

# ENGINE MECHANICAL

## SECTION **EM**

GI

MA

**EM**

LC

EC

FE

CL

MT

AT

TF

PD

AX

SU

BR

ST

RS

BT

HA

SC

EL

IDX

## CONTENTS

<b>PRECAUTIONS</b> .....	4
Supplemental Restraint System (SRS) "AIR BAG" .....	4
Parts Requiring Angular Tightening.....	4
Liquid Gasket Application Procedure .....	4
<b>PREPARATION</b> .....	5
Special Service Tools .....	5
Commercial Service Tools .....	8

### KA24DE

<b>NOISE, VIBRATION AND HARSHNESS (NVH)</b>	
<b>TROUBLESHOOTING</b> .....	10
NVH Troubleshooting Chart - Engine Noise .....	11
<b>OUTER COMPONENT PARTS</b> .....	12
Removal and Installation .....	12
<b>MEASUREMENT OF COMPRESSION PRESSURE</b> .....	15
<b>OIL PAN</b> .....	16
Components.....	16
Removal.....	16
Installation.....	17
<b>TIMING CHAIN</b> .....	18
Components.....	18
LIQUID GASKET APPLICATION PLACES.....	19
Removal.....	20
UPPER TIMING CHAIN .....	20
IDLER SPROCKET .....	21
LOWER TIMING CHAIN .....	21
Inspection.....	22
Installation.....	23
LOWER TIMING CHAIN .....	23
IDLER SPROCKET .....	24
UPPER TIMING CHAIN .....	24
<b>OIL SEAL</b> .....	26
Replacement.....	26
VALVE OIL SEAL.....	26
OIL SEAL INSTALLING DIRECTION .....	26
FRONT OIL SEAL.....	26
REAR OIL SEAL .....	27
<b>CYLINDER HEAD</b> .....	29

Components.....	29
Removal.....	30
Installation.....	31
Disassembly.....	31
Inspection.....	31
CYLINDER HEAD DISTORTION .....	31
CAMSHAFT VISUAL CHECK.....	32
CAMSHAFT RUNOUT .....	32
CAMSHAFT CAM HEIGHT .....	32
CAMSHAFT JOURNAL CLEARANCE.....	32
CAMSHAFT END PLAY.....	33
CAMSHAFT SPROCKET RUNOUT .....	33
VALVE GUIDE CLEARANCE .....	33
VALVE GUIDE REPLACEMENT.....	34
VALVE SEATS.....	35
REPLACING VALVE SEAT FOR SERVICE PARTS .....	35
VALVE DIMENSIONS.....	36
VALVE SPRING.....	37
VALVE LIFTER AND VALVE SHIM.....	37
Assembly .....	38
Valve Clearance.....	38
CHECKING .....	38
ADJUSTING .....	39
<b>ENGINE ASSEMBLY</b> .....	41
Removal and Installation .....	41
REMOVAL.....	42
INSTALLATION.....	43
<b>CYLINDER BLOCK</b> .....	44
Components.....	44
Removal and Installation .....	45
Disassembly.....	45
PISTON AND CRANKSHAFT.....	45
Inspection.....	45
PISTON AND PISTON PIN CLEARANCE .....	45
PISTON RING SIDE CLEARANCE .....	46
PISTON RING END GAP.....	46
CONNECTING ROD BEND AND TORSION .....	46
CYLINDER BLOCK DISTORTION AND WEAR.....	47
PISTON-TO-BORE CLEARANCE .....	47
CRANKSHAFT.....	48
BEARING CLEARANCE .....	49

# CONTENTS (Cont'd)

CONNECTING ROD BUSHING CLEARANCE (SMALL END).....	51	Tension Adjustment.....	79
REPLACEMENT OF CONNECTING ROD BUSHING (SMALL END).....	51	AFTER BELT REPLACEMENT.....	79
FLYWHEEL/DRIVE PLATE RUNOUT.....	52	AFTER ENGINE OVERHAUL OR ENGINE REASSEMBLY (WITH ROCKER COVERS REMOVED).....	80
Assembly.....	52	<b>OIL SEAL</b> .....	82
PISTON.....	52	Replacement.....	82
CRANKSHAFT.....	53	VALVE OIL SEAL.....	82
REPLACING PILOT BUSHING.....	54	OIL SEAL INSTALLING DIRECTION.....	82
<b>SERVICE DATA AND SPECIFICATIONS (SDS)</b> .....	55	CAMSHAFT OIL SEAL.....	83
General Specifications.....	55	FRONT OIL SEAL.....	83
COMPRESSION PRESSURE.....	55	REAR OIL SEAL.....	83
Cylinder Head.....	55	<b>CYLINDER HEAD</b> .....	84
Valve.....	56	Components.....	84
VALVE.....	56	Removal.....	85
VALVE SPRING.....	56	Disassembly.....	87
VALVE GUIDE.....	57	Inspection.....	88
VALVE LIFTER.....	57	CYLINDER HEAD DISTORTION.....	88
VALVE CLEARANCE ADJUSTMENT.....	57	CAMSHAFT VISUAL CHECK.....	88
AVAILABLE SHIMS.....	58	CAMSHAFT RUNOUT.....	88
VALVE SEAT.....	59	CAMSHAFT CAM HEIGHT.....	89
Cylinder Block.....	60	CAMSHAFT JOURNAL CLEARANCE.....	89
Camshaft and Camshaft Bearing.....	61	CAMSHAFT END PLAY.....	89
Piston, Piston Ring and Piston pin.....	62	CAMSHAFT SPROCKET RUNOUT.....	90
PISTON.....	62	VALVE GUIDE CLEARANCE.....	90
PISTON PIN.....	62	VALVE GUIDE REPLACEMENT.....	91
PISTON RING.....	62	VALVE SEATS.....	91
Connecting Rod.....	63	REPLACING VALVE SEAT FOR SERVICE PARTS.....	92
Crankshaft.....	63	VALVE DIMENSIONS.....	92
Bearing Clearance.....	64	VALVE SPRING.....	93
Available Main Bearing.....	64	ROCKER SHAFT AND ROCKER ARM.....	93
STANDARD.....	64	HYDRAULIC VALVE LIFTER.....	94
UNDERSIZE (SERVICE).....	64	Assembly.....	94
Available Connecting Rod Bearing.....	64	Installation.....	95
STANDARD.....	64	<b>ENGINE ASSEMBLY</b> .....	99
UNDERSIZE (SERVICE).....	64	Removal and Installation.....	99
Miscellaneous Components.....	65	REMOVAL.....	100
		<b>CYLINDER BLOCK</b> .....	102
		Components.....	102
		Removal and Installation.....	103
		Disassembly.....	103
		PISTON AND CRANKSHAFT.....	103
		Inspection.....	104
		PISTON AND PISTON PIN CLEARANCE.....	104
		PISTON RING SIDE CLEARANCE.....	104
		PISTON RING END GAP.....	104
		CONNECTING ROD BEND AND TORSION.....	105
		CYLINDER BLOCK DISTORTION AND WEAR.....	105
		PISTON-TO-BORE CLEARANCE.....	106
		CRANKSHAFT.....	107
		BEARING CLEARANCE.....	108
		CONNECTING ROD BUSHING CLEARANCE (SMALL END).....	110
		REPLACEMENT OF CONNECTING ROD BUSHING (SMALL END).....	110

VG33E

## NOISE, VIBRATION AND HARSHNESS (NVH)

### TROUBLESHOOTING.....66

NVH Troubleshooting Chart - Engine Noise.....67

### OUTER COMPONENT PARTS.....68

Removal and Installation.....68

### MEASUREMENT OF COMPRESSION PRESSURE.....70

### OIL PAN.....72

Removal.....72

Installation.....73

### TIMING BELT.....75

Components.....75

Removal.....76

Inspection.....77

BELT TENSIONER AND TENSIONER SPRING.....78

Installation.....78

# CONTENTS (Cont'd)

FLYWHEEL/DRIVE PLATE RUNOUT .....	110	
Assembly .....	111	
PISTON .....	111	
CRANKSHAFT.....	111	
REPLACING PILOT BUSHING (M/T) OR PILOT CONVERTER (A/T).....	113	
<b>SERVICE DATA AND SPECIFICATIONS (SDS) .....</b>	<b>114</b>	
General Specifications.....	114	
Cylinder Head.....	115	
Valve .....	115	
VALVE .....	115	
VALVE SPRING.....	116	
HYDRAULIC VALVE LIFTER .....	116	
VALVE GUIDE .....	116	
ROCKER SHAFT AND ROCKER ARM .....	116	
Valve Seat.....	117	
INTAKE VALVE SEAT .....	117	
EXHAUST VALVE SEAT.....	118	
Camshaft and Camshaft Bearing .....	119	
Cylinder Block.....	120	
Piston, Piston Ring and Piston Pin .....	122	GI
AVAILABLE PISTON .....	122	
PISTON RING .....	122	
AVAILABLE PISTON .....	123	MA
PISTON RING .....	123	
PISTON PIN .....	124	
Connecting Rod.....	124	<b>EM</b>
Crankshaft.....	124	
Available Main Bearing.....	125	
NO. 1 MAIN BEARING .....	125	LC
NO. 2 AND 3 MAIN BEARING .....	125	
NO. 4 MAIN BEARING .....	125	EC
UNDER SIZE.....	126	
Available Connecting Rod Bearing.....	126	
CONNECTING ROD BEARING UNDERSIZE .....	126	FE
Miscellaneous Components.....	126	
BEARING CLEARANCE .....	126	CL
		MT
		AT
		TF
		PD
		AX
		SU
		BR
		ST
		RS
		BT
		HA
		SC
		EL
		IDX

# PRECAUTIONS

## Supplemental Restraint System (SRS) "AIR BAG"

### Supplemental Restraint System (SRS) "AIR BAG"

NGEM0081

The Supplemental Restraint System "AIR BAG" and "SEAT BELT PRE-TENSIONER", used along with a seat belt, helps to reduce the risk or severity of injury to the driver and front passenger in certain types of collisions. The Supplemental Restraint System consists of air bag module (located in the center of the steering wheel), a front passenger air bag model (located on the instrument panel on the passenger side), seat belt pre-tensioners, a diagnosis sensor unit, a crash zone sensor (4WD models), a warning lamp, wiring harness, and spiral cable.

Information necessary to service the system safely is included in the **RS section** of this Service Manual.

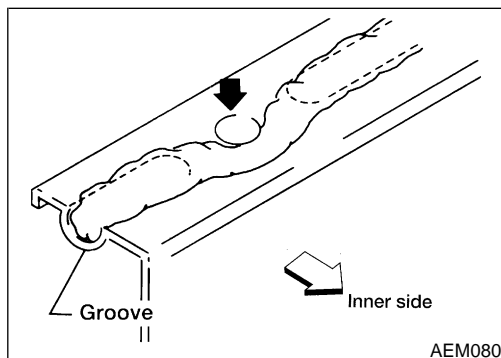
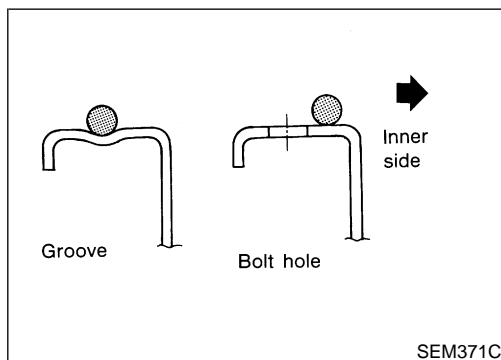
#### **WARNING:**

- To avoid rendering the SRS inoperative, which could increase the risk of personal injury or death in the event of a collision which would result in air bag inflation, all maintenance should be performed by an authorized NISSAN dealer.
- Improper maintenance, including incorrect removal and installation of the SRS, can lead to personal injury caused by unintentional activation of the system. For removal of Spiral Cable and Air Bag Module, see RS section.
- Do not use electrical test equipment on any circuit related to the SRS unless instructed to in this Service Manual. Spiral cable and wiring harnesses (except "SEAT BELT PRE-TENSIONER") are covered with yellow insulation either just before the harness connectors or on the complete harness, are related to the SRS.

### Parts Requiring Angular Tightening

NGEM0001

- Use an angle wrench for the final tightening of the following engine parts:
  - a) Cylinder head bolts
  - b) Connecting rod cap nuts
- 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.



### Liquid Gasket Application Procedure

NGEM0002

- 1) Use a scraper to remove all traces of old liquid gasket from mating surfaces and grooves. Also completely clean any oil stains from these portions.
- 2) Apply a continuous bead of liquid gasket to mating surfaces. (Use Genuine RTV silicone sealant Part No. 999MP-A7007 or equivalent.)
  - Be sure liquid gasket is 3.5 to 4.5 mm (0.138 to 0.177 in) dia. (for oil pan).
  - Be sure liquid gasket is 2.0 to 3.0 mm (0.079 to 0.118 in) dia. (in areas except oil pan).
- 3) Apply liquid gasket to inner surface around hole perimeter area (unless otherwise specified).
- 4) Assembly should be done within 5 minutes after coating.
- 5) Wait at least 30 minutes before refilling engine oil and engine coolant.

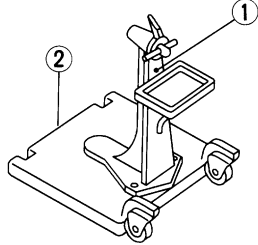
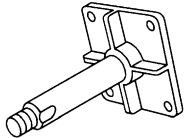
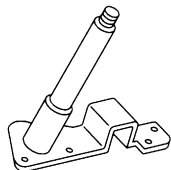
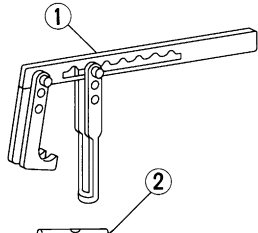
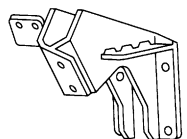
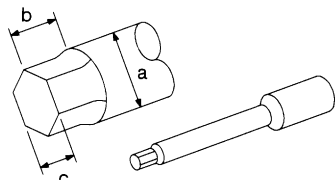
# PREPARATION

Special Service Tools

## Special Service Tools

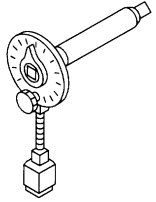
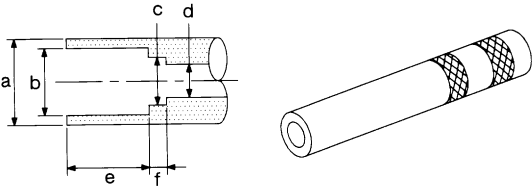
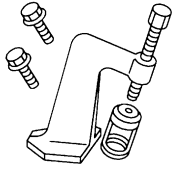
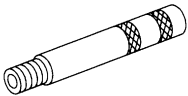
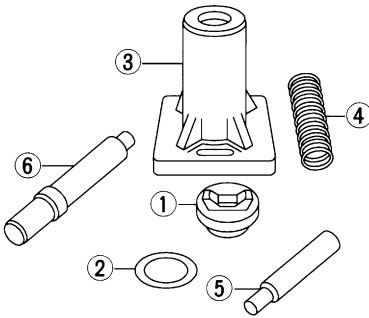
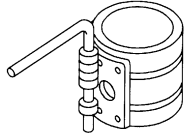
NGEM0003

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

Tool number (Kent-Moore No.) Tool name	Description	
ST0501S000 ( — ) Engine stand assembly <b>1</b> ST05011000 ( — ) Engine stand <b>2</b> ST05012000 ( — ) Base	 <p>Disassembling and assembling</p> <p>NT042</p>	GI  MA <b>EM</b>  LC  EC
KV10106500 ( — ) Engine stand shaft	 <p>NT028</p>	FE  CL
KV10105001 ( — ) Engine attachment	 <p>NT031</p>	MT  AT  TF
KV101092S0 (J26336-B) Valve spring compressor <b>1</b> KV10109210 ( — ) Compressor <b>2</b> KV100109220 ( — ) Adapter	 <p>Disassembling and assembling valve components</p> <p>NT021</p>	PD  AX  SU
KV10110001 ( — ) Engine sub-attachment	 <p>NT032</p>	BR  ST
ST10120000 (J24239-01) Cylinder head bolt wrench	 <p>Loosening and tightening cylinder head bolt  <b>a: 13 mm (0.51 in) dia.</b>  <b>b: 12 mm (0.47 in)</b>  <b>c: 10 mm (0.39 in)</b></p> <p>NT583</p>	RS  BT  HA

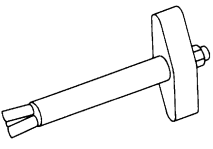
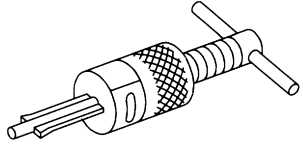
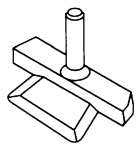
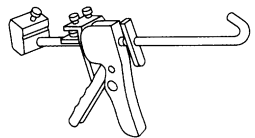
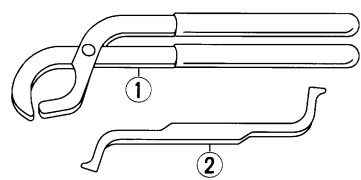
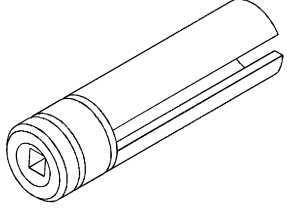
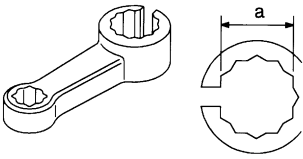
# PREPARATION

## Special Service Tools (Cont'd)

Tool number (Kent-Moore No.) Tool name	Description
KV10112100 (BT8653-A) Angle wrench	 <p>Tightening bearing cap, cylinder head bolts, etc.</p> <p>NT014</p>
KV10116300 (J-38955) Valve oil seal drift	 <p>Installing valve oil seal  <b>a: 25 (0.98) dia.</b>  <b>b: 14.4 (0.567) dia.</b>  <b>c: 11.8 (0.465) dia.</b>  <b>d: 10 (0.39) dia.</b>  <b>e: 11 (0.43)</b>  <b>f: 9 (0.35)</b></p> <p>NT602</p>
KV10110600 (J33986) Valve spring compressor	 <p>Disassembling and assembling valve components</p> <p>NT033</p>
KV10107501 ( — ) Valve oil seal drift	 <p>Installing valve oil seal</p> <p>NT025</p>
KV10110300 ( — ) Piston pin press stand assembly <b>1</b> KV10110310 ( — ) Cap <b>2</b> KV10110330 ( — ) Spacer <b>3</b> ST13030020 ( — ) Press stand <b>4</b> ST13030030 ( — ) Spring <b>5</b> KV10110340 ( — ) Drift <b>6</b> KV10110320 ( — ) Center shaft	 <p>Disassembling and assembling piston with connecting rod</p> <p>NT036</p>
EM03470000 (J8037) Piston ring compressor	 <p>Installing piston assembly into cylinder bore</p> <p>NT044</p>

# PREPARATION

Special Service Tools (Cont'd)

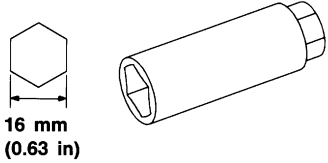
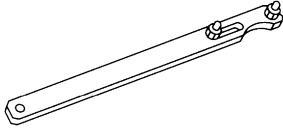

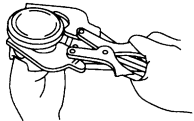
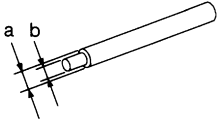
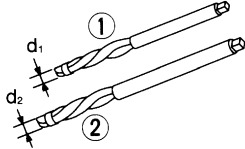
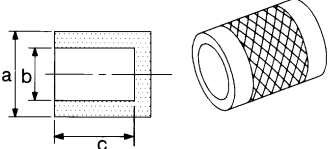
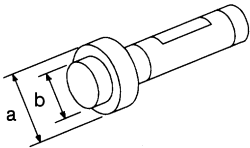
Tool number (Kent-Moore No.) Tool name	Description	
(J36467) Valve oil seal remover	 NT034	GI MA <b>EM</b>
ST16610001 (J23907) Pilot bushing puller	 NT045	LC EC
KV10111100 (J37228) Seal cutter	 NT046	FE CL MT
WS39930000 ( — ) Tube presser	 NT052	AT TF
KV101151S0 (J38972) Lifter stopper set 1 KV10115110 (J38972-1) Camshaft pliers 2 KV10115120 (J38972-2) Lifter stopper	 NT041	PD AX SU
KV10117100 (J3647-A) Heated oxygen sensor wrench	 NT379	BR ST RS
KV10114400 (J38365) Heated oxygen sensor wrench	 NT636	BT HA SC EL IDX

# PREPARATION

Commercial Service Tools

## Commercial Service Tools

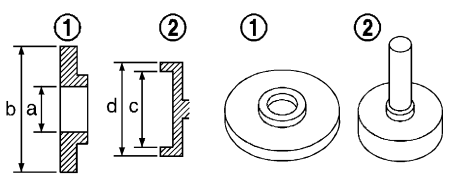
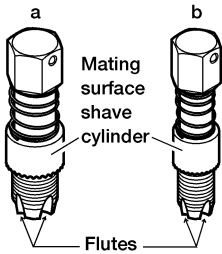

NGEM0004

Tool name	Description
Spark plug wrench	 <p>16 mm (0.63 in)</p> <p>NT047</p> <p>Removing and installing spark plug</p>
Pulley holder	 <p>NT035</p> <p>Holding camshaft pulley while tightening or loosening camshaft bolt</p>
Valve seat cutter set	 <p>NT048</p> <p>Finishing valve seat dimensions</p>
Piston ring expander	 <p>NT030</p> <p>Removing and installing piston ring</p>
Valve guide drift	 <p>NT015</p> <p>Removing and installing valve guide <b>Intake &amp; Exhaust:</b> a = 10.5 mm (0.413 in) dia. b = 6.6 mm (0.260 in) dia.</p>
Valve guide reamer	 <p>NT016</p> <p>Reaming valve guide 1 or hole for oversize valve guide 2 <b>Intake:</b> d<sub>1</sub> = 7.0 mm (0.276 in) dia. d<sub>2</sub> = 11.2 mm (0.441 in) dia. <b>Exhaust:</b> d<sub>1</sub> = 8.0 mm (0.315 in) dia. d<sub>2</sub> = 12.2 mm (0.480 in) dia.</p>
Camshaft oil seal drift	 <p>NT613</p> <p>Installing camshaft oil seal a: 60 mm (2.36 in) dia. b: 44.5 mm (1.752 in) dia. c: 75 mm (2.95 in)</p>
Front oil seal drift	 <p>NT049</p> <p>Installing front oil seal a: 52 mm (2.05 in) dia. b: 44 mm (1.73 in) dia.</p>



# PREPARATION

Commercial Service Tools (Cont'd)

Tool name	Description
Rear oil seal drift  NT719	 <p>Installing rear oil seal  <b>a: 46 mm (1.81 in)</b>  <b>b: 110 mm (4.33 in)</b>  <b>c: 84 mm (3.31 in)</b>  <b>d: 96 mm (3.78 in)</b></p>
a: (J-43897-18) b: (J-43897-12) Thread repair tool for oxygen sensor  AEM488	 <p><b>a: 18 mm (0.71 in)</b>  <b>b: 12 mm (0.47 in)</b></p>
Anti-seize thread compound  AEM489	 <p>For preventing corrosion, seizing, and galling on high temperature applications.</p>

GI

MA

EM

LC

EC

FE

CL

MT

AT

TF

PD

AX

SU

BR

ST

RS

BT

HA

SC

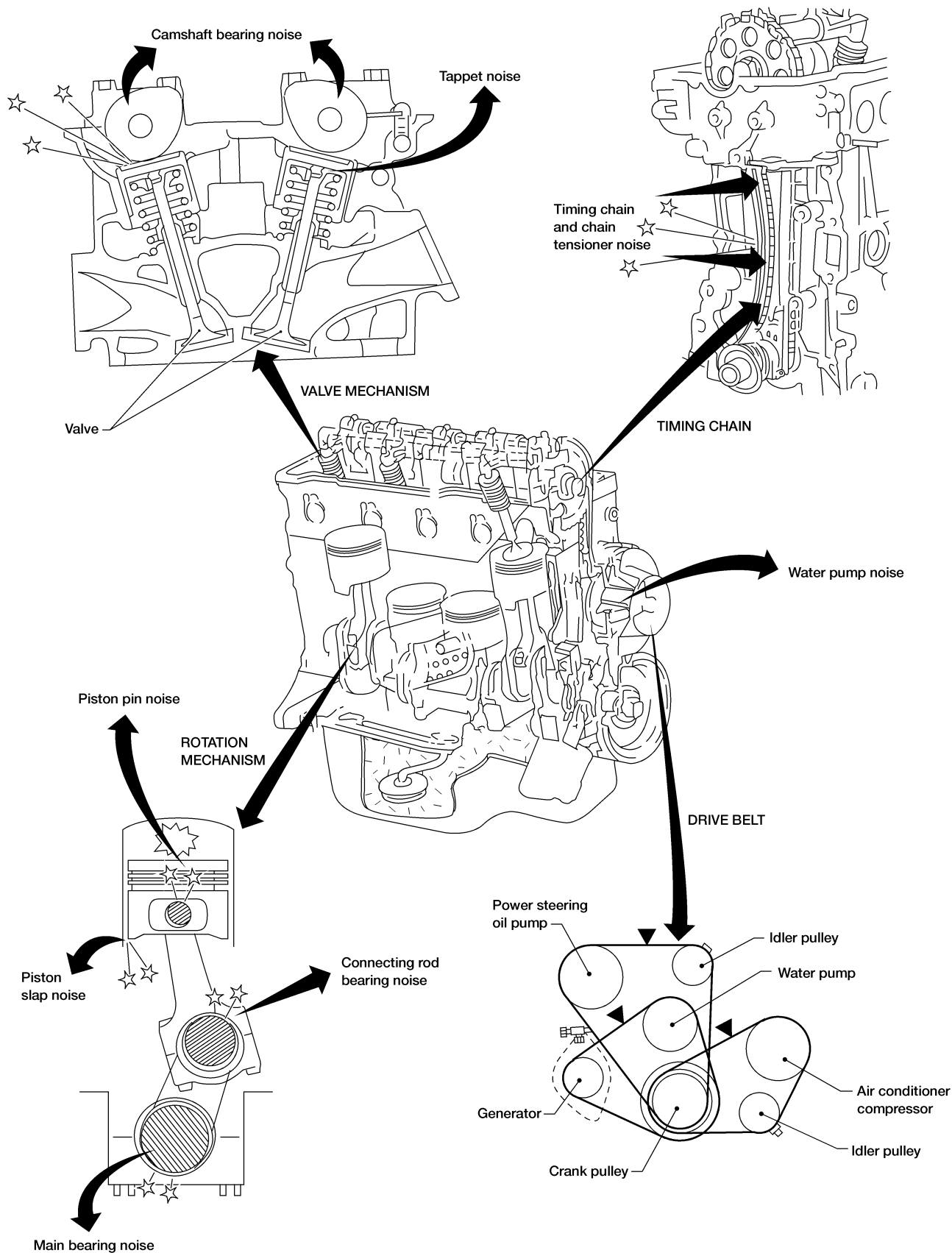
EL

IDX

# NOISE, VIBRATION AND HARSHNESS (NVH) TROUBLESHOOTING

NGEM0046

KA24DE



AEM466

# NOISE, VIBRATION AND HARSHNESS (NVH) TROUBLESHOOTING

KA24DE

NVH Troubleshooting Chart — Engine Noise

## NVH Troubleshooting Chart — Engine Noise

NGEM0046S01

Use the chart below to help you find the cause of the symptom.

