.0035)	0.1 (0.004)
	Oil ring	0.030 - 0.070 (0.0012 - 0.0028)	—
End gap	Top	0.20 - 0.30 (0.0079 - 0.0118)	1.0 (0.039)
	2nd	0.31 - 0.51 (0.0122 - 0.0201)	1.0 (0.039)
	Oil ring	0.30 - 0.55 (0.0118 - 0.0217)	1.0 (0.039)

Piston Pin

Unit: mm (in)

Piston pin outer diameter		27.995 - 28.000 (1.1022 - 1.1024)
Piston to piston pin clearance		0.003 - 0.014 (0.0001 - 0.0006)
Connecting rod bushing clearance	Standard	0.026 - 0.044 (0.0010 - 0.0017)
	Limit	0.057 (0.0022)

SERVICE DATA AND SPECIFICATIONS (SDS)

[YD22DDTi]

CONNECTING ROD

Unit: mm (in)

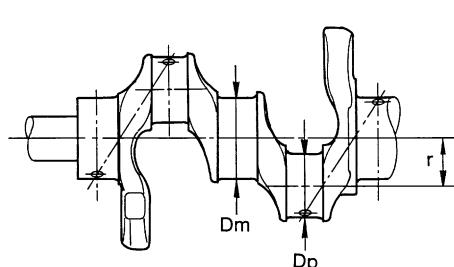
Center distance		157.5 (6.201)	A
Bend [per 100 (3.94)]	Limit	0.12 (0.0047)	EM
Torsion [per 100 (3.94)]	Limit	0.12 (0.0047)	C
Connecting rod bushing inner diameter*		28.026 - 28.038 (1.1034 - 1.1039)	D
Connecting rod big end inner diameter*		55.000 - 55.013 (2.1654 - 2.1659)	E
Side clearance	Standard	0.20 - 0.35 (0.0079 - 0.0138)	F
	Limit	0.40 (0.0157)	G

*: After installing in connecting rod

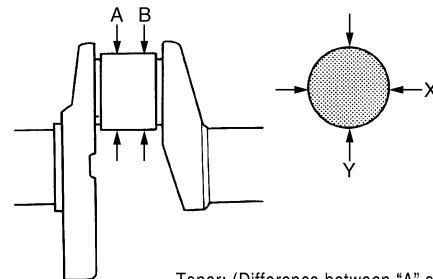
CRANKSHAFT

Unit: mm (in)

Main journal dia. "Dm"		62.951 - 62.975 (2.4784 - 2.4793)	E
Pin journal dia. "Dp"		51.954 - 51.974 (2.0454 - 2.0462)	F
Center distance "r"		46.97 - 47.03 (1.8492 - 1.8516)	G
Out-of-round (Difference between X and Y)	Standard	0.003 (0.0001)	H
	Limit	0.005 (0.0002)	I
Taper (Difference between A and B)	Standard	0.003 (0.0001)	J
	Limit	0.005 (0.0002)	K
Runout [TIR*]	Standard	0.05 (0.0020)	L
	Limit	0.10 (0.0039)	M
End play	Standard	0.10 - 0.25 (0.0039 - 0.0098)	
	Limit	0.30 (0.0118)	



SEM645



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

SBIA0535E

*: Total indicator reading

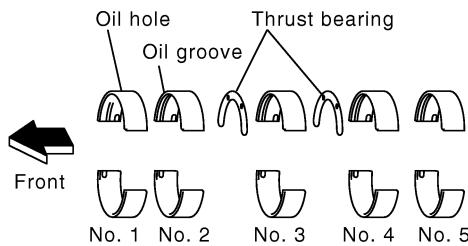
SERVICE DATA AND SPECIFICATIONS (SDS)

[YD22DDTi]

AVAILABLE MAIN BEARING

Main bearing

Unit: mm (in)



SEM255G

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

Under size

Unit: mm (in)

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

AVAILABLE CONNECTING ROD BEARING

Connecting Rod Bearing

Unit: mm (in)

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

Under size

Unit: mm (in)

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

MISCELLANEOUS COMPONENTS

Flywheel

Unit: mm (in)

Flywheel deflection [TIR]*	Standard	0.45 (0.0177) or less
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*: Total indicator reading

SERVICE DATA AND SPECIFICATIONS (SDS)

[YD22DDTi]

Bearing Clearance

Unit: mm (in)

Main bearing oil clearance	Standard	0.039 - 0.066 (0.0015 - 0.0026)
Connecting rod bearing oil clearance	Standard	0.031 - 0.061 (0.0012 - 0.0024)

EM

Tightening Torque

EBS000E0

*1: Parts to be tightened in particular orders.