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

If necessary, repair or replace these parts.

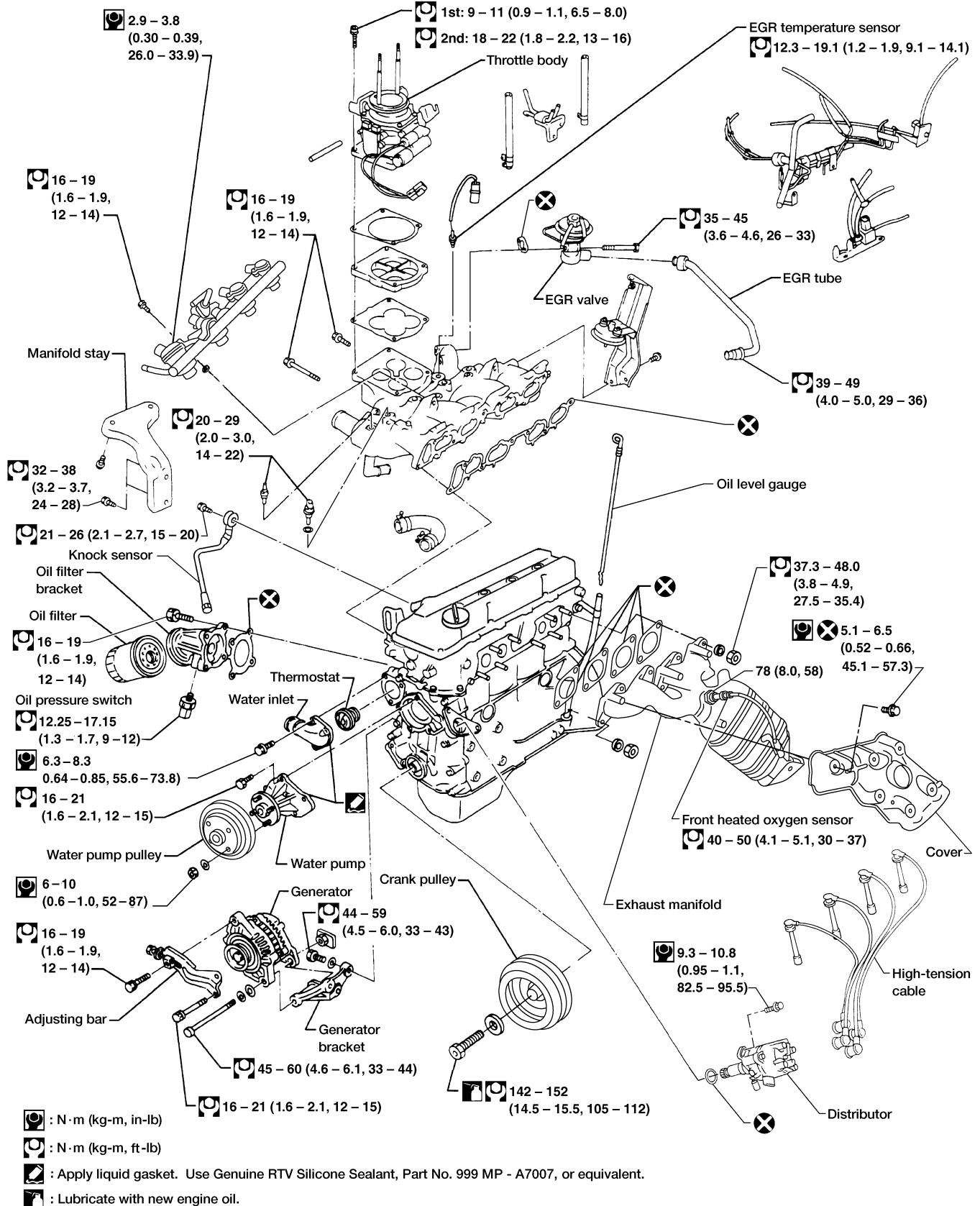
Location of noise	Type of noise	Operating condition of engine						Source of noise	Check item	Reference page
		Before warm-up	After warm-up	When starting	When idling	When revving	While driving			
Top of engine Rocker cover Cylinder head	Ticking or clicking	C	A	—	A	B	—	Tappet noise	Valve clearance	EM-38
	Rattle	C	A	—	A	B	C	Camshaft bearing noise	Camshaft journal clearance Camshaft runout	EM-32
Crankshaft pulley Cylinder block (upper side of engine) Oil pan	Slap or knock	—	A	—	B	B	—	Piston pin noise	Piston and piston pin clearance Connecting rod bushing clearance	EM-45, 51
	Slap or rap	A	—	—	B	B	A	Piston slap noise	Piston ring side clearance Piston ring end gap Connecting rod bend and torsion Piston-to-bore clearance	EM-47, 46
	Knock	A	B	C	B	B	B	Connecting rod-bearing noise	Connecting rod bearing clearance (Big end) Connecting rod bushing clearance (Small end)	EM-50, 51
	Knock	A	B	—	A	B	C	Main bearing noise	Crankshaft runout Main bearing oil clearance	EM-48
Front of engine Timing chain cover	Tapping or ticking	A	A	—	B	B	B	Timing chain and chain tensioner noise	Timing chain cracks and wear	EM-22
Front of engine	Squeaking or fizzing	A	B	—	B	—	C	Other drive belts (Sticking or slipping)	Drive belt deflection	<b>MA-17</b> , ("Checking Drive Belts", "ENGINE MAINTENANCE")
	Creaking	A	B	A	B	A	B	Other drive belts (Slipping)	Idler pulley bearing operation	
	Squall creak	A	B	—	B	A	B	Water pump noise	Water pump operation	<b>LC-12</b> , ("Water Pump Inspection", "ENGINE COOLING SYSTEM")

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

## Removal and Installation

NGEM0047

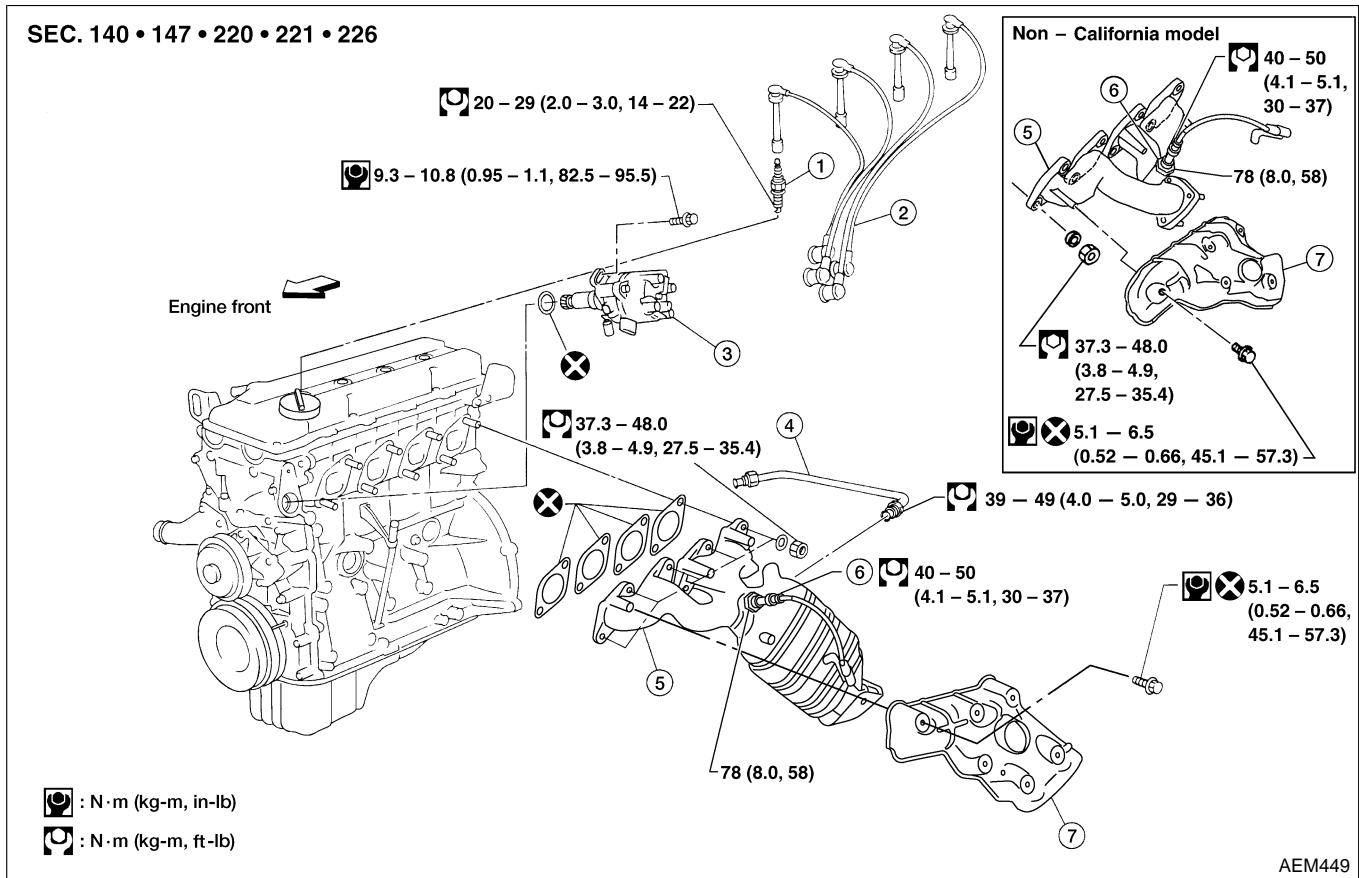
SEC. 120 • 140 • 147 • 150 • 163 • 164 • 210 • 220 • 221 • 230 • 231



# OUTER COMPONENT PARTS

**KA24DE**

Removal and Installation (Cont'd)



1. Spark plug
2. Ignition wire
3. Camshaft position sensor built into distributor

4. EGR tube
5. Exhaust manifold

6. Front heated oxygen sensor
7. Exhaust manifold cover

GI

MA

**EM**

LC

EC

FE

CL

MT

AT

TF

PD

AX

SU

BR

ST

RS

BT

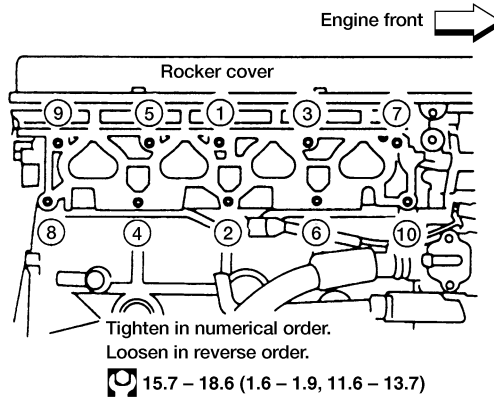
HA

SC

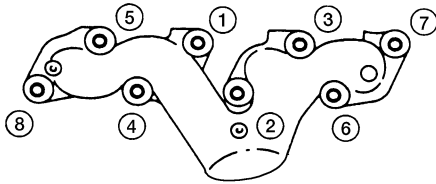
EL

IDX

## Intake manifold



## Exhaust manifold

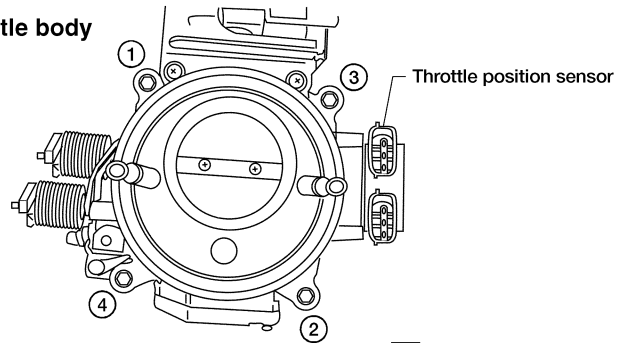


Tighten in numerical order.  
Loosen in reverse order.

37.3 - 48.0 (3.8 - 4.9, 27.5 - 35.4)

: N·m (kg-m, ft-lb)

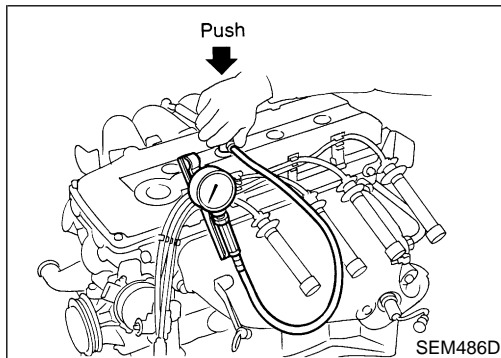
## Throttle body



Tighten in numerical order.  
Loosen in reverse order.

1st: 9 - 11 (0.9 - 1.1, 6.5 - 8.0)  
2nd: 18 - 22 (1.8 - 2.2, 13 - 16)

AEM467



1. Warm up engine.
2. Turn ignition switch OFF.
3. Release fuel pressure.  
Refer to **EC-40**, ("Fuel Pressure Release").
4. Remove all spark plugs.
  - **Clean area around plug with compressed air before removing the spark plug.**
5. Disconnect camshaft position sensor harness connector at the distributor.
6. Remove fuel injector fuse 3 on FUSE BLOCK (J/B) behind the instrument lower panel driver's side.
7. Attach a compression tester to No. 1 cylinder.
8. Depress accelerator pedal fully to keep throttle valve wide open.
9. Crank engine and record highest gauge indication.
10. Repeat the measurement on each cylinder as shown above.
  - **Always use a fully-charged battery to obtain specified engine speed.**

**Compression pressure: kPa (kg/cm<sup>2</sup>, psi)/300 rpm**

**Standard**

**1,226 (12.5, 178)**

**Minimum**

**1,030 (10.5, 149)**

**Difference limit between cylinders**

**98 (1.0, 14)**

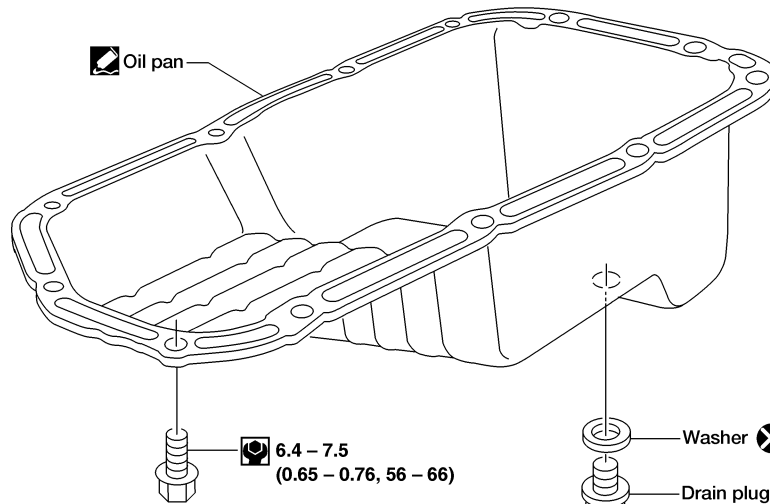
11. If compression in one or more cylinders is low:
  - a. Pour a small amount of engine oil into cylinders through spark plug holes.
  - b. Retest compression.
    - **If adding oil improves cylinder compression, piston rings may be worn or damaged. If so, replace piston rings after checking piston.**
    - **If pressure stays low, a valve may be sticking or seating improperly. Inspect and repair valve and valve seat. (Refer to SDS, EM-56 and EM-59.) If valve or valve seat is damaged excessively, replace it.**
    - **If compression in any two cylinders adjacent cylinders is low, and if adding oil does not improve compression, there is leakage past the gasket surface. If so, replace cylinder head gasket.**
12. Reinstall spark plugs, fuel injector fuse, fuel pump fuse, and reconnect camshaft position sensor harness connector at the distributor.
13. Erase the DTC stored in the ECM.

**CAUTION:**

**Always erase the DTC after checking compression. Refer to "HOW TO ERASE EMISSION-RELATED DIAGNOSTIC INFORMATION" in EC section.**

## Components

NGEN0049

**SEC. 110**


: N·m (kg·m, in·lb)

: N·m (kg·m, ft·lb)

: Apply liquid gasket. Use Genuine RTV Silicone Sealant, Part No. 999 MP - A7007, or equivalent.

**6.4 – 7.5**  
(0.65 – 0.76, 56 – 66)

Washer

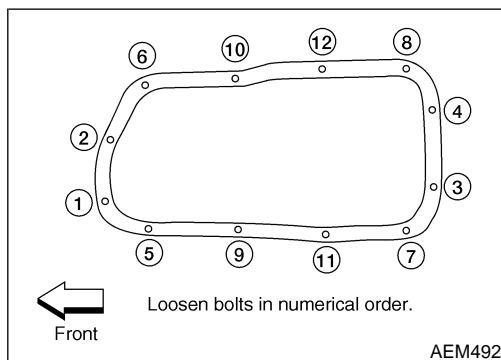
 Drain plug **29.4 – 39.2**  
(3.00 – 4.00, 21.69 – 28.91)

AEM468

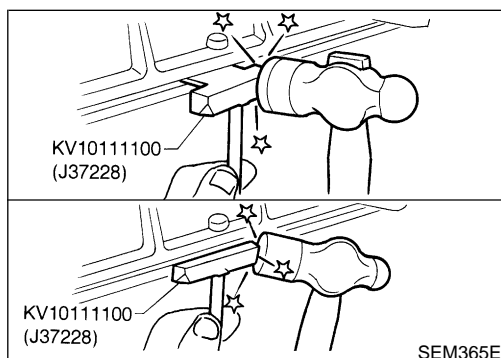
## Removal

NGEN0050

1. Raise vehicle and support it with safety stands.
2. Remove engine under cover.
3. Drain engine oil.
4. Remove front suspension member.

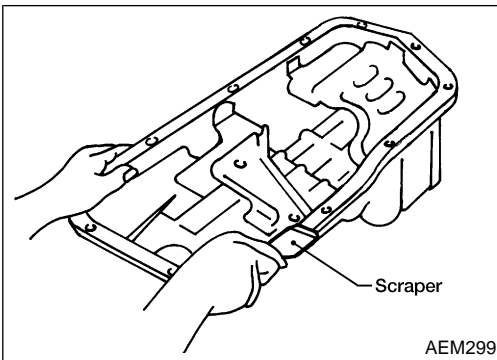


5. Remove oil pan bolts.

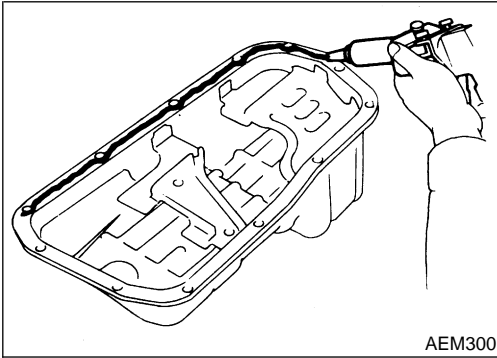


6. Remove oil pan.
  - a. Insert Tool between cylinder block and oil pan.
    - **Be careful not to damage aluminum mating surface.**
    - **Do not insert screwdriver, or oil pan flange will be damaged.**
  - b. Slide Tool by tapping on the side of the Tool with a hammer.
7. Pull out oil pan from front side.

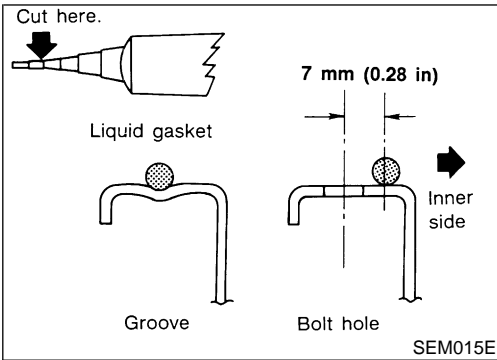




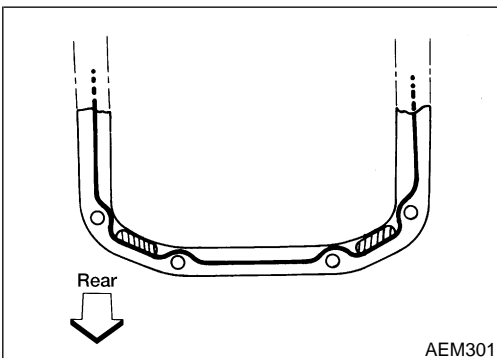
AEM299



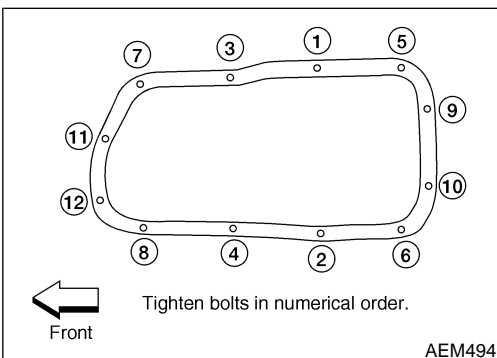
AEM300



SEM015E



AEM301



AEM494

## Installation

NGEM0051

- Use a scraper to remove old liquid gasket from mating surface of oil pan.
  - Also remove traces of liquid gasket from mating surface of cylinder block.
- Apply a continuous bead of liquid gasket to mating surface of oil pan.
  - Use Genuine RTV Silicone Sealant, Part No. 999 MP-A7007 or equivalent.
  - Apply to groove on mating surface.
  - Allow 7 mm (0.28 in) clearance around bolt hole.
- Install oil pan.
  - Tighten oil pan bolts in numerical order.
    - ⚙️ : 6.4 - 7.5 N·m (0.65 - 0.76 kg·m, 56 - 66 in·lb)**
  - Wait at least 30 minutes before refilling engine oil.
- Install parts in reverse order of removal.

GI

MA

EM

LC

EC

FE

CL

MT

AT

TF

PD

AX

SU

BR

ST

RS

BT

HA

SC

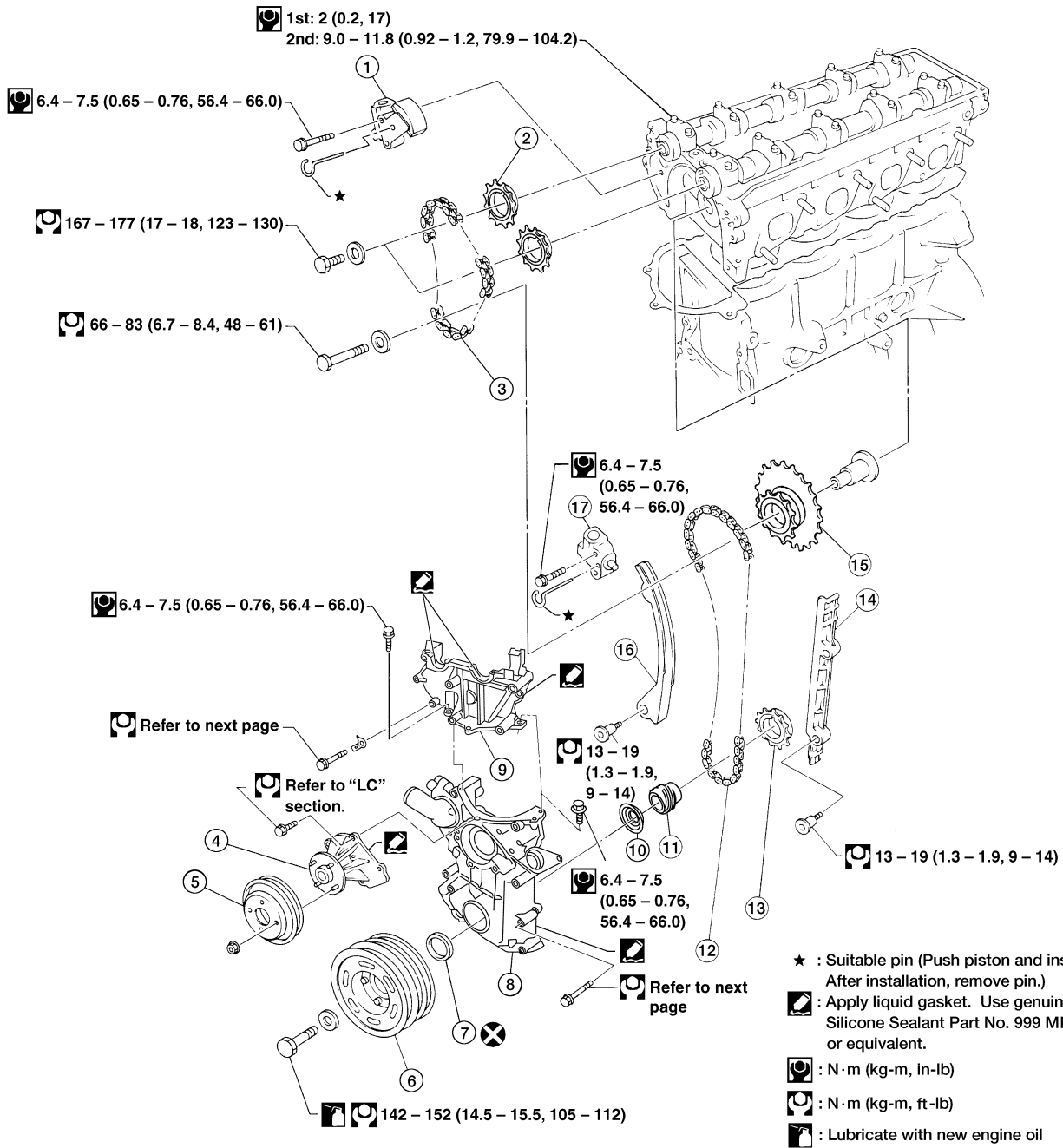
EL

IDX

## Components

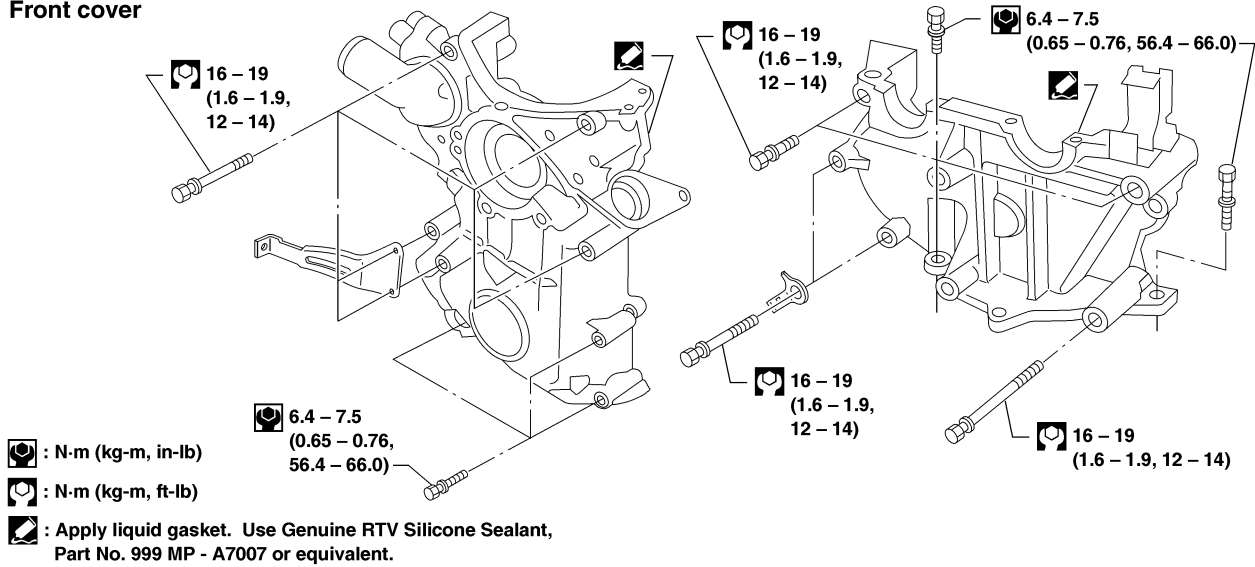
NGEM0052

SEC. 120 • 130 • 135 • 210



AEM464

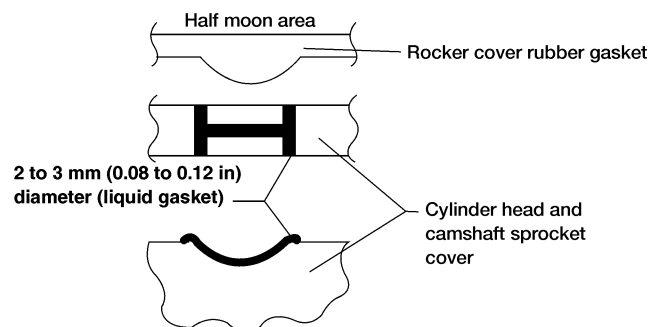
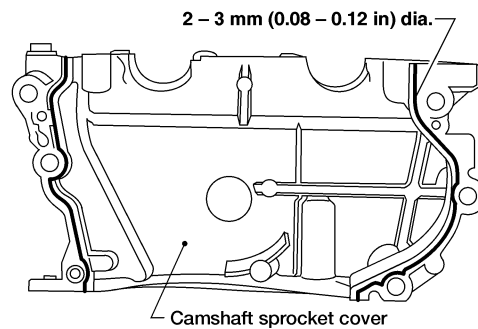
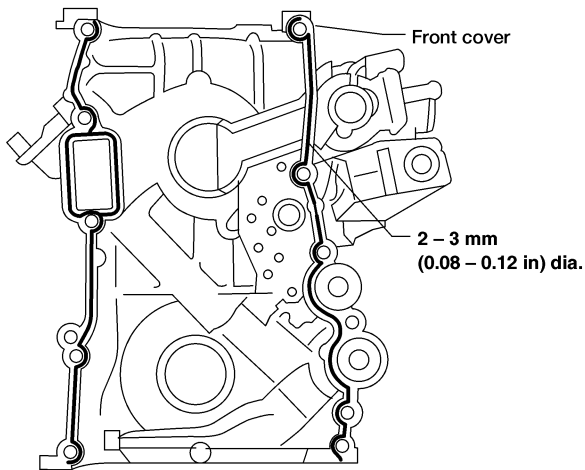
- |                                 |                            |                                  |
|---------------------------------|----------------------------|----------------------------------|
| 1. Upper timing chain tensioner | 7. Front oil seal          | 13. Crankshaft sprocket          |
| 2. Cam sprocket                 | 8. Front cover             | 14. Chain guide                  |
| 3. Upper timing chain           | 9. Camshaft sprocket cover | 15. Idler sprocket               |
| 4. Water pump                   | 10. Oil slinger            | 16. Chain tension arm            |
| 5. Water pump pulley            | 11. Oil pump drive gear    | 17. Lower timing chain tensioner |
| 6. Crankshaft pulley            | 12. Lower timing chain     |                                  |

**SEC. 135**  
**Front cover**
**Camshaft sprocket cover**


AEM470

**LIQUID GASKET APPLICATION PLACES**

NGEM0052S01



AEM479

GI

MA

**EM**

LC

EC

FE

CL

MT

AT

TF

PD

AX

SU

BR

ST

RS

BT

HA

SC

EL

IDX

## Removal

NGEM0053

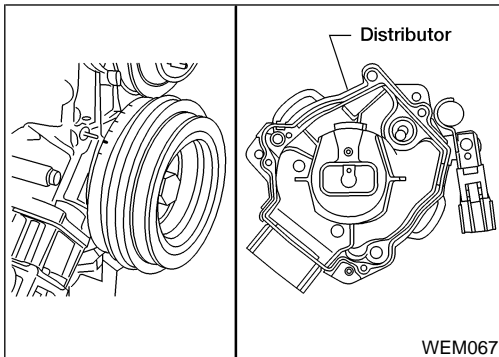
**CAUTION:**

- After removing timing chain, do not turn crankshaft and camshaft separately, or valves will strike piston heads.
- When installing chain tensioners or other sliding parts, lubricate contacting surfaces with new engine oil.
- Apply new engine oil to bolt threads and seat surfaces when installing camshaft sprockets and crankshaft pulley.
- Do not spill engine coolant on drive belts.

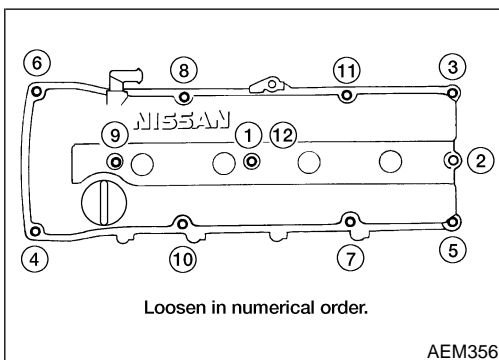
## UPPER TIMING CHAIN

NGEM0053S01

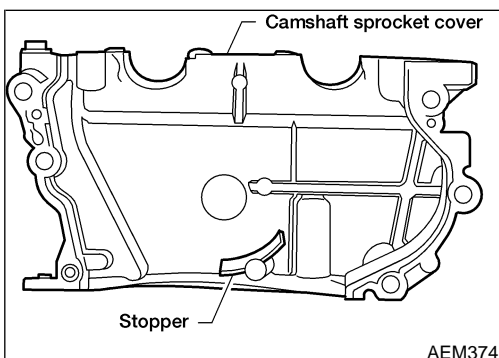
1. Remove the air cleaner assembly.
2. Remove the spark plug wires.



3. Set No.1 piston at TDC on its compression stroke.
4. Remove vacuum hoses, electrical harness connectors, and harness clamps.
5. Remove the power steering belt.
6. Remove the power steering pump and position it to one side. Remove the idler pulley and bracket as well.



7. Remove the rocker cover.
- Remove in numerical order as shown.

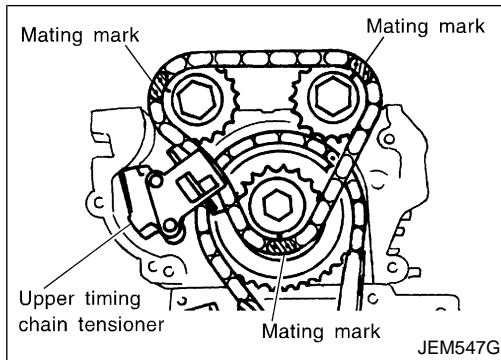


8. Remove the camshaft sprocket cover.

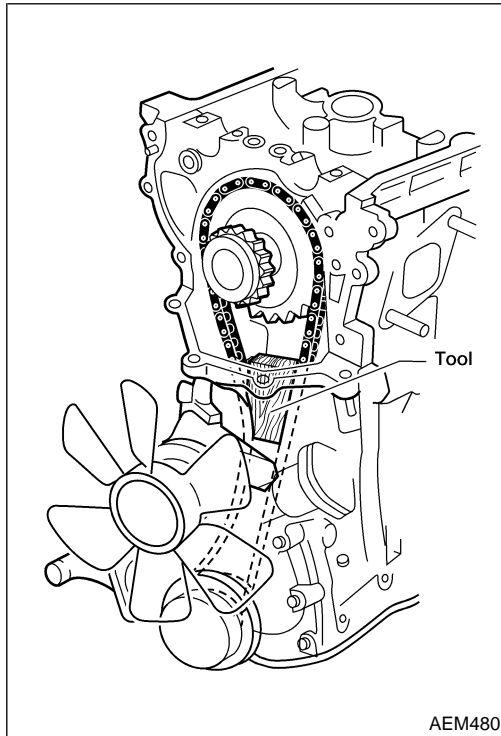
# TIMING CHAIN

**KA24DE**

Removal (Cont'd)



9. Wipe off the links of the timing chain next to the timing marks on the sprockets. Put paint marks on the timing chain, matching them with the timing marks on the cam sprockets and idler sprocket.
10. Remove cam sprocket bolts, cam sprockets and upper timing chain.



## IDLER SPROCKET

NGEM0053S03

1. Remove upper timing chain. Refer to "UPPER TIMING CHAIN", "Removal" EM-20.
2. Support lower timing chain by using a suitable tool to prevent chain tensioner spring from coming out.

### NOTE:

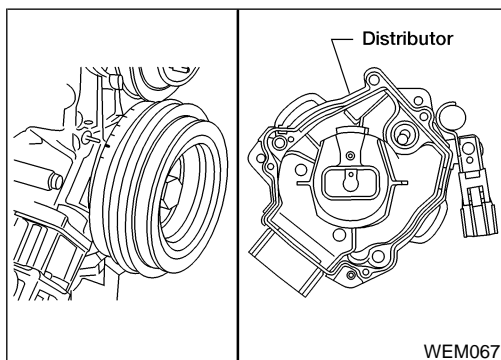
**This step is only to be applied when the lower cover is not being removed.**

3. Remove the idler sprocket.

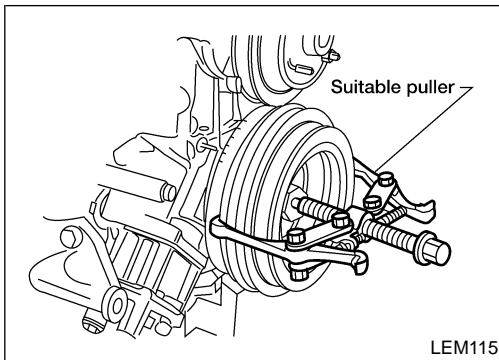
## LOWER TIMING CHAIN

NGEM0053S02

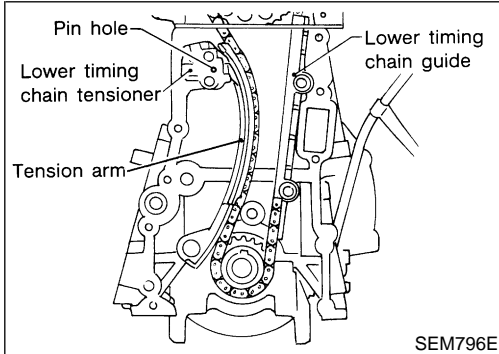
1. Drain coolant by removing the cylinder block drain plug and opening the radiator drain cock. Refer to MA section of the Service Manual.
2. Drain engine oil from drain plug of oil pan.
3. Remove the following parts.
  - Alternator drive belt.
  - A/C compressor drive belt.
  - Cooling fan with coupling.
  - Radiator shroud.
4. Remove A/C compressor and position it to the side. Remove the idler pulley and bracket as well.
5. Set No. 1 piston to TDC on its compression stroke.
6. Remove the distributor.



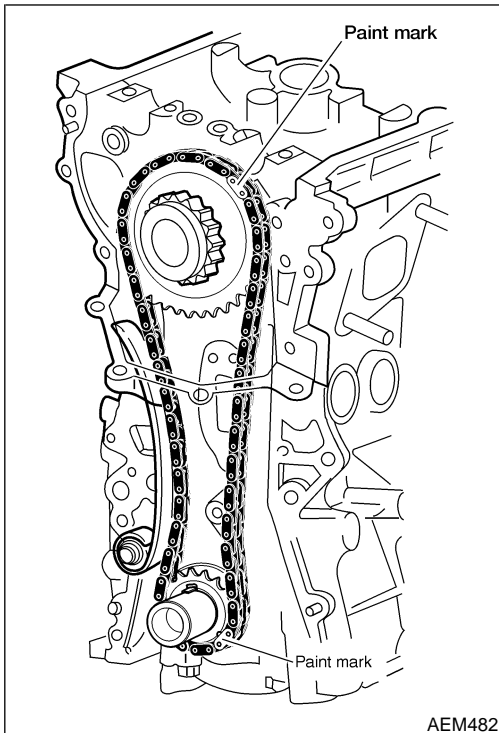
## Removal (Cont'd)



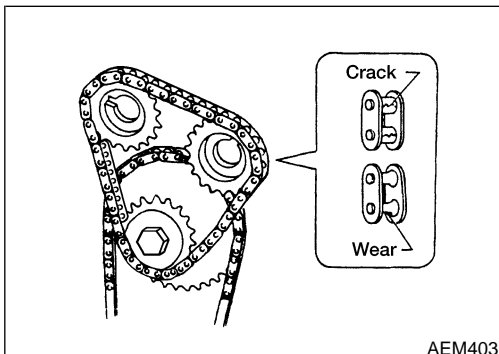
LEM115



SEM796E



AEM482



AEM403

7. Remove the crankshaft pulley with suitable puller.
8. Remove oil pan.  
**Refer to "Removal" in "OIL PAN" (EM-16).**
9. Remove the oil pump and distributor drive shaft, then the oil pickup strainer.
10. Remove the front cover.

**CAUTION:**

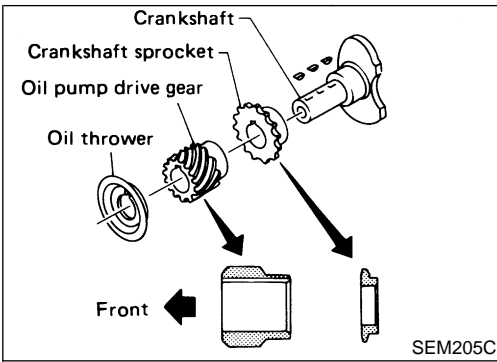
**Be careful not to tear or damage the cylinder head gasket.**

11. Remove the following parts.
  - Lower timing chain tensioner (Push piston and insert a suitable pin into pin hole.)
  - Chain tension arm
  - Lower timing chain guide
12. Remove the upper timing chain and idler sprocket. **Refer to "UPPER TIMING CHAIN" in "Removal"(EM-20) and "IDLER SPOCKET" (EM-21).**
13. Wipe off the links of the timing chain next to the timing marks on the sprockets. Put paint marks on the timing chain, matching them with the timing marks on the crankshaft sprocket and idler sprocket.
14. Remove the lower timing chain and sprocket.

**Inspection**

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

NGEM0054



## Installation

### LOWER TIMING CHAIN

NGEM0055

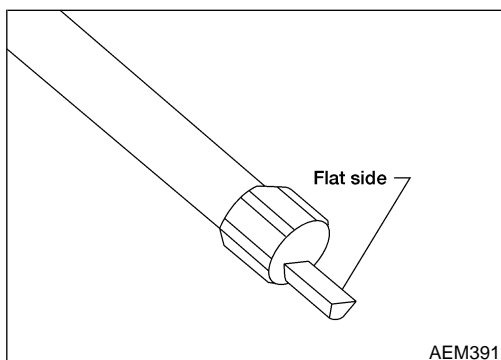
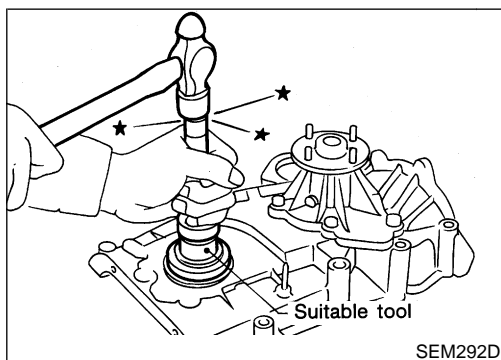
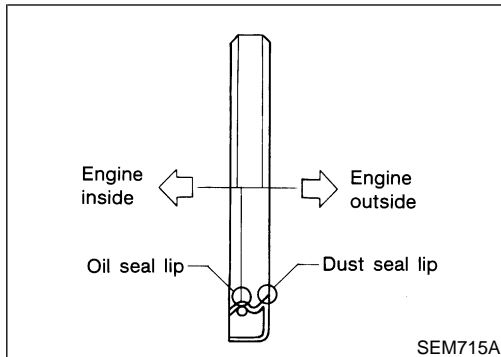
NGEM0055S01

1. Install crankshaft sprocket.
  - **Make sure that mating marks of crankshaft sprocket face front of engine.**
2. Install the idler sprocket and lower timing chain using the mating marks and the paint marks made during the removal process.

#### CAUTION:

**Be careful not to tear or damage the cylinder head gasket.**

3. Install chain guide and chain tension arm.
4. Install lower chain tensioner and remove the pin securing the piston into the tensioner body.



5. Front cover installation:
    - Using a scraper or other suitable tool remove all traces of liquid gasket from the cylinder block and front cover mating surfaces.
    - Install new crankshaft seal in front cover.
    - **Apply a continuous bead of liquid gasket to front cover (Refer to EM-19).**
- NOTE:**  
Use Genuine Nissan RTV Silicone Sealant P/N 999MP-A7007 or equivalent.
- **Be sure to install new front oil seal. Refer to EM-26.**
  - Also place RTV sealant on the head gasket surface.
  - Install the front cover to the engine.
6. Install oil strainer and oil pan. Refer to "Installation" in "OIL PAN", EM-17.

7. Install the oil pump and distributor drive shaft.

#### NOTE:

Make sure the flat side of the distributor drive shaft is facing the engine. Failure to do so will result in the distributor being out of time.

8. Install the following parts:
  - Crankshaft pulley.
  - A/C compressor and idler pulley bracket.
  - Radiator shroud and cooling fan with coupling.
  - A/C compressor, alternator and power steering pump drive belts.