1)-: Order of tightening when tightening two or more times separately.

Unit: N·m (kg·m, ft-lb)
Unit: N·m (kg·m, in-lb)*2

Alternator	Nut C	19 - 24 (1.9 - 2.5, 14 - 18)
	Nut D	44 - 57 (4.4 - 5.9, 32 - 42)
Idler pulley	Nut A	31 - 39 (3.1 - 4.0, 23 - 28)
Catalyst		48.5 (4.9, 36)
Catalyst rear diffuser		33.5 (3.4, 25)
Catalyst insulator	Catalyst side	7.4 (0.75, 65)*2
	Catalyst rear diffuser side	9.6 (0.97, 85)*2
Turbocharger		43 - 54 (4.3 - 5.5, 32 - 40)
Charge air cooler Bracket		22 (2.2, 16)
Charge air cooler cover		7.0 (0.71, 62)*2
EGR volume control valve		62 - 78 (6.3 - 8.0, 46 - 57)
EGR cooler	Exhaust manifold side	60 - 69 (6.1 - 7.1, 45 - 51)
	EGR volume control valve side	62 - 78 (6.3 - 8.0, 46 - 57)
Bracket	EGR volume control valve side	21 - 26 (2.1 - 2.7, 16 - 19)
	Intake manifold side	5.0 - 8.4 (0.51 - 0.86, 45 - 74)
Exhaust manifold insulator		5.1 - 6.4 (0.52 - 0.66, 46 - 57)*2
*1 Exhaust manifold		29 - 33 (2.9 - 3.4, 21 - 24)
*1 Rocker cover	1)	7.8 (0.8, 69)*2
	2)	7.8 (0.8, 69) *2
Oil pan lower		7 (0.7, 62)*2
Oil pan drain plug		34 (3.5, 25)
Oil strainer		17 (1.7, 13)
*1 Oil pan upper	M6 bolt	7 (0.7, 62)*2
	M8 bolt	21.5 (2.2, 16)
	M10 bolt	33.5 (3.4, 25)
Vacuum pump		23.5 (2.4, 17)
Cylinder head rear cover	M6 bolt	9.7 (0.98, 86) *2
	M8 bolt	17 (1.7, 13)
Injection tube	Nozzle side	23.0 (2.3, 17)
	Fuel rail side	23.0 (2.3, 17)
Injection tube center		23.0 (2.3, 17)
Nozzle support		26.2 (2.7, 19)

A

EM

C

D

E

F

G

H

I

J

K

L

M

SERVICE DATA AND SPECIFICATIONS (SDS)

[YD22DDTi]

Spill tube	Nozzle side	18.7 (1.9, 14)
	Cylinder head side	18.7 (1.9, 14)
Fuel rail		57.5 (5.9, 42)
Fuel pump		31.4 (3.2, 23)
Fuel pump sprocket		39 (4.0, 29)
*1 Camshaft bracket		1) 2 (0.2, 1) 2) 6 (0.6, 4) 3) 12 - 13 (1.2 - 1.4, 9 - 10)
Front chain case		7.9 (0.8, 70)*2
Chain tensioner		9.6 (0.98, 85)*2
Tension guide		23.5 (2.4, 18)
Slack guide		23.5 (2.4, 18)
Camshaft sprocket		143 (15, 105)
Oil pump housing		12.5 (1.3, 9)
Power steering oil pump		53.5 (5.5, 39)
Rear chain case		12.5 (1.3, 9)
Engine coolant temperature sensor		13.5 (1.4, 10)
*1 Cylinder head		1) 35 - 44 (3.5 - 4.5, 26 - 32) 2) 180 degrees to 185 degrees 3) 0 (0, 0) 4) 35 - 44 (3.5 - 4.5, 26 - 32) 5) 90 degrees to 95 degrees (angle tightening) 6) 90 degrees to 95 degrees (angle tightening) Glow plug
*1 Flywheel		20.5 (2.1, 15) 103 - 112 (10.5 - 11.5, 76 - 83)
Oil pressure switch		13 - 17 (1.25 - 1.75, 9 - 12)
Oil jet		6.0 - 10.8 (0.62 - 1.1, 54 - 95)
Oil jet relief valve		40 - 58 (4.0 - 6.0, 29 - 43)
Rear oil seal retainer		12 - 13 (1.2 - 1.4, 9 - 10)