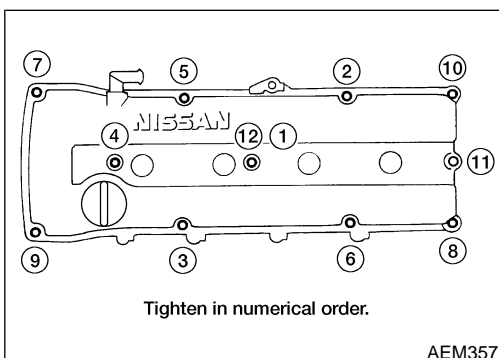
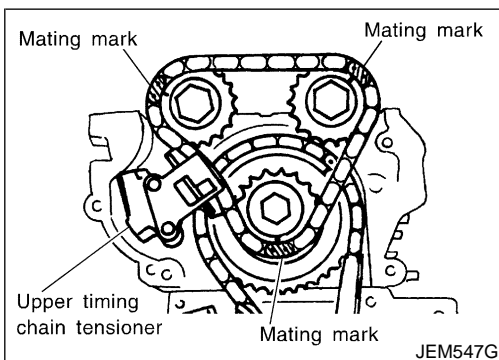
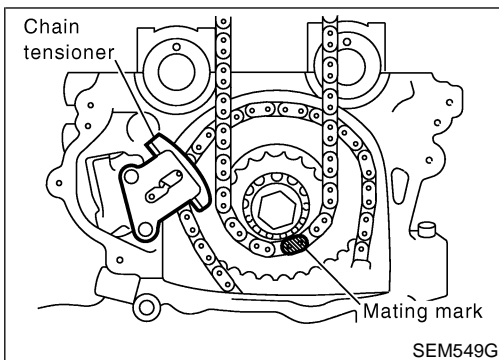
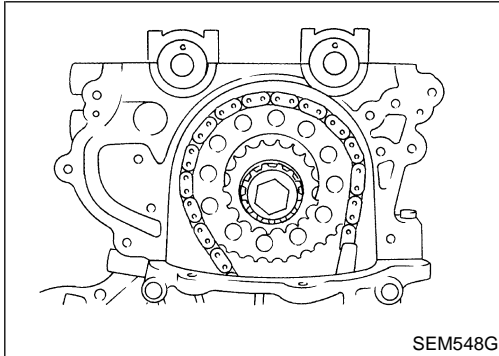
GI  
MA  
EM  
LC  
EC  
FE  
CL  
MT  
AT  
TF  
PD  
AX  
SU  
BR  
ST  
RS  
BT  
HA  
SC  
EL  
IDX

- Air duct.

## IDLER SPROCKET

NGEM0055S03

1. Install lower timing chain.  
Refer to "LOWER TIMING CHAIN", "Installation".
2. Install idler sprocket and bolt.



## UPPER TIMING CHAIN

NGEM0055S02

1. Install lower timing chain and idler sprocket.  
Refer to "LOWER TIMING CHAIN" (EM-23) and "IDLER SPROCKET" (EM-24) in "Installation".

2. Install upper timing chain and sprockets, referring to the painted marks made during removal.
3. Install chain tensioner. Remove the pin holding the tensioner piston in the bore of the tensioner.
4. Install camshaft sprocket cover:
  - Use a scraper to remove all traces of liquid gasket from mating surfaces of the engine block and camshaft sprocket cover.
  - Apply a continuous bead of RTV sealant to the cover. Refer to EM-19.
  - Also place RTV sealant on the head gasket surface.

### NOTE:

Use Nissan Genuine RTV Silicone Sealant, Part No. 999 MP-A7007 or equivalent.

### CAUTION:

- Be careful not to tear or damage the cylinder head gasket.
  - Be careful upper timing chain does not slip or jump when installing camshaft sprocket cover.
5. Install rocker cover gasket.
    - Apply liquid gasket to cylinder head camshaft sprocket cover. Refer to EM-19.

6. Install rocker cover. Tighten bolts in numerical order.

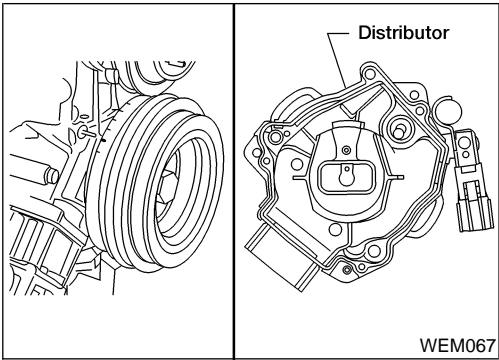
: 8 - 11 N·m (0.8 - 1.1 kg·m, 69 - 95 in·lb).



# TIMING CHAIN

**KA24DE**

*Installation (Cont'd)*



7. Install distributor, aligning as shown.
8. Install vacuum hoses, electrical harnesses, connectors, and harness clamps.

GI

MA

**EM**

LC

EC

FE

CL

MT

AT

TF

PD

AX

SU

BR

ST

RS

BT

HA

SC

EL

IDX

## Replacement

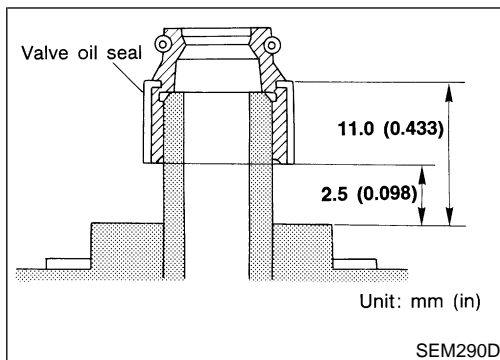
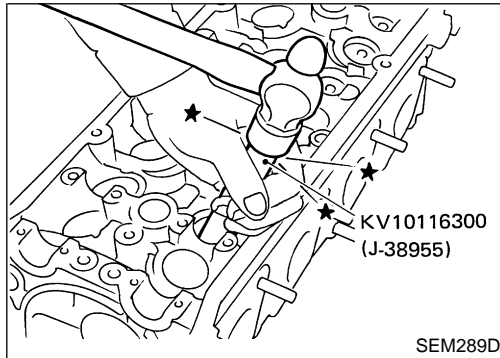
### VALVE OIL SEAL

NGEM0056

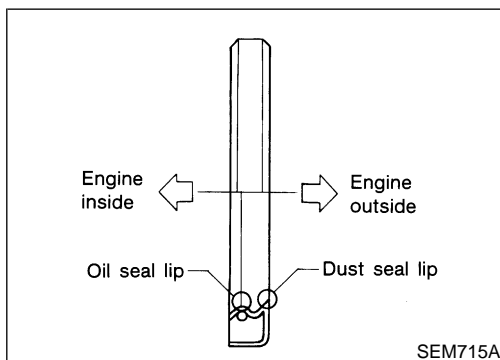
NGEM0056S01

1. Remove rocker cover.
2. Remove camshaft. Refer to "TIMING CHAIN" (EM-18).
3. Remove valve spring and valve oil seal with Tool or a suitable tool.

**Piston concerned should be set at TDC to prevent valve from falling.**



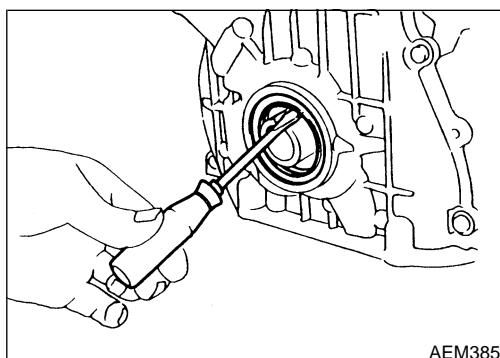
4. Apply engine oil to new valve oil seal and install it with Tool.



### OIL SEAL INSTALLING DIRECTION

NGEM0056S02

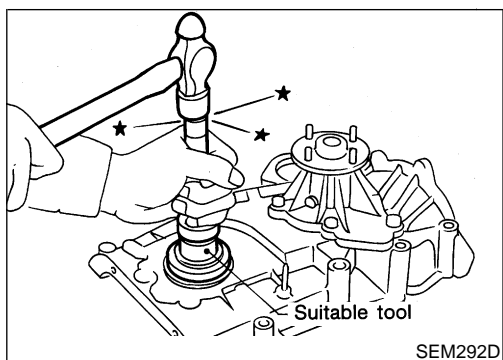
- Install new oil seal in the direction shown.



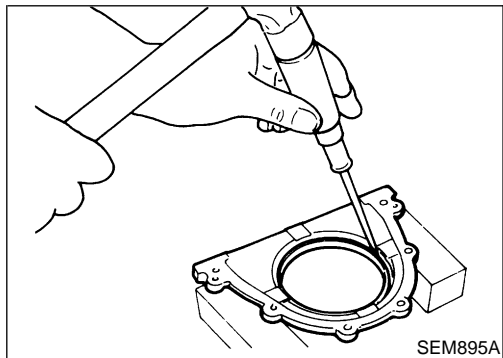
### FRONT OIL SEAL

NGEM0056S03

1. Remove radiator shroud and crankshaft pulley.
  2. Remove front oil seal
- **Be careful not to scratch front cover.**



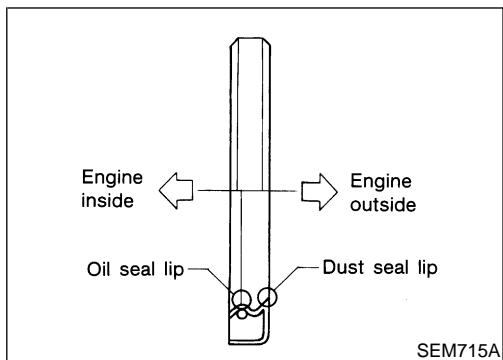
3. Apply engine oil to new oil seal and install it using a suitable tool.



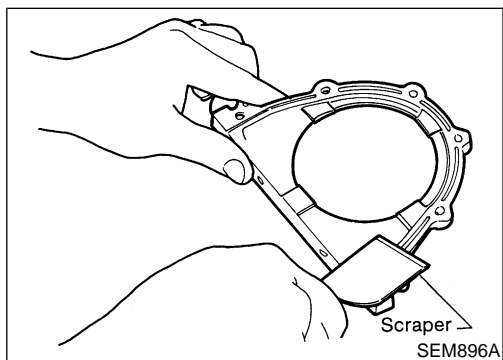
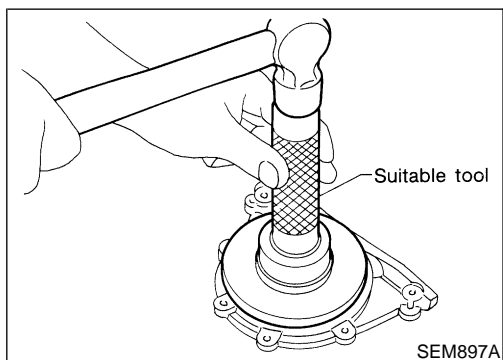
## REAR OIL SEAL

NGEM0056S04

1. Remove flywheel or drive plate.
  2. Remove rear oil seal retainer.
  3. Remove rear oil seal from retainer.
- **Be careful not to scratch rear oil seal retainer.**



4. Apply engine oil to new oil seal and install it using suitable tool.
- **Install new oil seal in the direction shown.**



5. Install rear oil seal retainer.
    - a. Before installing rear oil seal retainer, remove all traces of liquid gasket from mating surface using a scraper.
- **Also remove traces of liquid gasket from mating surface of cylinder block.**

GI

MA

**EM**

LC

EC

FE

CL

MT

AT

TF

PD

AX

SU

BR

ST

RS

BT

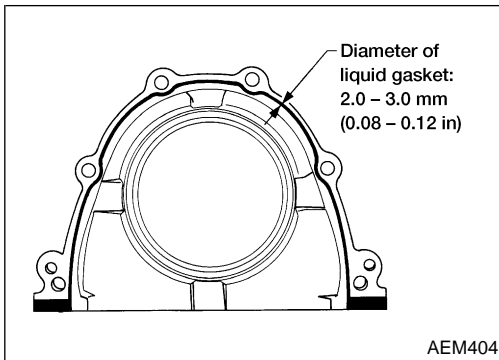
HA

SC

EL

IDX

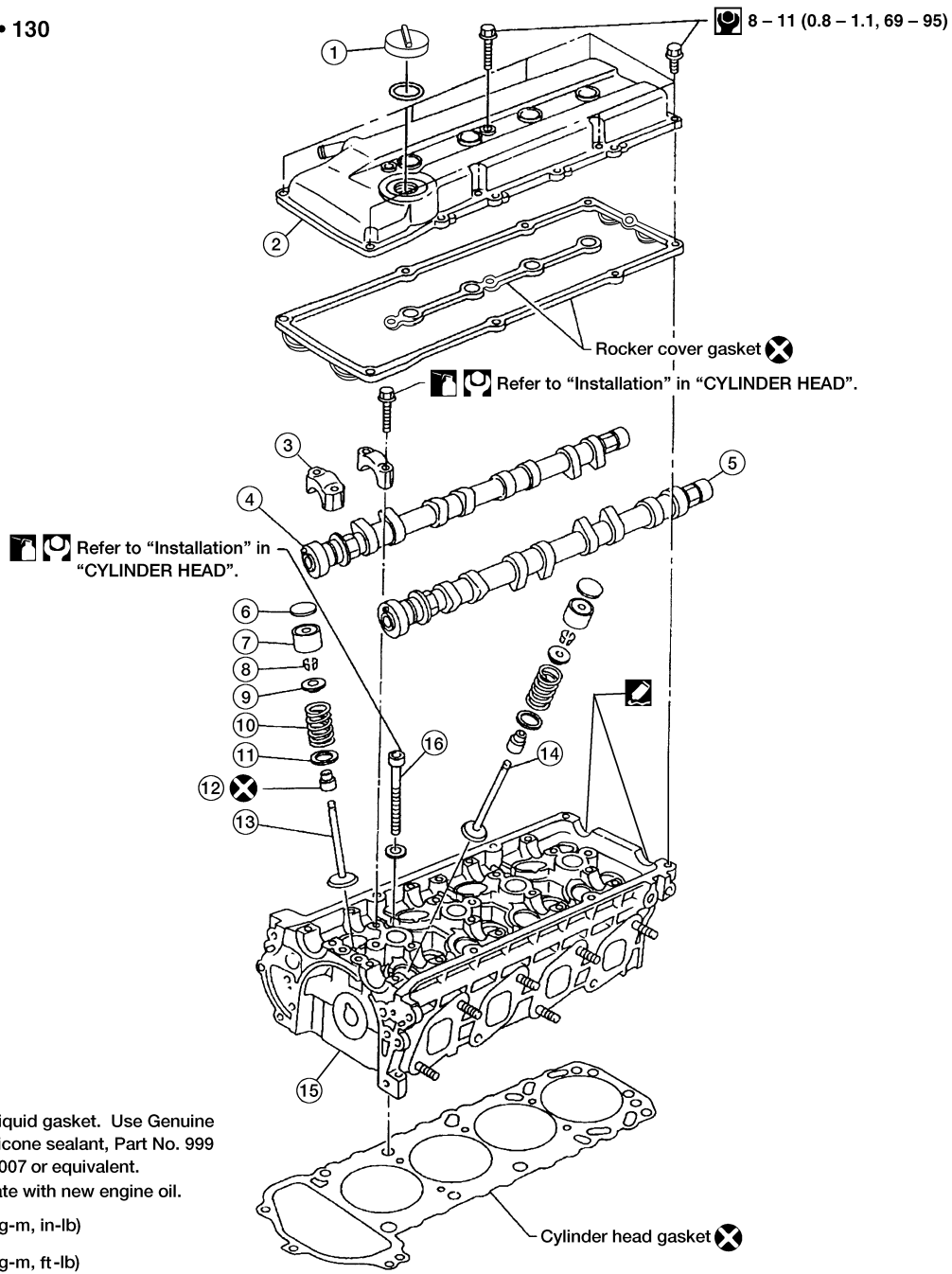
Replacement (Cont'd)



- b. Apply a continuous bead of liquid gasket to mating surface of rear oil seal retainer.
- **Use Genuine RTV Silicone Sealant, Part No. 999 MP-A7007 or equivalent.**
  - **Apply around inner side of bolt holes.**

SEC. 111 • 130

## Components



- |                     |                    |                        |
|---------------------|--------------------|------------------------|
| 1. Oil filler cap   | 7. Valve lifter    | 13. Intake valve       |
| 2. Rocker cover     | 8. Valve cotter    | 14. Exhaust valve      |
| 3. Camshaft bracket | 9. Spring retainer | 15. Rubber plug        |
| 4. Intake camshaft  | 10. Valve spring   | 16. Cylinder head      |
| 5. Exhaust camshaft | 11. Spring seat    | 17. Cylinder head bolt |
| 6. Shim             | 12. Valve oil seal |                        |

AEM485

GI

MA

**EM**

LC

EC

FE

CL

MT

AT

TF

PD

AX

SU

BR

ST

RS

BT

HA

SC

EL

IDX

## Removal

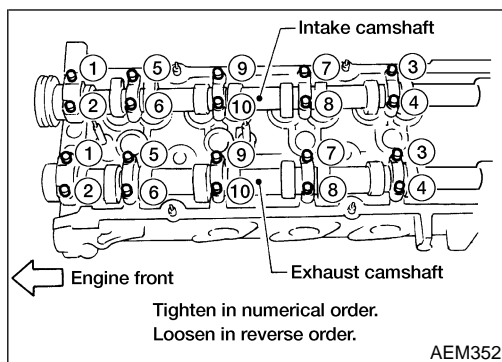
NGEM0058

**CAUTION:**

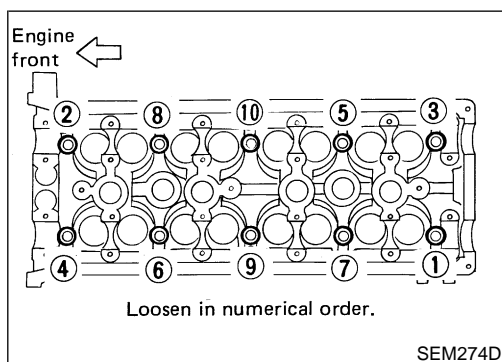
- When installing camshafts, chain tensioners, oil seals, or other sliding parts, lubricate contacting surfaces with new engine oil.
- Apply new engine oil to threads and seat surfaces when installing cylinder head, camshaft sprocket, crankshaft pulley, and camshaft bracket.
- Attach tags to valve lifters so as not to mix them up.

- Before removing camshaft and idler sprockets, apply paint marks to them for retiming.

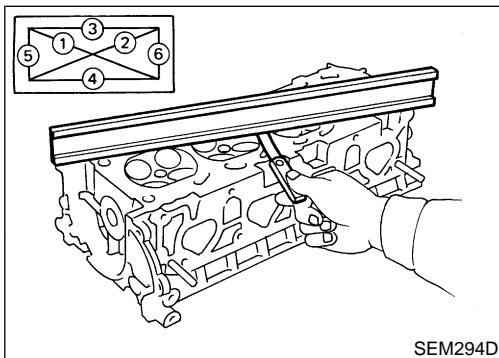
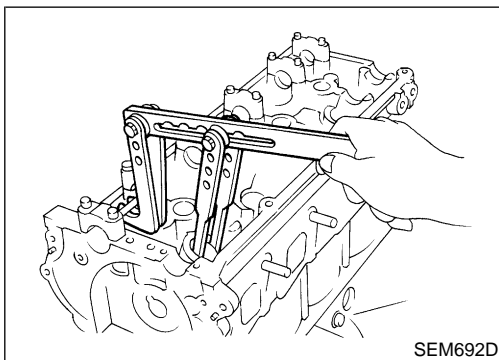
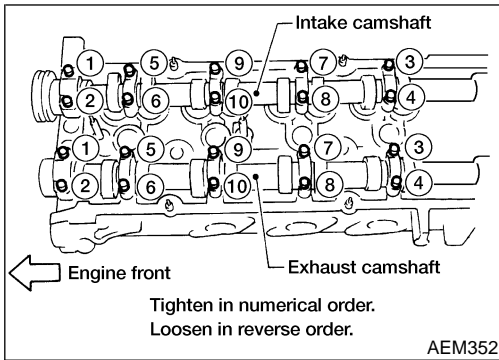
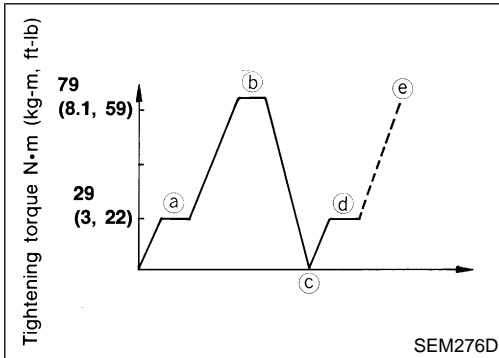
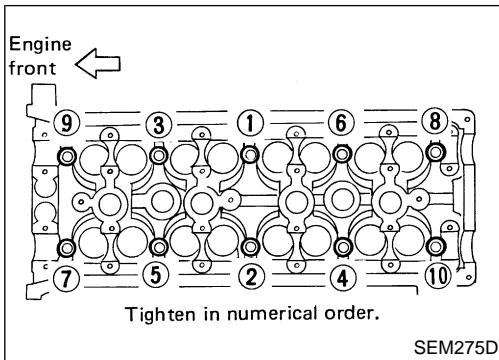
- 1) Remove upper timing chain and idler sprocket.
  - Refer to “UPPER TIMING CHAIN”EM-20 and “IDLER SPROCKET” EM-21 in “Removal”, “TIMING CHAIN”.
  - For retiming during cylinder head removal/installation, apply paint marks to camshaft sprockets, upper timing chain, lower timing chain, and idler sprocket.



- 2) Remove camshaft brackets and camshafts.
  - Mark these parts' original positions for reassembly.



- 3) Remove cylinder head bolts in numerical order.
  - Removing bolts in incorrect order could result in a warped or cracked cylinder head.
  - Loosen cylinder head bolts in two or three steps.
- 4) Remove cylinder head and cylinder head gasket.



**Installation**

NGEM0083

- 1) Tighten cylinder head bolts in numerical order using the following procedure:
  - a) Tighten all bolts to 29 N-m (3.0 kg-m, 22 ft-lb).
  - b) Tighten all bolts to 79 N-m (8.1 kg-m, 59 ft-lb).
  - c) Loosen all bolts completely.
  - d) Tighten all bolts to 25 to 34 N-m (2.5 to 3.5 kg-m, 18 to 25 ft-lb).
  - e) Turn all bolts 86 to 91 degrees clockwise. If angle wrench is not available, mark all cylinder head bolts on the side facing engine front. Then turn each cylinder head bolts 86 to 91 degrees clockwise.
- 2) Install camshafts and camshaft brackets in the order shown using the following procedure:
  - a) Set camshafts and camshaft brackets.
    - Dowel pins of both intake and exhaust camshafts should be at 12 o'clock positions when installing the camshafts.
  - b) Tighten all bolts to 2 N-m (0.2 kg-m, 17 in-lb).
  - c) Tighten all bolts to 9.0 to 11.8 N-m (0.92 to 1.2 kg-m, 79.9 to 104.2 in-lb).
    - Apply new engine oil to bolt threads and seat surfaces.
- 3) Install upper timing chain and idler sprocket.
  - Refer to "UPPER TIMING CHAIN" EM-24 and "IDLER SPROCKET" EM-24 in "Installation", "TIMING CHAIN".

GI  
MA  
EM  
LC  
EC  
FE  
CL  
MT  
AT  
TF  
PD  
AX  
SU  
BR  
ST  
RS  
BT  
HA  
SC  
EL  
IDX

**Disassembly**

NGEM0059

1. Remove intake manifold and exhaust manifold. Refer to "OUTER COMPONENT PARTS" (EM-12).
2. Remove valve components.
3. Remove valve oil seal with a suitable tool.

**Inspection**

NGEM0060

**CYLINDER HEAD DISTORTION**

NGEM0060S01

Clean surface of cylinder head.  
Use a reliable straightedge and feeler gauge to check the flatness of cylinder head surface.  
Check along six positions shown in the figure.

- Head surface flatness:**
- Standard Less than 0.03 mm (0.0012 in)
  - Limit 0.1 mm (0.004 in)

If beyond the specified limit, replace it or resurface it.

**Resurfacing limit:**

The limit of cylinder head resurfacing is determined by the cylinder block resurfacing.

Amount of cylinder head resurfacing is "A".

Amount of cylinder block resurfacing is "B".

**The maximum limit:**

$$A + B = 0.2 \text{ mm (0.008 in)}$$

After resurfacing cylinder head, check that camshaft rotates freely by hand. If resistance is felt, cylinder head must be replaced.

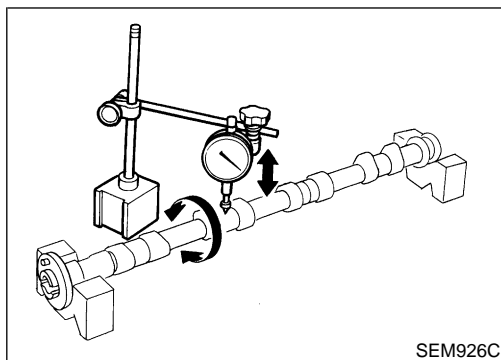
**Nominal cylinder head height:**

$$126.3 - 126.5 \text{ mm (4.972 - 4.980 in)}$$

**CAMSHAFT VISUAL CHECK**

Check camshaft for scratches, seizure and wear.

NGEM0060S02

**CAMSHAFT RUNOUT**

1. Measure camshaft runout at the center journal.

NGEM0060S03

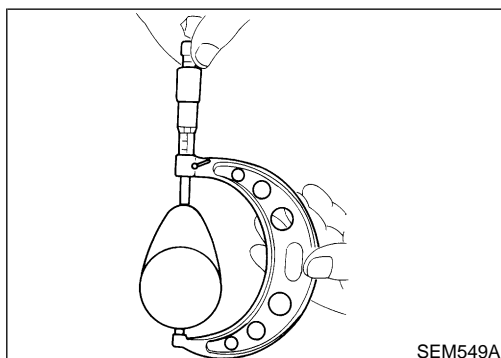
**Runout (Total indicator reading):****Standard:**

$$\text{Less than } 0.02 \text{ mm (0.0008 in)}$$

**Limit:**

$$0.04 \text{ mm (0.0016 in)}$$

2. If it exceeds the limit, replace camshaft.

**CAMSHAFT CAM HEIGHT**

1. Measure camshaft cam height.

NGEM0060S04

**Standard cam height:**

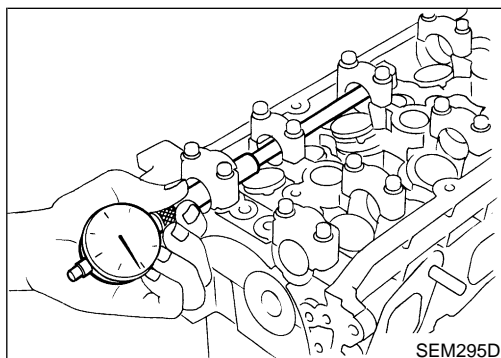
$$\text{Intake } 42.505 - 42.695 \text{ mm (1.673 - 1.681 in)}$$

$$\text{Exhaust } 40.905 - 41.095 \text{ mm (1.610 - 1.618 in)}$$

**Cam height wear limit:****Intake & Exhaust**

$$0.2 \text{ mm (0.008 in)}$$

2. If wear is beyond the limit, replace camshaft.

**CAMSHAFT JOURNAL CLEARANCE**

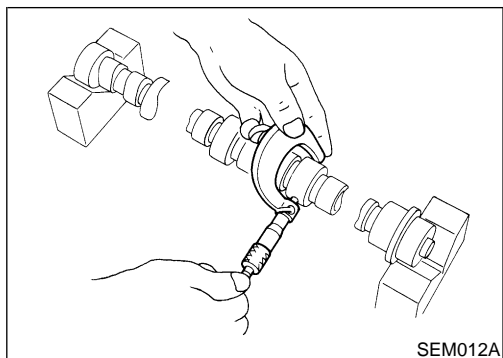
NGEM0060S05

1. Install camshaft bracket and tighten bolts to the specified torque.
2. Measure inner diameter of camshaft bearing.

**Standard inner diameter:****#1 to #5 journals**

$$28.000 - 28.025 \text{ mm (1.1024 - 1.1033 in)}$$





SEM012A

3. Measure outer diameter of camshaft journal.

**Standard outer diameter:**

**#1 to #5 journals**

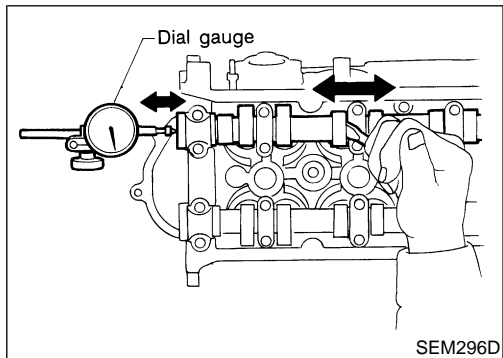
**27.935 - 27.955 mm (1.0998 - 1.1006 in)**

4. If clearance exceeds the limit, replace camshaft and/or cylinder head.

**Camshaft journal clearance:**

**Standard 0.045 - 0.090 mm (0.0018 - 0.0035 in)**

**Limit 0.12 mm (0.0047 in)**



SEM296D

## CAMSHAFT END PLAY

NGEM0060S06

1. Install camshaft in cylinder head.

2. Measure camshaft end play.

**Camshaft end play:**

**Standard**

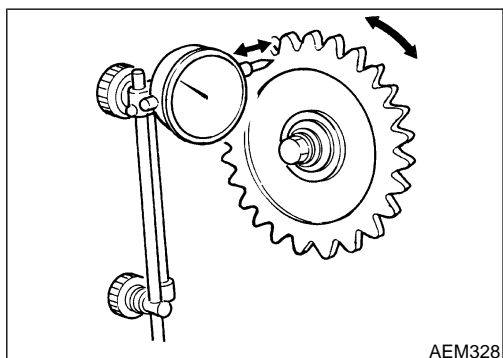
**0.070 - 0.148 mm (0.0028 - 0.0058 in)**

**Limit**

**0.2 mm (0.008 in)**

3. If end play exceeds the limit, replace camshaft and remeasure camshaft end play.

4. If end play still exceeds the limit after replacing camshaft, replace cylinder head.



AEM328

## CAMSHAFT SPROCKET RUNOUT

NGEM0060S07

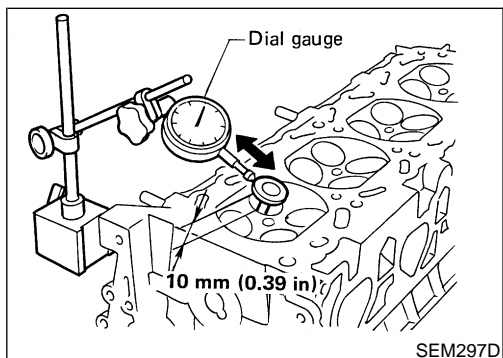
1. Install sprocket on camshaft.

2. Measure camshaft sprocket runout.

**Runout (Total indicator reading):**

**Limit 0.15 mm (0.0059 in)**

3. If it exceeds the limit, replace camshaft sprocket.



SEM297D

## VALVE GUIDE CLEARANCE

NGEM0060S08

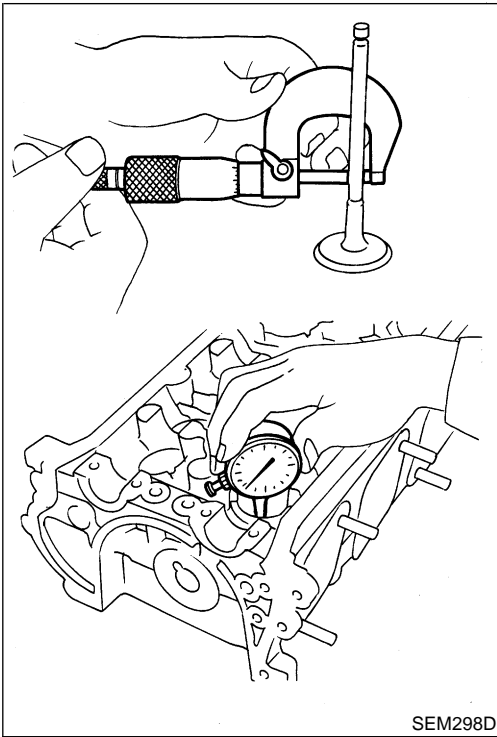
1. Measure valve deflection as shown in figure. (Valve and valve guide mostly wear in this direction.)

**Valve deflection limit (Dial gauge reading):**

**Intake & Exhaust**

**0.2 mm (0.008 in)**

## Inspection (Cont'd)



SEM298D

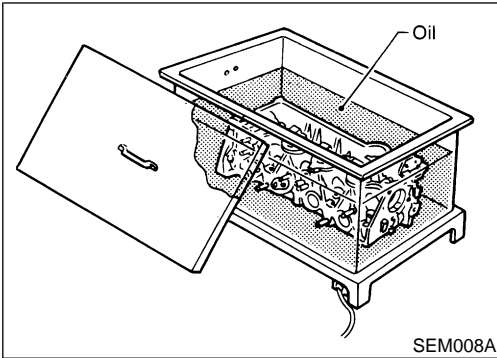
2. If it exceeds the limit, check valve to valve guide clearance.
  - a. Measure valve stem diameter and valve guide inner diameter.
  - b. Check that clearance is within specification.

**Valve to valve guide clearance = Valve guide inner diameter - Valve stem diameter:**

Unit: mm (in)

	Standard	Limit
Intake	0.020 - 0.053 (0.0008 - 0.0021)	0.08 (0.0031)
Exhaust	0.040 - 0.073 (0.0016 - 0.0029)	0.1 (0.004)

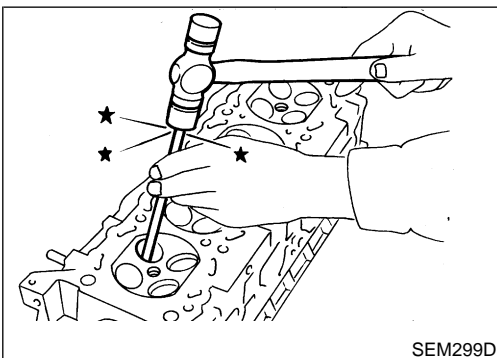
- c. If it exceeds the limit, replace valve and remeasure clearance.
  - If clearance still exceeds the limit after replacing valve, replace the valve guide.



SEM008A

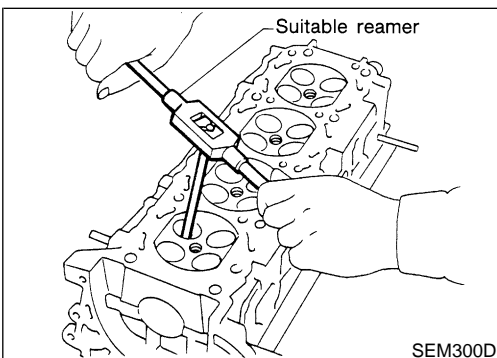
## VALVE GUIDE REPLACEMENT

1. To remove valve guide, heat cylinder head to 120 to 140°C (248 to 284°F) by soaking in heated oil. NGEM0060S09



SEM299D

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.



SEM300D

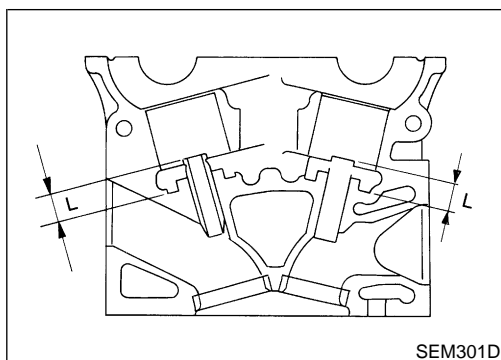
3. Ream cylinder head valve guide hole.

**Valve guide hole diameter**

**(for service parts):**

**Intake & Exhaust**

**11.175 - 11.196 mm (0.4400 - 0.4408 in)**

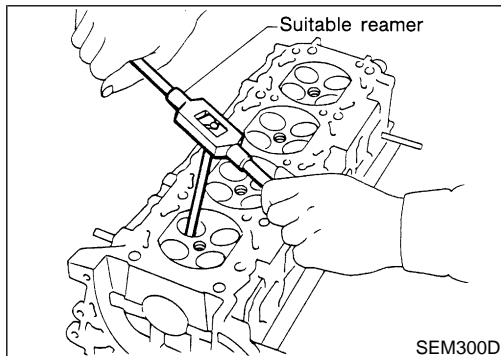


SEM301D

- Heat cylinder head to 120 to 140°C (248 to 284°F) and press service valve guide onto cylinder head.

**Projection "L":**

**13.3 - 13.9 mm (0.524 - 0.547 in)**



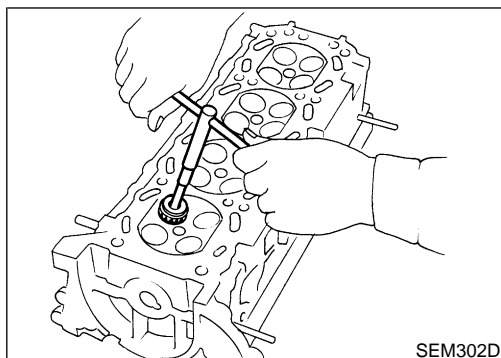
SEM300D

- Ream valve guide.

**Finished size:**

**Intake & Exhaust**

**7.000 - 7.018 mm (0.2756 - 0.2763 in)**

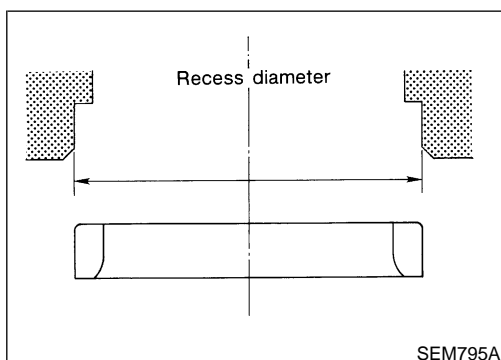


SEM302D

## VALVE SEATS

Check valve seats for pitting at contact surface. Resurface or replace if excessively worn. NGEM0060S10

- Before repairing valve seats, check valve and valve guide for wear. If they have worn, replace them. Then correct valve seat.
- Use both hands to cut uniformly.



SEM795A

## REPLACING VALVE SEAT FOR SERVICE PARTS

- 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. NGEM0060S11
- Ream cylinder head recess.

**Reaming bore for service valve seat**

**Oversize [0.5 mm (0.020 in)]:**

**Intake 38.000 - 38.016 mm (1.4961 - 1.4967 in)**

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

Use the valve guide center for reaming to ensure valve seat will have the correct fit.

GI

MA

**EM**

LC

EC

FE

CL

MT

AT

TF

PD

AX

SU

BR

ST

RS

BT

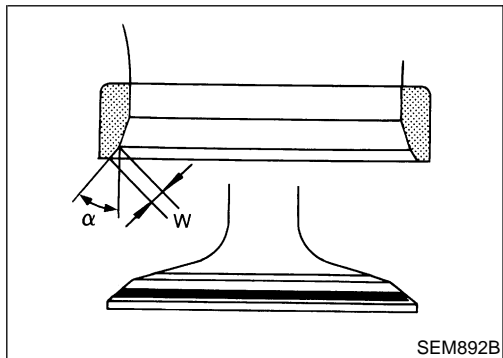
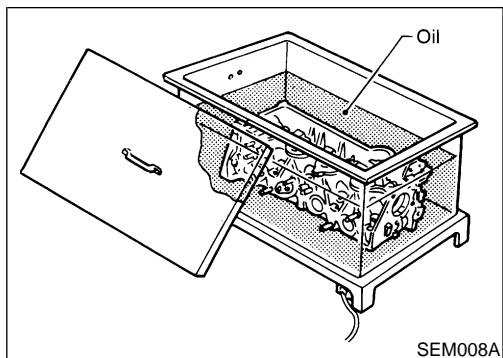
HA

SC

EL

IDX

Inspection (Cont'd)



3. Heat cylinder head to 120 to 140°C (248 to 284°F).
4. Press fit valve seat until it seats on the bottom.

5. Cut or grind valve seat using suitable tool to the specified dimensions as shown in SDS.
6. After cutting, lap valve seat with abrasive compound.
7. Check valve seating condition.

**Seat face angle "α":**

**45°15' - 45°45' deg.**

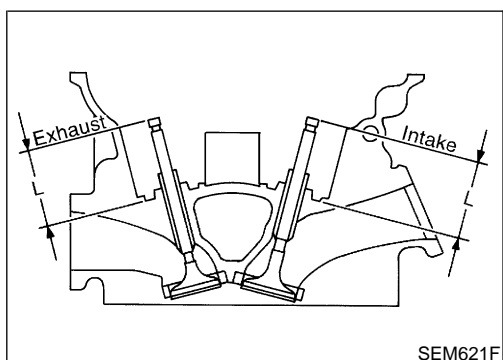
**Contacting width "W":**

**Intake**

**1.48 - 1.63 mm (0.0583 - 0.0642 in)**

**Exhaust**

**1.8 - 2.0 mm (0.071 - 0.079 in)**

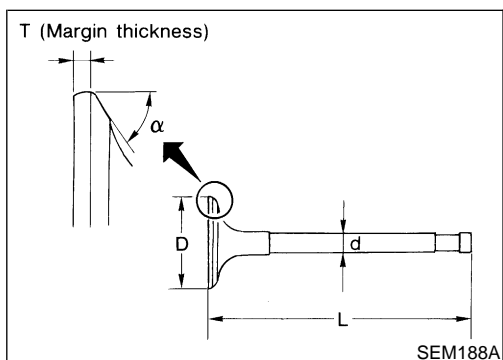


8. Use a depth gauge to measure the distance between the mounting surface of the cylinder head spring seat and the valve stem end. If the distance is shorter than specified, repeat step 5 above to adjust it. If it is longer, replace the valve seat with a new one.

**Valve seat resurface limit "L":**

**Intake 42.02 - 42.52 mm (1.6543 - 1.6740 in)**

**Exhaust 42.03 - 42.53 mm (1.6547 - 1.6744 in)**

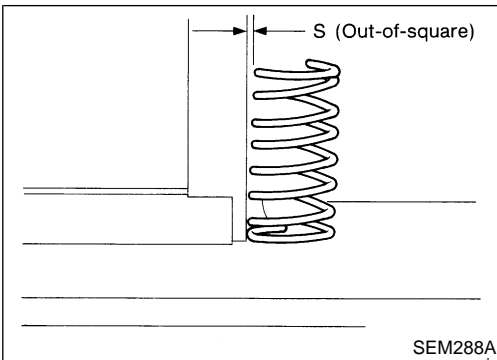


## VALVE DIMENSIONS

NGEM0060S12

Check dimensions of each valve. For dimensions, refer to SDS (EM-56). When valve head has been worn down to 0.5 mm (0.020 in) in margin thickness, replace valve.

**Grinding allowance for valve stem tip is 0.2 mm (0.008 in) or less.**



## VALVE SPRING

### Squareness

1. Measure dimension "S".  
**Out-of-square "S":**  
**Less than 2.2 mm (0.087 in)**
2. If it exceeds the limit, replace spring.

NGEM0060S13

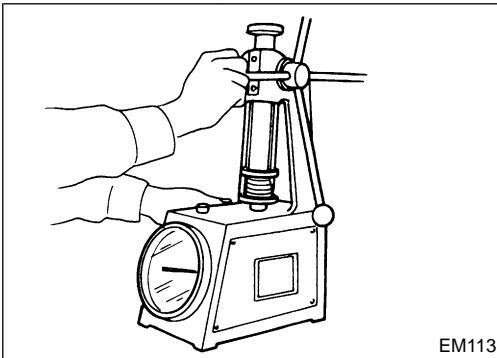
NGEM0060S1301

GI

MA

**EM**

LC



### Pressure

Check valve spring pressure at specified spring height.

**Pressure: N (kg, lb) at height mm (in)**

**Standard**

**418.0 (42.6, 93.9) at 29.17 (1.1484)**

**Limit**

**393.0 (40.1, 88.4) at 29.17 (1.1484)**

If it exceeds the limit, replace spring.

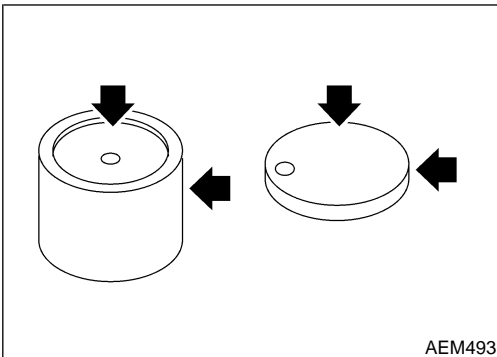
NGEM0060S1302

EC

FE

CL

MT



## VALVE LIFTER AND VALVE SHIM

1. Visually check contact and sliding surfaces for wear and scratches.

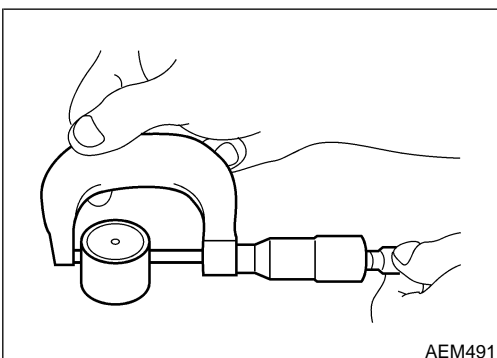
NGEM0060S14

AT

TF

PD

AX



2. Check diameter of valve lifter and valve lifter guide bore.

**Valve lifter outer diameter:**

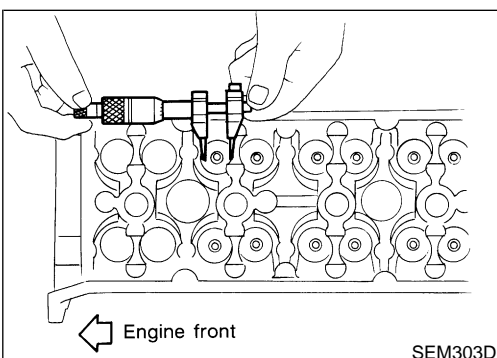
**33.960 - 33.975 mm (1.3370 - 1.3376 in)**

SU

BR

ST

RS



**Lifter guide bore diameter:**

**34.000 - 34.021 mm (1.3386 - 1.3394 in)**

**Valve lifter to valve lifter guide clearance:**

**0.025 - 0.061 mm (0.0010 - 0.0024 in)**

If it exceeds the standard diameter or clearance, replace valve lifter or cylinder head.

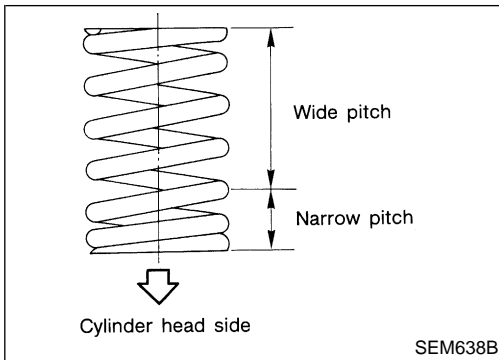
BT

HA

SC

EL

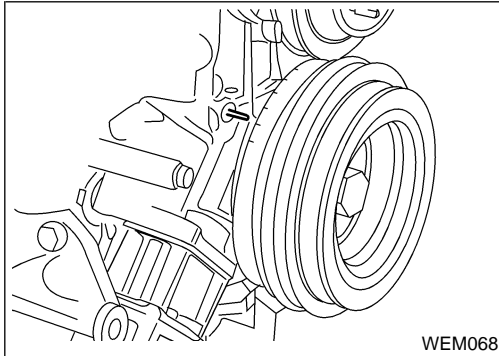
IDX



## Assembly

NGEM0061

1. Install valve component parts.
  - Always use new valve oil seal. Refer to “OIL SEAL REPLACEMENT” (EM-26).
  - Before installing valve oil seal, install valve spring seat.
  - Install outer valve spring (uneven pitch type) with its narrow pitch side toward cylinder head side.
  - After installing valve component parts, tap valve stem tip with plastic hammer to assure a proper fit.



## Valve Clearance

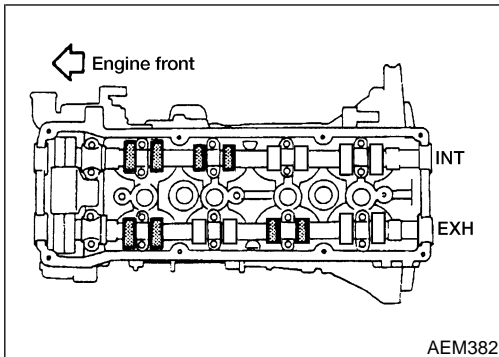
NGEM0062

### CHECKING

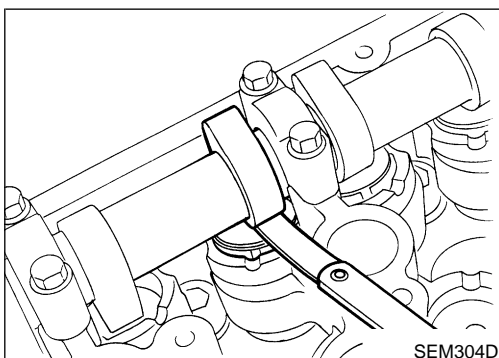
NGEM0062S01

Check valve clearance while engine is warm but not running.

1. Remove rocker cover and all spark plugs.
2. Set No. 1 cylinder at TDC on its compression stroke.
  - Align pointer with TDC mark on crankshaft pulley.
  - Check that valve lifters on No. 1 cylinder are loose and valve lifters on No. 4 are tight.
 If not, turn crankshaft one revolution (360°) and align as above.



3. Check only those valves shown in the figure.



4. Using a feeler gauge, measure clearance between valve lifter and camshaft.
  - Record any valve clearance measurements which are out of specification. They will be used later to determine the required replacement adjusting shim.

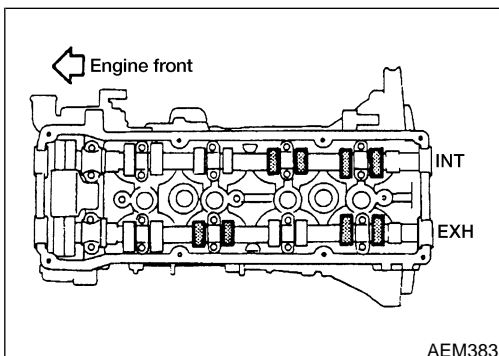
#### Valve clearance (Hot):

##### Intake

0.31 - 0.39 mm (0.012 - 0.015 in)

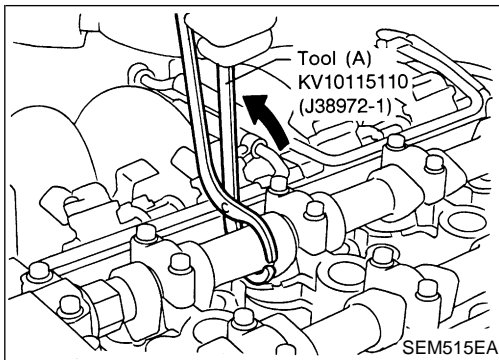
##### Exhaust

0.33 - 0.41 mm (0.013 - 0.016 in)



5. Turn crankshaft one revolution (360°) and align mark on crankshaft pulley with pointer.
6. Check those valves shown in the figure.
  - Use the same procedure as mentioned in step 4.
7. If all valve clearances are within specification, install the following parts.
  - Rocker cover
  - All spark plugs

NGEM0062S02



### ADJUSTING

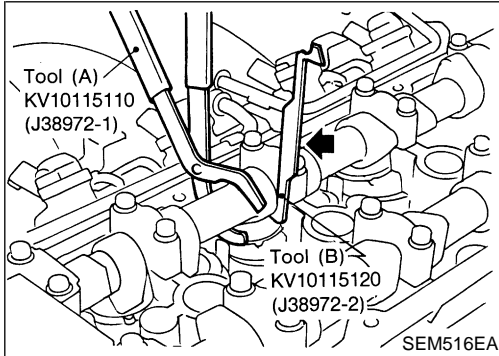
**Adjust valve clearance while engine is cold.**

1. Turn crankshaft to position cam lobe on camshaft of valve that must be adjusted upward.
2. Place Tool (A) around camshaft as shown in figure.
3. Rotate Tool (A) so that lifter is pushed down.

**Before placing Tool (A), rotate notch toward center of cylinder head (See figure.), to simplify shim removal later.**

**CAUTION:**

**Be careful not to damage cam surface with Tool (A).**

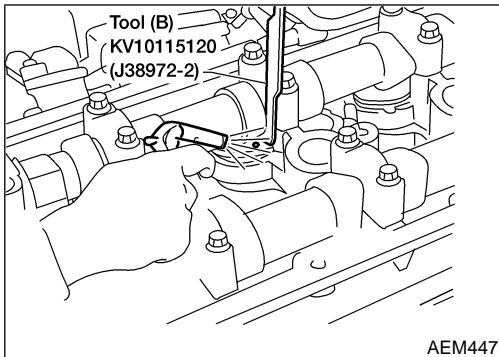


4. Place Tool (B) between camshaft and the edge of the valve lifter to retain valve lifter.

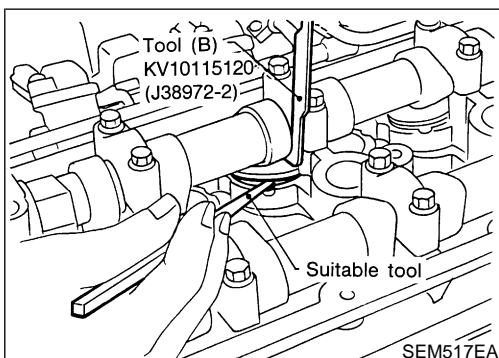
**CAUTION:**

- Tool (B) must be placed as close to camshaft bracket as possible.
- Be careful not to damage cam surface with Tool (B).

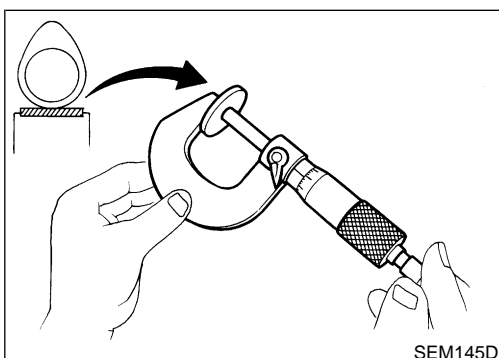
5. Remove Tool (A).



6. Rotate adjusting shim until hole is visible. Blow air into the hole to separate adjusting shim from valve lifter.



7. Remove adjusting shim using a small screwdriver and a magnetic finger.



8. Determine replacement adjusting shim size as follows.
  - a. Using a micrometer determine thickness of removed shim.
  - b. Calculate thickness of new adjusting shim so valve clearance comes within specified values.

R = Thickness of removed shim

N = Thickness of new shim

M = Measured valve clearance

**Intake & Exhaust:**

$$N = R + [M - 0.37 \text{ mm (0.0146 in)}]$$

GI

MA

EM

LC

EC

FE

CL

MT

AT

TF

PD

AX

SU

BR

ST

RS

BT

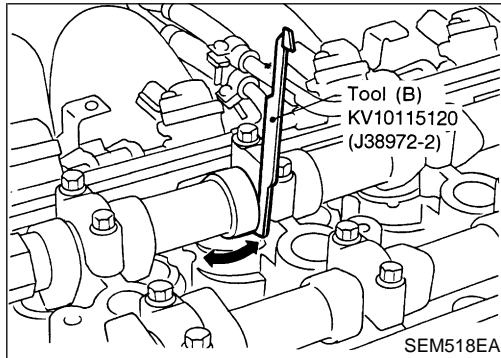
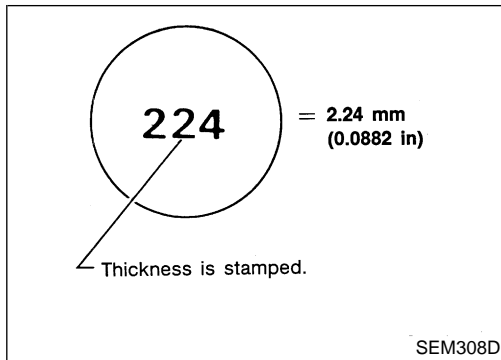
HA

SC

EL

IDX

## Valve Clearance (Cont'd)



Shims are available in thicknesses from 1.96 mm (0.0772 in) to 2.68 mm (0.1055 in), in steps of 0.02 mm (0.0008 in).

- c. Select new shim with thickness as close as possible to calculated value.

Refer to SDS, EM-58.

9. Install new shim using a suitable tool.

- **Install with the surface on which the thickness is stamped facing down.**

10. Place Tool (A) as mentioned in steps 2 and 3.

11. Remove Tool (B).

12. Remove Tool (A).

13. Recheck valve clearance.

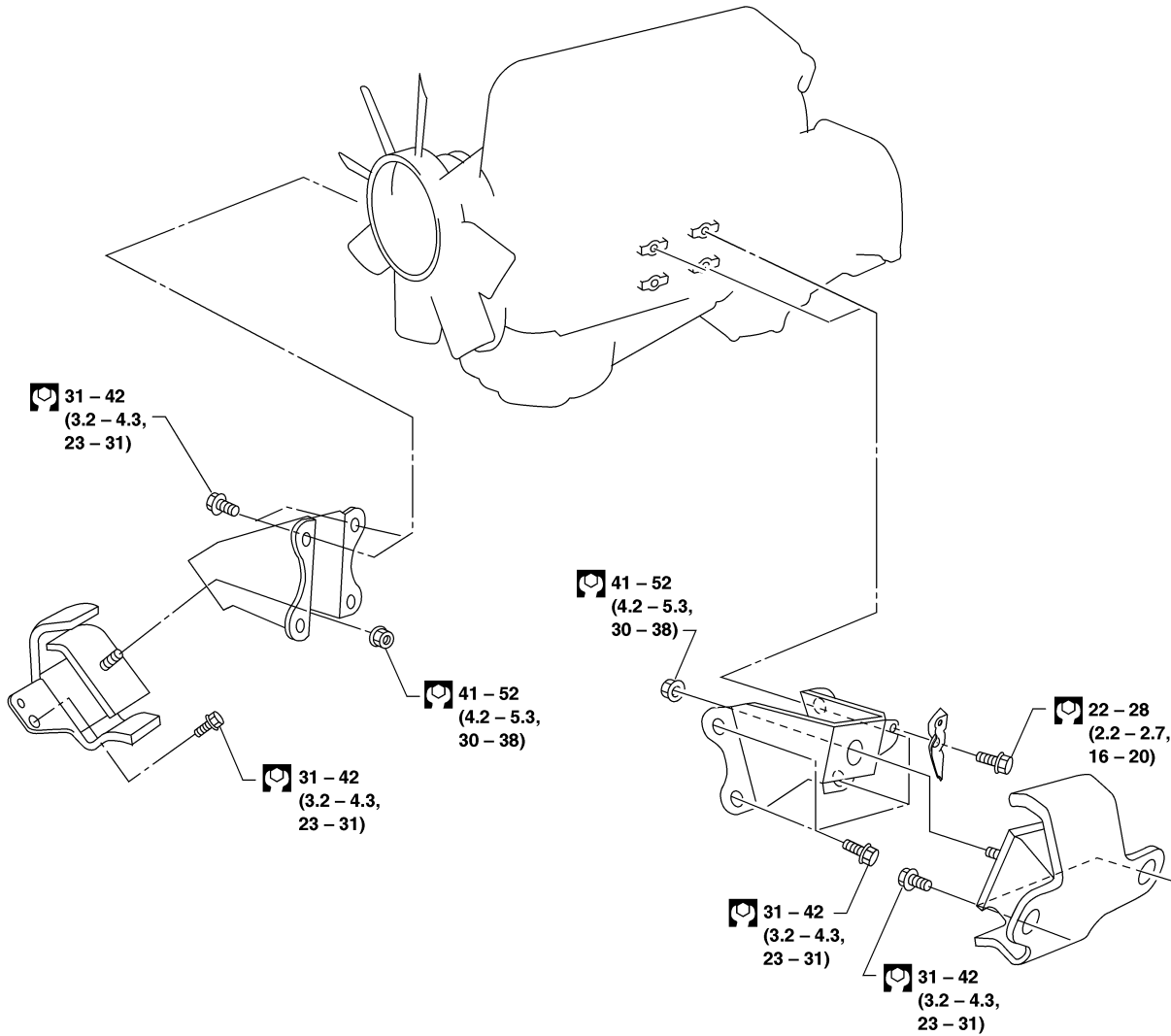
Refer to "CHECKING" (EM-38).



## Removal and Installation

NGEM0063

SEC. 112



: N·m (kg·m, ft·lb)

GI

MA

**EM**

LC

EC

FE

CL

MT

AT

TF

PD

AX

SU

BR

ST

RS

BT

HA

SC

EL

IDX

AEM462

**WARNING:**

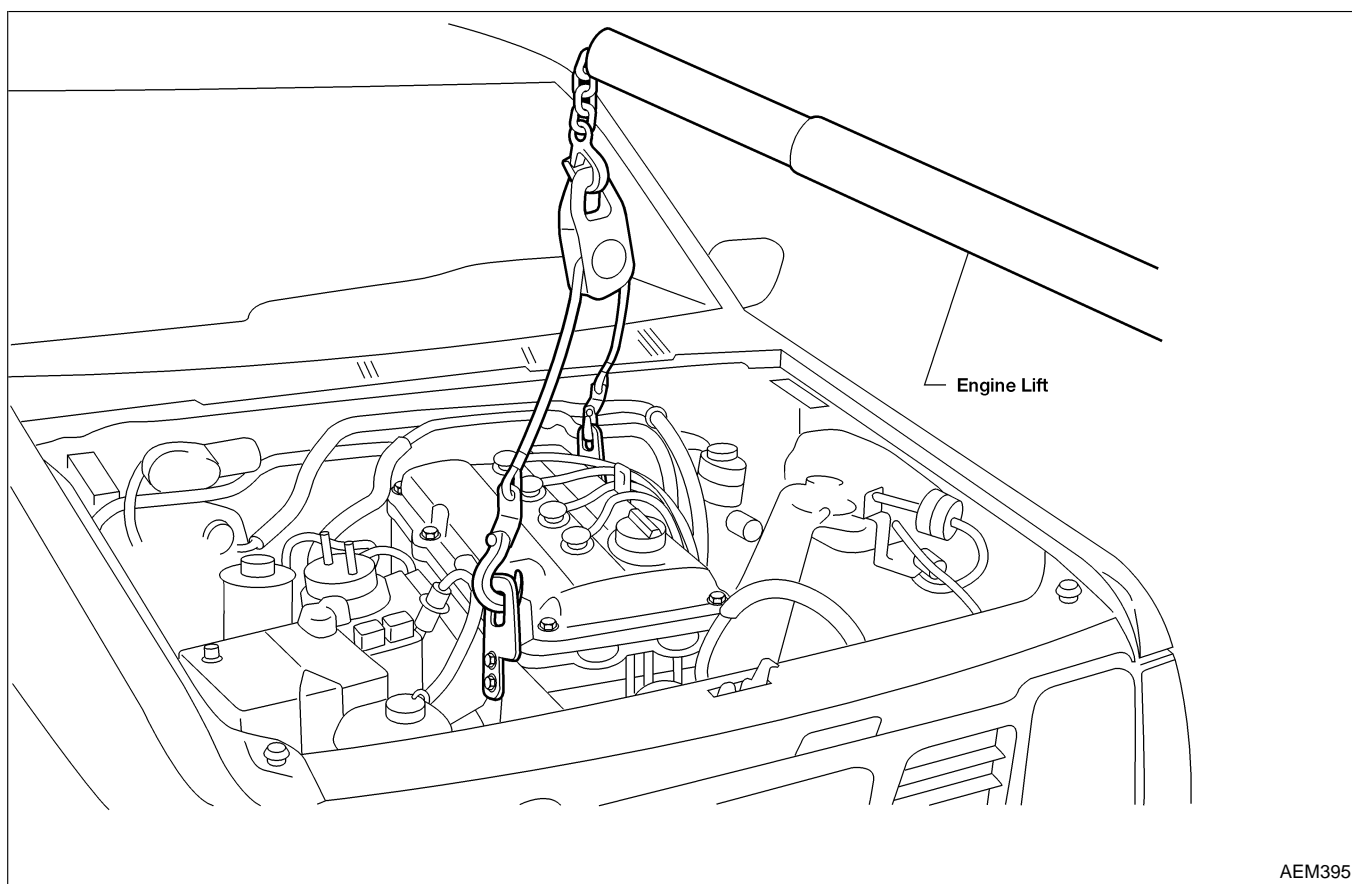
- Position vehicle on a flat and solid surface.
- Place chocks at front and back of rear wheels.
- Do not remove engine until exhaust system has completely cooled off.  
Otherwise, you may burn yourself and/or fire may break out in fuel line.
- Before disconnecting fuel hose, release fuel pressure. Refer to EC section (“Fuel Pressure Release”, “BASIC SERVICE PROCEDURE”).
- Be sure to hoist engine and transmission in a safe manner.
- For engines not equipped with engine slingers, attach proper slingers and bolts described in PARTS CATALOG.

**CAUTION:**

- When lifting engine, be sure to clear surrounding parts. Take special care near accelerator wire casing, brake lines and brake master cylinder.
- In hoisting the engine, always use engine slingers in a safe manner.
- Before separating engine and transmission, remove the crankshaft position sensor (OBD) from the assembly.
- Always take extra care not to damage edge of crankshaft position sensor (OBD) or ring gear teeth.

**REMOVAL**

1. Drain coolant from engine block and radiator. Refer to <sup>NGEM0063S01</sup> **MA-18**, (“Changing Engine Coolant”, “ENGINE MAINTENANCE”).
2. Release fuel pressure. Refer to **EC-40**, (“Fuel Pressure Release”, “BASIC SERVICE PROCEDURE”).
3. Remove negative battery cable.
4. Remove hood. Refer to **BT-12**.
5. Remove air cleaner.
6. Remove power steering drive belt, generator drive belt and A/C compressor drive belt.
7. Remove radiator. Refer to **LC-14**, (“Radiator”, “ENGINE COOLING SYSTEM”).
8. Remove exhaust manifold heat shield.
9. Disconnect exhaust system from #1 catalytic converter.
10. Remove A/C compressor from bracket. Refer to **HA-67**, (“Compressor Mounting”, “SERVICE PROCEDURES”).
11. Disconnect accelerator wire, vacuum hoses, electrical connectors, heater hoses and vacuum booster hose.
12. Remove four power steering pump bolts.
13. Remove transmission Refer to **MT-9** or **AT-261**, (“Removal”, “REMOVAL AND INSTALLATION”).
14. Remove LH and RH engine mounts.
15. Remove engine.



AEM395

## INSTALLATION

- Install in reverse order of removal.

NGEM0063S02

GI

MA

**EM**

LC

EC

FE

CL

MT

AT

TF

PD

AX

SU

BR

ST

RS

BT

HA

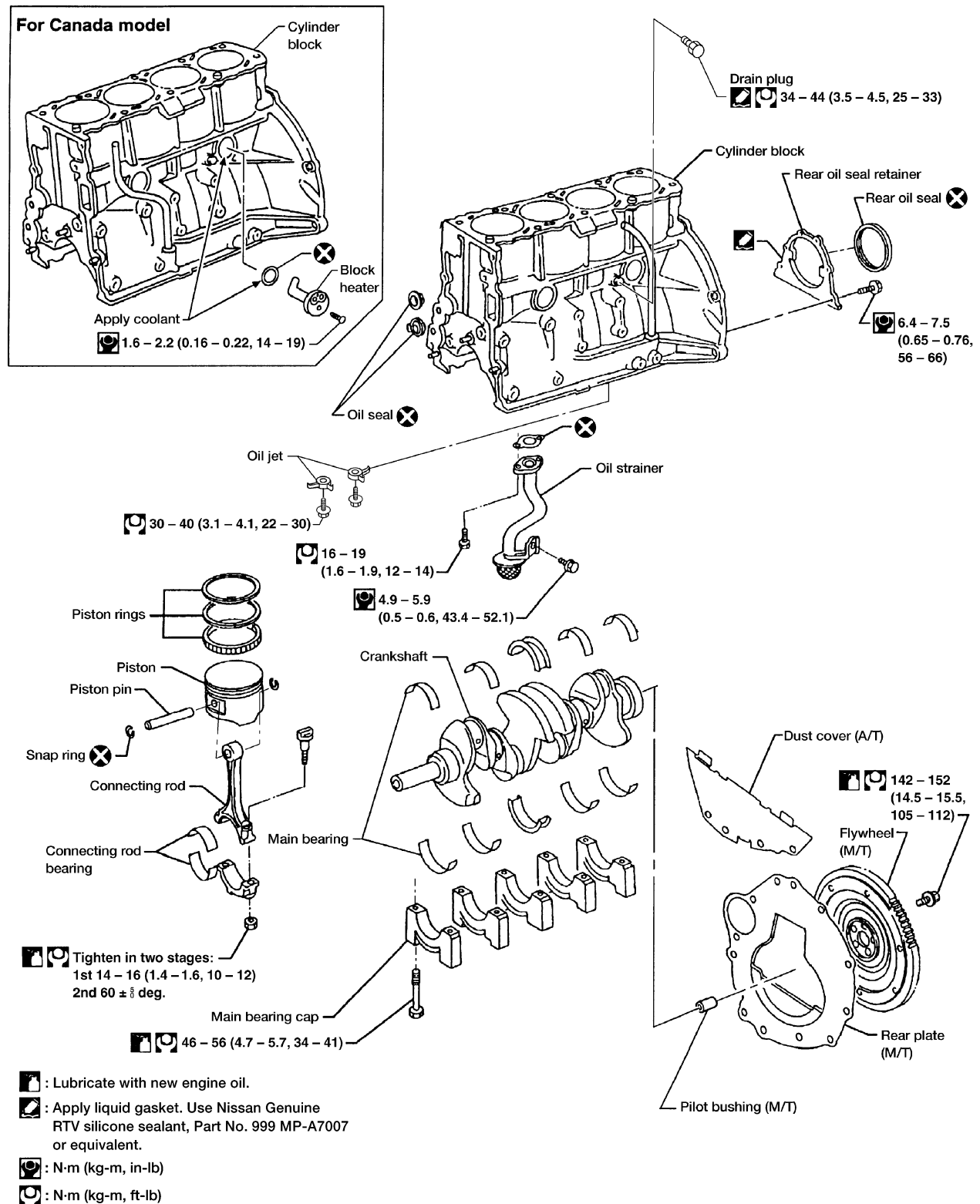
SC

EL

IDX

## Components

SEC. 110 • 120 • 135 • 150 • 210

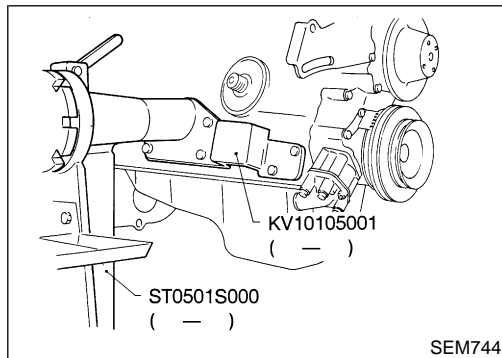


## Removal and Installation

NGEM0065

### CAUTION:

- When installing sliding parts (bearings, pistons, etc.), lubricate contacting surfaces with new engine oil.
- Place removed parts such as bearings and bearing caps in their proper order and direction.
- When installing connecting rod nuts and main bearing cap bolts, apply new engine oil to threads and seating surfaces.
- Do not allow any magnetic materials to contact the ring gear teeth of flywheel or drive plate.



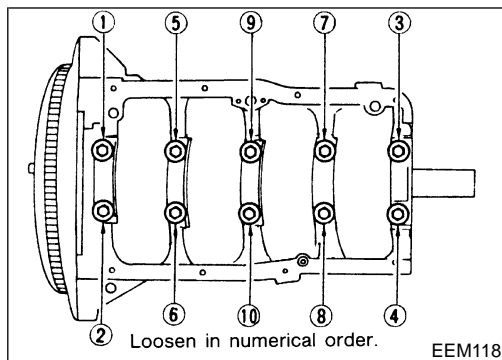
## Disassembly

### PISTON AND CRANKSHAFT

NGEM0066

NGEM0066S01

1. Place engine on a work stand.
  2. Drain coolant and oil.
  3. Remove oil pan.
  4. Remove timing chain. Refer to "Removal" in "TIMING CHAIN" (EM-20).
  5. Remove water pump.
  6. Remove cylinder head.
  7. Remove pistons with connecting rods.
  8. Remove bearing caps and crankshaft.
- Before removing bearing caps, measure crankshaft end play. Refer to EM-53.
  - Bolts should be loosened in two or three steps.



## Inspection

### PISTON AND PISTON PIN CLEARANCE

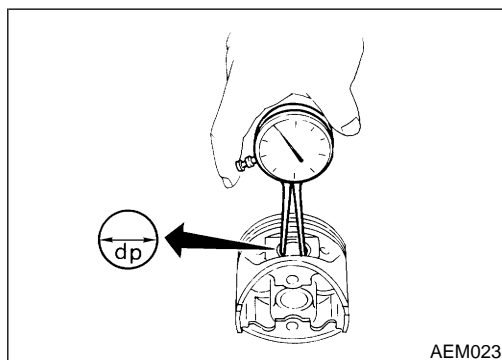
NGEM0067

NGEM0067S01

1. Measure inner diameter of piston pin hole "dp".

**Standard diameter "dp":**

**20.993 - 21.005 mm (0.8265 - 0.8270 in)**



2. Measure outer diameter of piston pin "Dp".

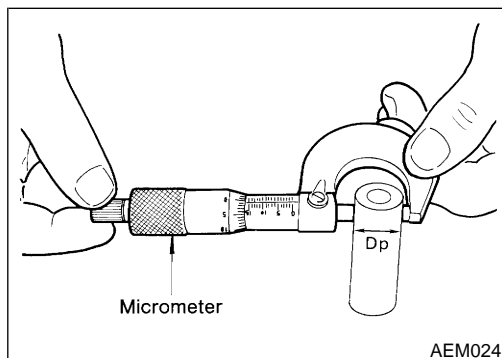
**Standard diameter "Dp":**

**20.989 - 21.001 mm (0.8263 - 0.8268 in)**

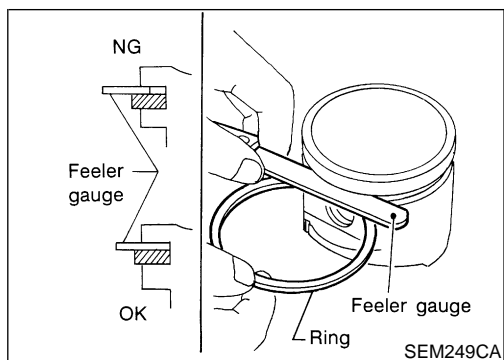
3. Calculate piston pin clearance.

**dp - Dp = -0.002 - 0.01 mm (-0.0001 - 0.0004 in)**

If it exceeds the above value, replace piston assembly with pin.



Inspection (Cont'd)



## PISTON RING SIDE CLEARANCE

NGEM0067S02

### Side clearance:

**Top ring 0.04 - 0.08 mm (0.0016 - 0.0031 in)**

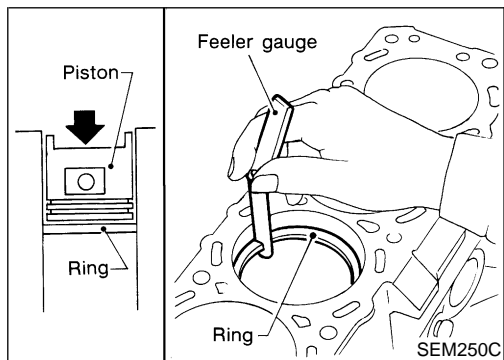
**2nd ring 0.03 - 0.07 mm (0.0012 - 0.0028 in)**

### Max. limit of side clearance:

**0.1 mm (0.004 in)**

If out of specification, replace piston ring.

If clearance exceeds maximum limit with new ring, replace piston.



## PISTON RING END GAP

NGEM0067S03

### End gap:

#### Top ring

**0.28 - 0.52 mm (0.0110 - 0.0205 in)**

#### 2nd ring

**0.45 - 0.69 mm (0.0177 - 0.0272 in)**

**(R or T is punched on the ring.)**

**0.55 - 0.70 mm (0.0217 - 0.0276 in)**

**(N is punched on the ring.)**

#### Oil ring

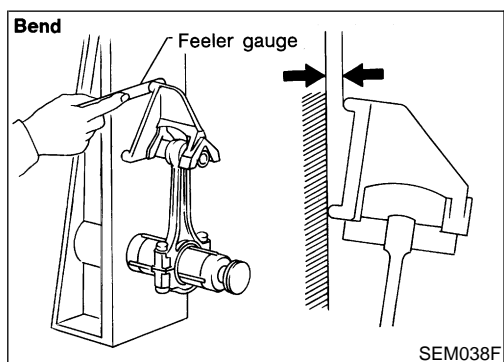
**0.20 - 0.69 mm (0.0079 - 0.0272 in)**

### Max. limit of ring gap:

**Refer to SDS, EM-62.**

If out of specification, replace piston ring. If gap exceeds maximum limit with a new ring, rebore cylinder and use oversized piston and piston rings. Refer to SDS, EM-62.

- When replacing the piston, check cylinder block surface for scratches or seizure. If scratches or seizure are found, hone or replace the cylinder block.



## CONNECTING ROD BEND AND TORSION

NGEM0067S04

### Bend:

**Limit 0.15 mm (0.0059 in)**

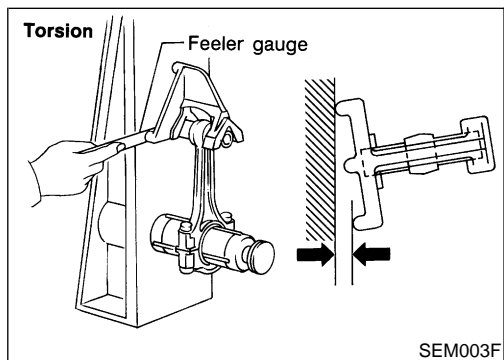
**per 100 mm (3.94 in) length**

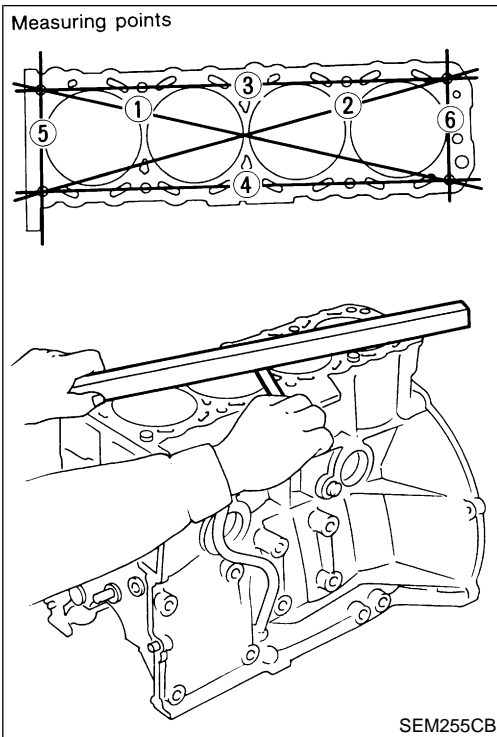
### Torsion:

**Limit 0.30 mm (0.0118 in)**

**per 100 mm (3.94 in) length**

If it exceeds the limit, replace connecting rod assembly.





## CYLINDER BLOCK DISTORTION AND WEAR

NGEM0067S05

1. Clean upper face of cylinder block.  
Use a reliable straightedge and feeler gauge to check the flatness of cylinder block surface. Check along six positions shown in figure.

**Limit:**

**0.1 mm (0.004 in)**

2. If out of specification, resurface it.  
The limit for cylinder block resurfacing is determined by cylinder head resurfacing.

**Amount of cylinder head resurfacing is "A"**

**Amount of cylinder block resurfacing is "B"**

**The maximum limit is as follows:**

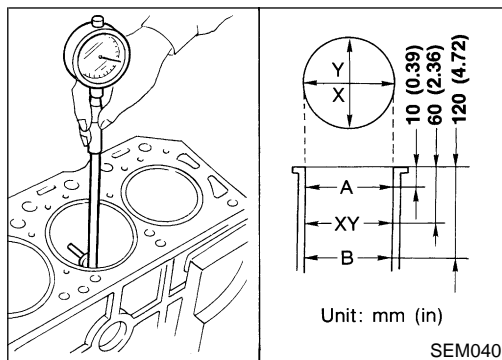
**$A + B = 0.2 \text{ mm (0.008 in)}$**

**Nominal cylinder block height**

**from crankshaft center:**

**246.95 - 247.05 mm (9.7224 - 9.7264 in)**

3. If necessary, replace cylinder block.



## PISTON-TO-BORE CLEARANCE

NGEM0067S06

1. Using a bore gauge, measure cylinder bore for wear, out-of-round and taper.

**Standard inner diameter:**

**Refer to SDS, EM-60.**

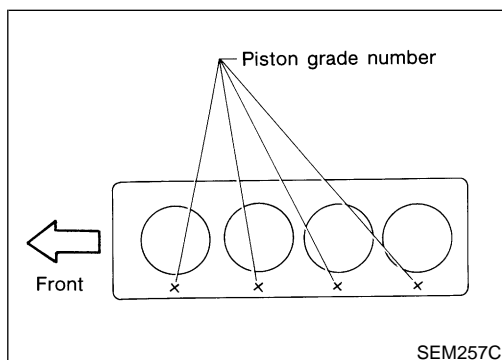
**Wear limit: 0.2 mm (0.008 in)**

**Out-of-round (X - Y) standard: 0.015 mm (0.0006 in)**

**Taper (A - B) standard: 0.010 mm (0.0004 in)**

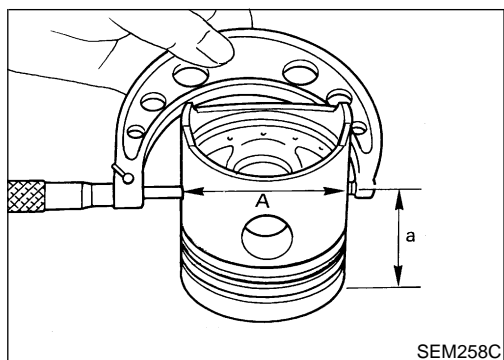
If it exceeds the limit, rebore all cylinders. Replace cylinder block if necessary.

2. Check for scratches and seizure. If seizure is found, hone it.



- If cylinder block and piston are replaced, match piston grade with grade number on cylinder block upper surface.

Inspection (Cont'd)



3. Measure piston skirt diameter.  
**Piston diameter "A":**  
Refer to SDS, EM-62.  
**Measuring point "a" (Distance from the top):**  
**Approximately 48 mm (1.89 in)**
4. Check that piston-to-bore clearance is within specification.  
**Piston-to-bore clearance "B":**  
**0.020 - 0.040 mm (0.0008 - 0.0016 in)**
5. Determine piston oversize according to amount of cylinder wear.

**Oversize pistons are available for service. Refer to SDS, EM-62.**

6. Cylinder bore size is determined by adding piston-to-bore clearance to piston diameter "A".

**Rebored size calculation:**

$$D = A + B - C$$

where,

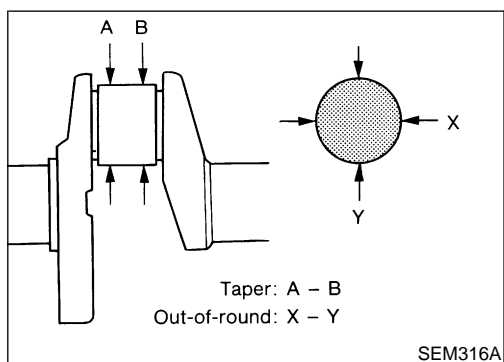
**D: Bored diameter**

**A: Piston diameter as measured**

**B: Piston-to-bore clearance**

**C: Honing allowance 0.02 mm (0.0008 in)**

7. Install main bearing caps and tighten bolts to the specified torque. This will prevent distortion of cylinder bores.
8. Cut cylinder bores.
  - **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.**
9. Hone cylinders to obtain specified piston-to-bore clearance.
10. Measure finished cylinder bore for out-of-round and taper.
  - **Measurement should be done after cylinder bore cools down.**



## CRANKSHAFT

NGEM0067S07

1. Check crankshaft main and pin journals for score, wear or cracks.
2. With a micrometer, measure journals for taper and out-of-round.

**Out-of-round (X - Y):**

**Main journal Less than 0.01 mm (0.0004 in)**

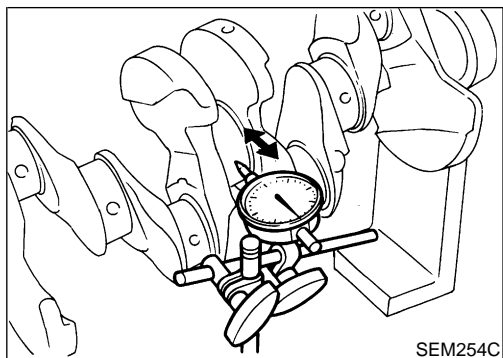
**Crank pin Less than 0.005 mm (0.0002 in)**

**Taper (A - B):**

**Main journal Less than 0.01 mm (0.0004 in)**

**Crank pin Less than 0.005 mm (0.0002 in)**





SEM254C

3. Measure crankshaft runout.

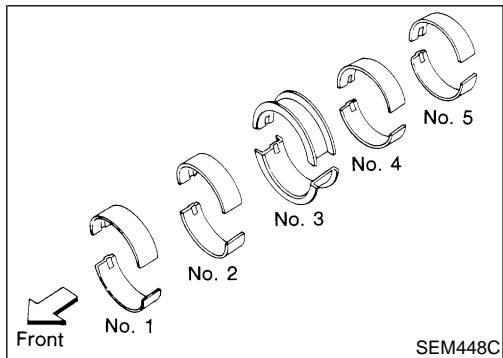
**Runout (Total indicator reading):**  
**Less than 0.10 mm (0.0039 in)**

GI

MA

**EM**

LC



SEM448C

## BEARING CLEARANCE

NGEM0067S08

- Use Method A or Method B. Method A is preferred because it is more accurate.

EC

### Method A (Using bore gauge and micrometer)

#### Main bearing

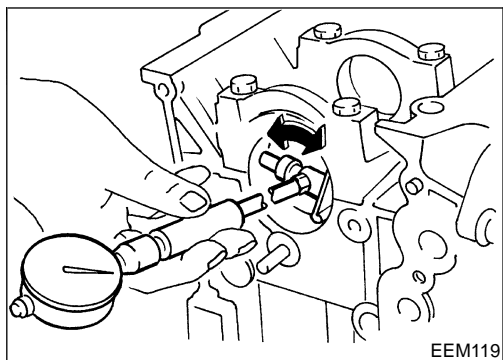
NGEM0067S0801

1. Set main bearings in their proper positions on cylinder block and main bearing cap.

FE

CL

MT



EEM119

2. Install main bearing cap to cylinder block.

- **Tighten all bolts in correct order in two or three stages. Refer to EM-44 and EM-53.**

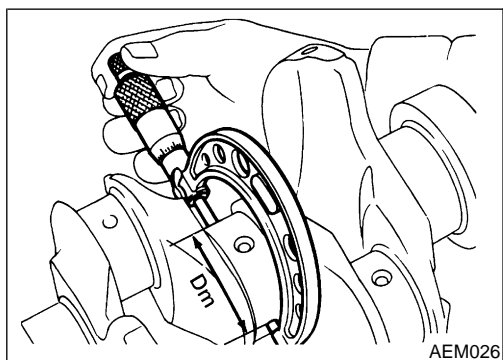
AT

3. Measure inner diameter "A" of each main bearing.

TF

PD

AX



AEM026

4. Measure outer diameter "Dm" of each crankshaft main journal.

SU

5. Calculate main bearing clearance.  
 Main bearing clearance = A - Dm

#### Standard:

**0.020 - 0.047 mm (0.0008 - 0.0019 in)**

BR

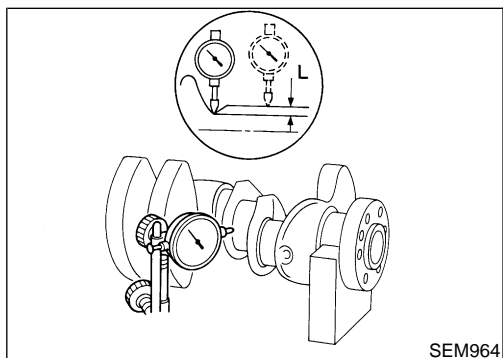
#### Limit:

**0.1 mm (0.004 in)**

ST

6. If it exceeds the limit, replace bearing.
7. If clearance cannot be adjusted within the standard of any bearing, grind crankshaft journal and use undersized bearing.

RS



SEM964

- a. **When grinding crankshaft journal, confirm that "L" dimension in fillet roll is more than the specified limit.**

BT

**"L": 0.1 mm (0.004 in)**

HA

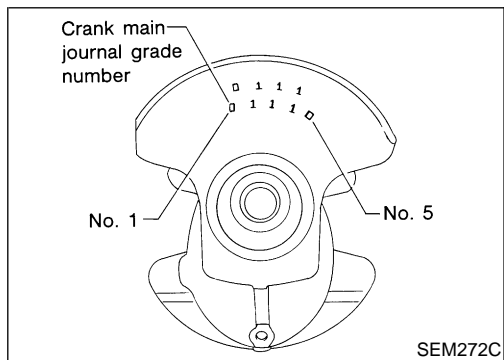
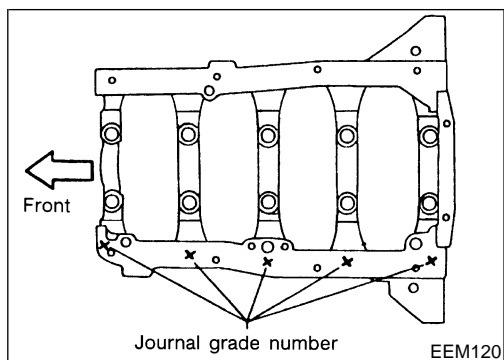
- b. Refer to SDS EM-63 & EM-64 for grinding crankshaft and available service parts.

SC

EL

IDX

Inspection (Cont'd)



8. If crankshaft is reused, measure main bearing clearance and select thickness of main bearing.  
If crankshaft or cylinder block is replaced, select thickness of main bearings as follows:

a. Grade number of each cylinder block main journal is punched on the respective cylinder block. These numbers are punched in either Arabic or Roman numerals.

b. Grade number of each crankshaft main journal is punched on crankshaft. These numbers are punched in either Arabic or Roman numerals.

c. Select main bearing with suitable thickness according to the following example or table.

For example:

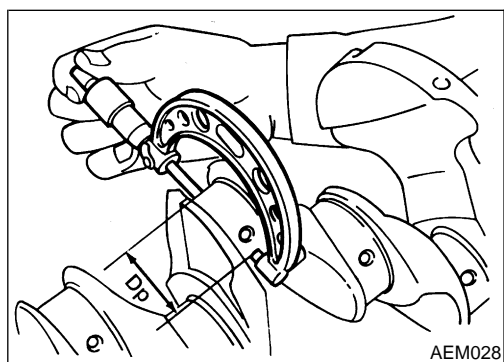
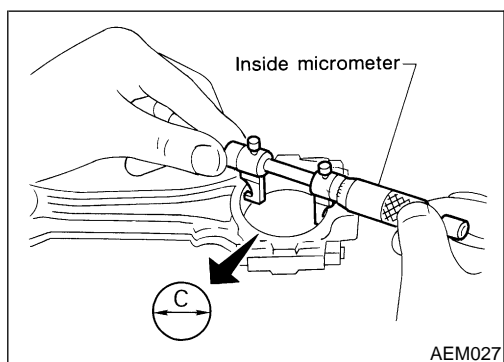
Main journal grade number: 1

Crankshaft journal grade number: 2

Main bearing grade number = 1 + 2 = 3 (Yellow)

**Main bearing grade number and identification color:**

		Main journal grade number		
		0	1	2
Crankshaft journal grade number	0	0 (Black)	1 (Brown)	2 (Green)
	1 or I	1 (Brown)	2 (Green)	3 (Yellow)
	2 or II	2 (Green)	3 (Yellow)	4 (Blue)



## Connecting Rod Bearing (Big end)

NGEM0067S0802

1. Install connecting rod bearing to connecting rod and cap.
2. Install connecting rod cap to connecting rod.
- **Tighten bolts to the specified torque.**
3. Measure inner diameter "C" of each bearing.

4. Measure outer diameter "Dp" of each crankshaft pin journal.
5. Calculate connecting rod bearing clearance.

**Connecting rod bearing clearance = C - Dp:**

**Standard**

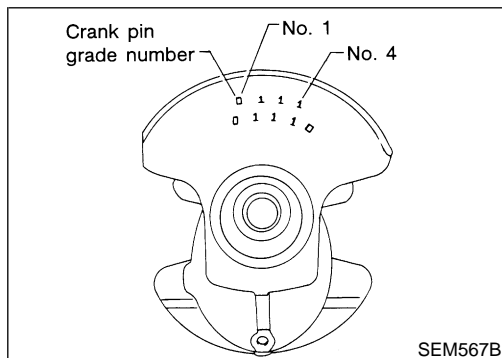
**0.010 - 0.035 mm (0.0004 - 0.0014 in)**

**Limit**

**0.09 mm (0.0035 in)**

6. If it exceeds the limit, replace bearing.
7. If clearance cannot be adjusted within the standard of any bearing, grind crankshaft journal and use undersized bearing.

Refer to step 5 of "BEARING CLEARANCE", EM-49.

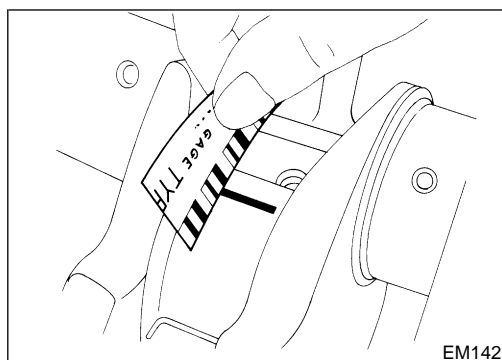


8. If crankshaft is replaced, select connecting rod bearing according to the following table.

### Connecting rod bearing grade number:

These numbers are punched in either Arabic or Roman numerals.

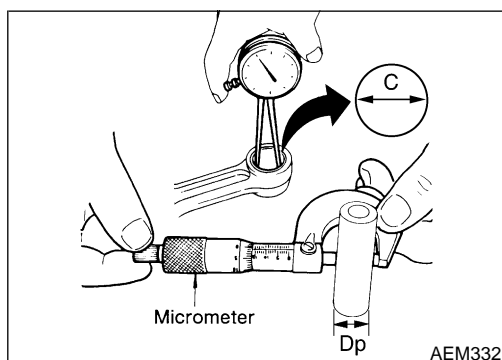
Crank pin grade number	Connecting rod bearing grade number
0	0
1 or I	1
2 or II	2



### Method B (Using plastigage)

#### CAUTION:

- Do not turn crankshaft or connecting rod while plastigage is being inserted.
- When bearing clearance exceeds the specified limit, ensure that the proper bearing has been installed. Then if excessive bearing clearance exists, use a thicker main bearing or undersized bearing so that the specified bearing clearance is obtained.



### CONNECTING ROD BUSHING CLEARANCE (SMALL END)

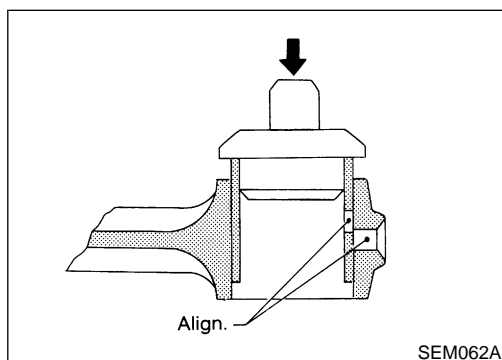
NGEM0067S09

- Measure inner diameter "C" of bushing.
- Measure outer diameter "Dp" of piston pin.
- Calculate connecting rod bushing clearance.

$$C - Dp =$$

**0.005 - 0.017 mm (0.0002 - 0.0007 in) (Standard)**  
**0.023 mm (0.0009 in) (Limit)**

If out of specification, replace connecting rod assembly and/or piston set with pin.



### REPLACEMENT OF CONNECTING ROD BUSHING (SMALL END)

NGEM0067S10

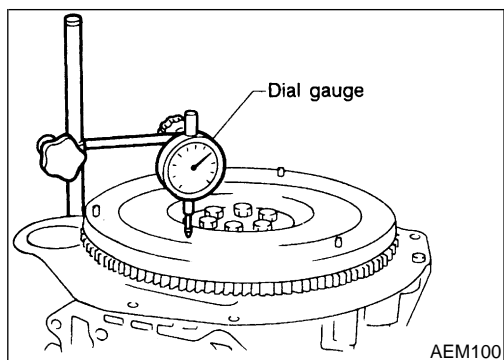
- Drive in small end bushing until it is flush with end surface of rod.

#### Be sure to align the oil holes.

- Ream the bushing until clearance with piston pin is within specification.

#### Clearance between connecting rod bushing and piston pin:

**0.005 - 0.017 mm (0.0002 - 0.0007 in)**



## FLYWHEEL/DRIVE PLATE RUNOUT

NGEM0067S11

Runout (Total indicator reading):

Flywheel (M/T model)

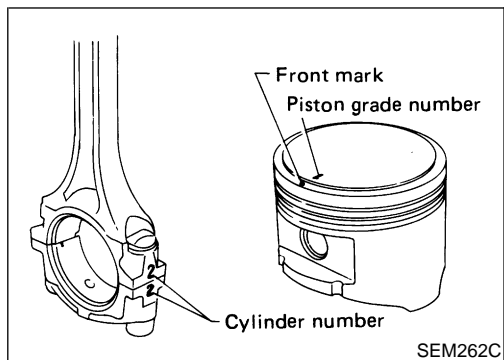
Less than 0.15 mm (0.006 in)

Drive plate (A/T model)

Less than 0.15 mm (0.006 in)

### CAUTION:

- Be careful not to damage the ring gear teeth.
- Check the drive plate for deformation and cracks.
- Do not allow any magnetic materials to contact the ring gear teeth.
- Do not resurface the flywheel. Replace as necessary.



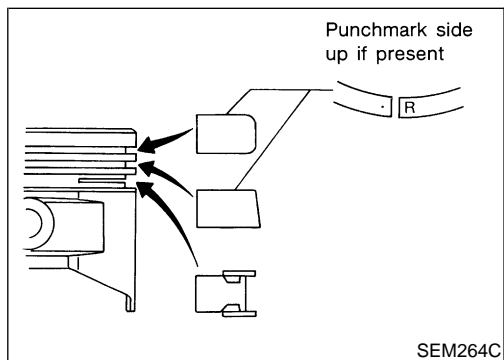
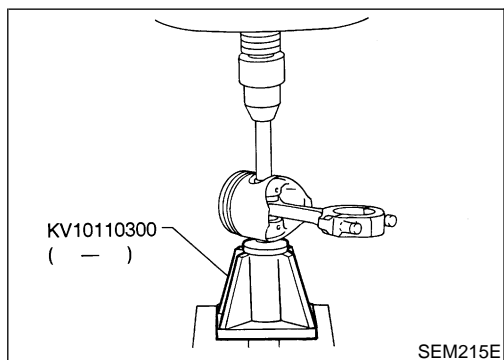
## Assembly

NGEM0068

### PISTON

NGEM0068S01

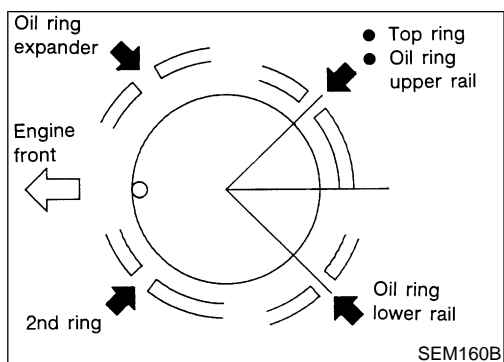
1. Heat piston to 60 to 70°C (140 to 158°F) and assemble piston, piston pin and connecting rod.
  - Align the direction of piston and connecting rod.
  - Numbers stamped on connecting rod and cap correspond to each cylinder.
  - After assembly, make sure connecting rod swings smoothly.



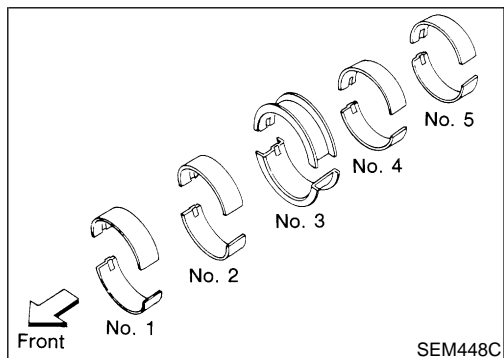
2. Set piston rings as shown.

### CAUTION:

- When piston rings are not replaced, make sure that piston rings are mounted in their original positions.
- When piston rings are being replaced and no punchmark is present, piston rings can be mounted with either side up.



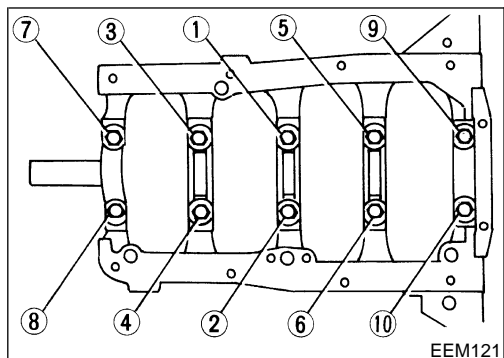
- Align piston rings so that end gaps are positioned as shown.



## CRANKSHAFT

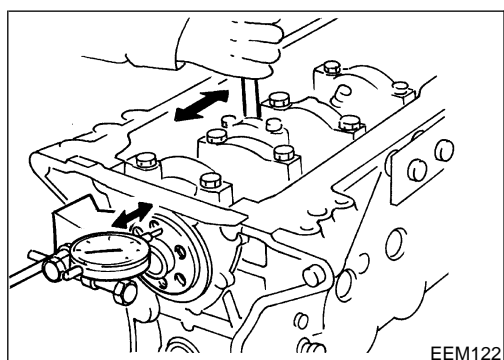
NGEM0068S02

- Set main bearings in their proper positions on cylinder block and main bearing caps.
  - Confirm that correct main bearings are used. Refer to EM-49.
  - Apply new engine oil to bearing surfaces.



- Install crankshaft and main bearing caps and tighten bolts to the specified torque. Refer to EM-44.

- Apply new engine oil to the bolt threads and seat surface.
- Prior to tightening bearing cap bolts, place bearing cap in its proper position by shifting crankshaft in the axial direction.
- Tighten bearing cap bolts gradually in two or three stages. Start with center bearing and move outward as shown in figure.
- After securing bearing cap bolts, make sure crankshaft turns smoothly by hand.



- Measure crankshaft end play.

### Crankshaft end play:

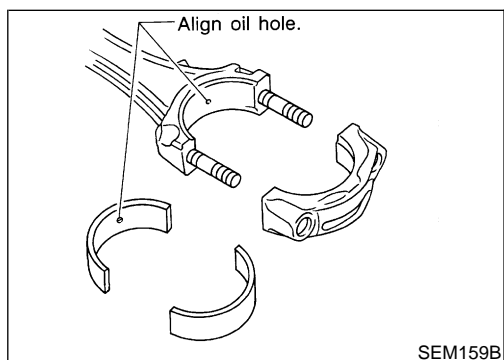
#### Standard

0.05 - 0.18 mm (0.0020 - 0.0071 in)

#### Limit

0.3 mm (0.012 in)

If beyond the limit, replace No. 3 bearing with a new one.



- Install connecting rod bearings in connecting rods and connecting rod caps.

- Confirm that correct bearings are used. Refer to EM-50.
- Install bearings so that oil hole in connecting rod aligns with oil hole of bearing.
- Apply new engine oil to bearing surfaces, bolt threads and seating surfaces.

GI

MA

EM

LC

EC

FE

CL

MT

AT

TF

PD

AX

SU

BR

ST

RS

BT

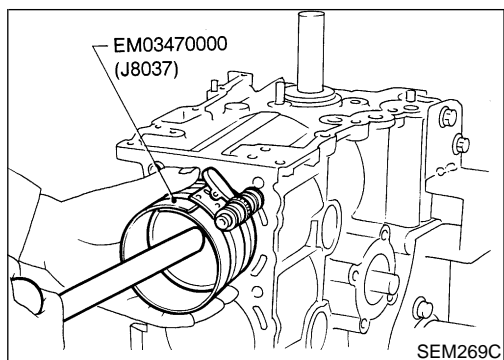
HA

SC

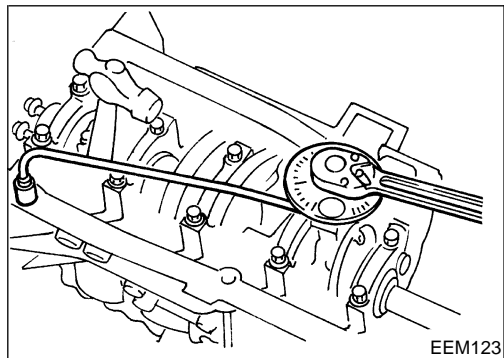
EL

IDX

Assembly (Cont'd)



5. Install pistons with connecting rods.
  - a. Install them into corresponding cylinders with Tool.
    - Arrange so that front mark on piston head faces toward front of engine.
    - Make sure connecting rod does not scratch cylinder wall.
    - Make sure connecting rod bolts do not scratch crankshaft journals.
    - Apply new engine oil to piston rings and sliding surface of piston.



- b. Install connecting rod bearing caps. Tighten connecting rod bearing cap nuts using the following procedure.

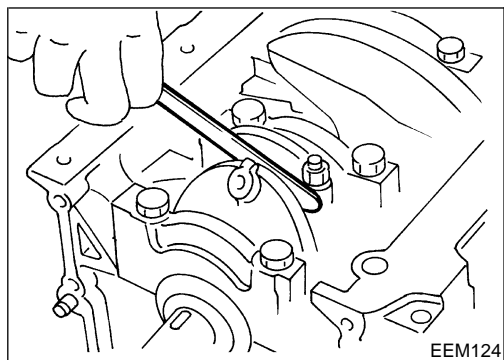
**Connecting rod bearing nut:**

(1) Tighten to 14 - 16 N·m

(1.4 - 1.6 kg-m, 10 - 12 ft-lb).

(2) Tighten bolts  $60^{+5}/_{-0}$  degrees clockwise with an angle wrench.

If an angle wrench is not available, tighten them to 38 - 44 N·m (3.9 - 4.5 kg-m, 28 - 33 ft-lb).



6. Measure connecting rod side clearance.

**Connecting rod side clearance:**

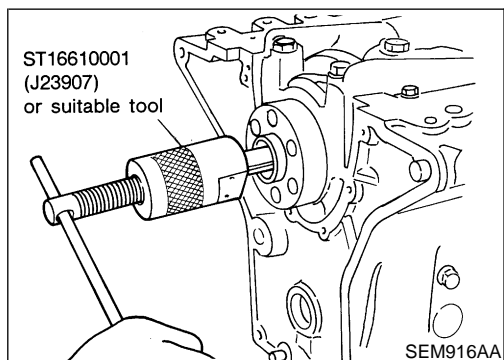
**Standard**

0.2 - 0.4 mm (0.008 - 0.016 in)

**Limit**

0.6 mm (0.024 in)

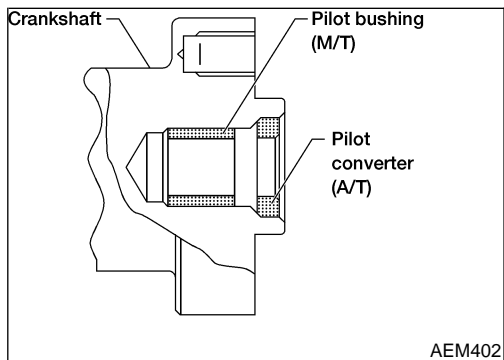
If beyond the limit, replace connecting rod and/or crankshaft.



## REPLACING PILOT BUSHING

NGEM0068S03

1. Remove pilot bushing (M/T) or pilot converter (A/T).



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

**General Specifications**

NGEM0069

Cylinder arrangement		In-line 4
Displacement		2,389 cm <sup>3</sup> (145.78 cu in)
Bore and stroke		89 x 96 mm (3.50 x 3.78 in)
Valve arrangement		DOHC
Firing order		1-3-4-2
Number of piston rings	Compression	2
	Oil	1
Number of main bearings		5
Compression ratio		9.2

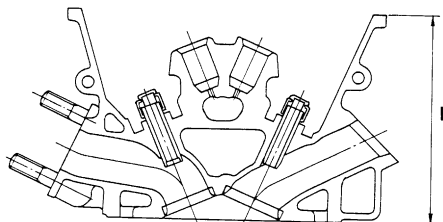
**COMPRESSION PRESSURE**

Unit: kPa (kg/cm<sup>2</sup>, psi)/300 rpm NGEM0069S01

Standard	1,226 (12.5, 178)
Minimum	1,030 (10.5, 149)
Differential limit between cylinders	98 (1.0, 14)

**Cylinder Head**

Unit: mm (in) NGEM0070

 <p>Nominal cylinder head height: H = 126.3 - 126.5 (4.972 - 4.980)</p> <p>SEM519E</p>		Standard	Limit
	Head surface distortion	Less than 0.03 (0.0012)	0.1 (0.004)

GI

MA

**EM**

LC

EC

FE

CL

MT

AT

TF

PD

AX

SU

BR

ST

RS

BT

HA

SC

EL

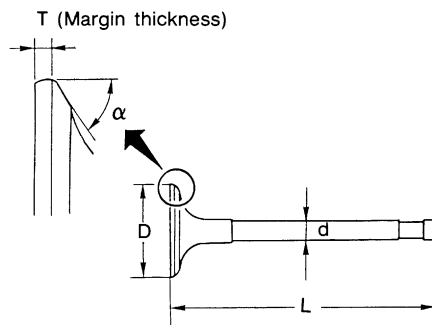
IDX

Valve

NGEM0071

VALVE

NGEM0071S01  
Unit: mm (in)



SEM188

Valve head diameter "D"	Intake	36.5 - 36.7 (1.437 - 1.445)
	Exhaust	31.2 - 31.4 (1.228 - 1.236)
Valve length "L"	Intake	101.17 - 101.47 (3.9831 - 3.9949)
	Exhaust	98.67 - 98.97 (3.8846 - 3.8964)
Valve stem diameter "d"	Intake	6.965 - 6.980 (0.2742 - 0.2748)
	Exhaust	6.945 - 6.960 (0.2734 - 0.2740)
Valve seat angle "α"	Intake & Exhaust	45°15' - 45°45'
Valve margin "T"	Intake	0.95 - 1.25 (0.0374 - 0.0492)
	Exhaust	1.15 - 1.45 (0.0453 - 0.0571)
Valve margin "T" limit		More than 0.5 (0.020)
Valve stem end surface grinding limit		Less than 0.2 (0.008)

VALVE SPRING

NGEM0071S02

Free height mm (in)		50.3 (1.9831)
Pressure N (kg, lb) at height mm (in)	Standard	418.0 (42.6, 93.9) at 29.17 (1.1484)
	Limit	393.0 (40.1, 88.4) at 29.17 (1.1484)
Out-of-square mm (in)		Less than 2.2 (0.087)

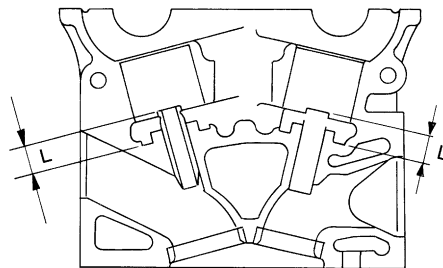


# SERVICE DATA AND SPECIFICATIONS (SDS)

**KA24DE**  
Valve (Cont'd)

## VALVE GUIDE

NGEM0071S03  
Unit: mm (in)



SEM301D

		Standard	Service
Valve guide Outer diameter	Intake	11.023 - 11.034 (0.4340 - 0.4344)	11.223 - 11.234 (0.4418 - 0.4423)
	Exhaust	11.023 - 11.034 (0.4340 - 0.4344)	11.223 - 11.234 (0.4418 - 0.4423)
Valve guide Inner diameter (Finished size)	Intake	7.000 - 7.018 (0.2756 - 0.2763)	
	Exhaust	7.000 - 7.018 (0.2756 - 0.2763)	
Cylinder head valve guide hole diameter	Intake	10.975 - 10.996 (0.4321 - 0.4329)	11.175 - 11.196 (0.4400 - 0.4408)
	Exhaust	10.975 - 10.996 (0.4321 - 0.4329)	11.175 - 11.196 (0.4400 - 0.4408)
Interference fit of valve guide		0.027 - 0.059 (0.0011 - 0.0023)	
		Standard	Limit
Stem to guide clearance	Intake	0.020 - 0.053 (0.0008 - 0.0021)	0.08 (0.0031)
	Exhaust	0.040 - 0.073 (0.0016 - 0.0029)	0.1 (0.004)
Valve deflection limit		0.2 (0.008)	
Projection length "L"		13.3 - 13.9 (0.524 - 0.547)	

## VALVE LIFTER

NGEM0071S04  
Unit: mm (in)

Valve lifter outer diameter	33.960 - 33.975 (1.3370 - 1.3376)
Lifter guide inner diameter	34.000 - 34.021 (1.3386 - 1.3394)
Clearance between lifter and filter guide	0.025 - 0.061 (0.0010 - 0.0024)

## VALVE CLEARANCE ADJUSTMENT

NGEM0071S05  
Unit: mm (in)

Valve clearance (Hot)	Intake	0.31 - 0.39 (0.012 - 0.015)
	Exhaust	0.33 - 0.41 (0.013 - 0.016)

# SERVICE DATA AND SPECIFICATIONS (SDS)

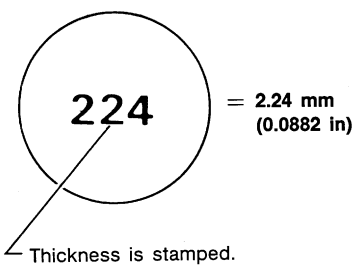
**KA24DE**

Valve (Cont'd)

## AVAILABLE SHIMS

NGEM0071S06

Thickness mm (in)	Identification mark	Thickness mm (in)	Identification mark
1.96 (0.0772)	196	1.98 (0.0780)	198
2.00 (0.0787)	200	2.02 (0.0795)	202
2.04 (0.0803)	204	2.06 (0.0811)	206
2.08 (0.819)	208	2.10 (0.0827)	210
2.12 (0.0835)	212	2.14 (0.0843)	214
2.16 (0.0850)	216	2.18 (0.0858)	218
2.20 (0.0866)	220	2.22 (0.0874)	222
2.24 (0.0882)	224	2.26 (0.0890)	226
2.28 (0.0898)	228	2.30 (0.0906)	230
2.32 (0.0913)	232	2.34 (0.0921)	234
2.36 (0.0929)	236	2.38 (0.0937)	238
2.40 (0.0945)	240	2.42 (0.0953)	242
2.44 (0.0961)	244	2.46 (0.0969)	246
2.48 (0.0976)	248	2.50 (0.0984)	250
2.52 (0.0992)	252	2.54 (0.1000)	254
2.56 (0.1008)	256	2.58 (0.1016)	258
2.60 (0.1024)	260	2.62 (0.1031)	262
2.64 (0.1039)	264	2.66 (0.1047)	266
2.68 (0.1055)	268	—	—



SEM308D



# SERVICE DATA AND SPECIFICATIONS (SDS)

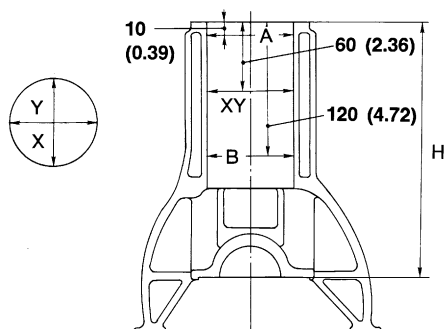
**KA24DE**

Valve (Cont'd)

Height (h <sub>2</sub> )	Intake	0.24 - 0.64 (0.0094 - 0.0252) 0.34 - 0.64 (0.0134 - 0.0252)
	Exhaust	0.43 - 0.73 (0.0169 - 0.0287)
Depth (L)	Intake	42.02 - 42.52
	Exhaust	42.03 - 42.53

## Cylinder Block

NGEM007Z  
Unit: mm (in)



SEM400E

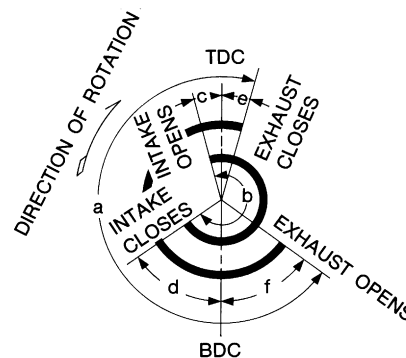
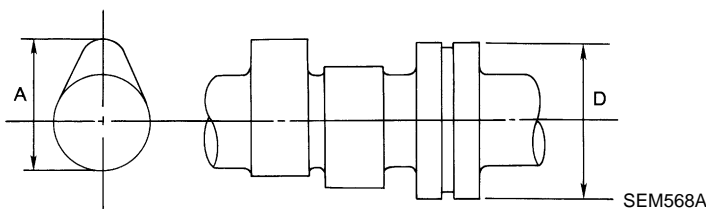
			Standard	Limit
Distortion			—	0.1 (0.004)
Cylinder bore	Inner diameter	Grade 1	89.000 - 89.010 (3.5039 - 3.5043)	0.2 (0.008)*
		Grade 2	89.010 - 89.020 (3.5043 - 3.5047)	
		Grade 3	89.020 - 89.030 (3.5047 - 3.5051)	
	Out-of-round (X - Y)		Less than 0.015 (0.0006)	—
Taper (A - B)		Less than 0.010 (0.0004)	—	
Difference in inner diameter between cylinders			Less than 0.03 (0.0012)	0.2 (0.008)
Piston-to-cylinder clearance			0.020 - 0.040 (0.0008 - 0.0016)	—
Cylinder block height (From crankshaft center)			246.95 - 247.05 (9.7224 - 9.7264)	0.2 (0.008)**

\* Wear limit

\*\* Total amount of cylinder head resurfacing and cylinder block resurfacing

Camshaft and Camshaft Bearing

Unit: mm (in) <sup>NGEM0073</sup>



		Standard	Limit
Cam height (A)	Intake	42.505 - 42.695 (1.673 - 1.681)	—
	Exhaust	40.905 - 41.095 (1.610 - 1.618)	—
Wear limit of cam height		—	0.2 (0.008)
Camshaft journal to bearing clearance		0.045 - 0.090 (0.0018 - 0.0035)	0.12 (0.0047)
Inner diameter of camshaft bearing	#1 to #5 journals	28.000 - 28.025 (1.1024 - 1.1033)	—
Outer diameter of camshaft journal (D)	#1 to #5 journals	27.935 - 27.955 (1.0998 - 1.1006)	—
Camshaft runout*		Less than 0.02 (0.0008)	0.04 (0.0016)
Camshaft end play		0.070 - 0.148 (0.0028 - 0.0058)	0.2 (0.008)
Valve timing (Degree on crankshaft)	a	216	—
	b	232	—
	c	-1	—
	d	53	—
	e	4	—
	f	32	—

\* Total indicator reading

GI

MA

EM

LC

EC

FE

CL

MT

AT

TF

PD

AX

SU

BR

ST

RS

BT

HA

SC

EL

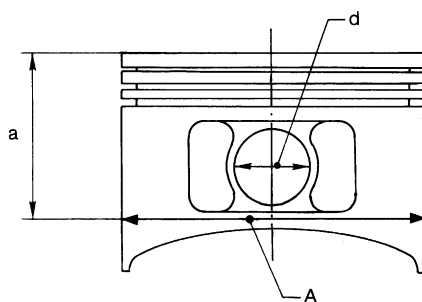
IDX

Piston, Piston Ring and Piston pin

NGEM0074

PISTON

NGEM0074S01  
Unit: mm (in)



SEM804E

Piston skirt diameter (A)	Standard	Grade No. 1	88.970 - 88.980 (3.5027 - 3.5031)
		Grade No. 2	88.980 - 88.990 (3.5031 - 3.5035)
		Grade No. 3	88.990 - 89.000 (3.5035 - 3.5039)
	Service (Oversize)	0.5 (0.020)	89.470 - 89.500 (3.5224 - 3.5236)
		1.0 (0.039)	89.970 - 90.000 (3.5421 - 3.5433)
Dimension (a)		Approximately 48 (1.89)	
Piston pin hole diameter (d)		20.993 - 21.005 (0.8265 - 0.8270)	
Piston pin-to-cylinder bore clearance		0.020 - 0.040 (0.0008 - 0.0016)	

PISTON PIN

NGEM0074S02  
Unit: mm (in)

	Standard	Limit
Piston pin outer diameter	20.989 - 21.001 (0.8263 - 0.8268)	—
Interference fit of piston pin to piston pin hole	-0.002 to 0.01 (-0.0001 to 0.0004)	—
Piston pin to connecting rod bearing clearance	0.005 - 0.017 (0.0002 - 0.0007)	0.023 (0.0009)

PISTON RING

NGEM0074S03  
Unit: mm (in)

		Standard	Limit
Side clearance	Top	0.040 - 0.080 (0.0016 - 0.0031)	0.1 (0.004)
	2nd	0.030 - 0.070 (0.0012 - 0.0028)	0.1 (0.004)
Ring gap	Top	0.28 - 0.52 (0.0110 - 0.0205)	1.0 (0.039)
	2nd	0.45 - 0.69 (0.0177 - 0.0272)	1.0 (0.039)
	Oil (rail ring)	0.20 - 0.69 (0.0079 - 0.0272)	1.0 (0.039)

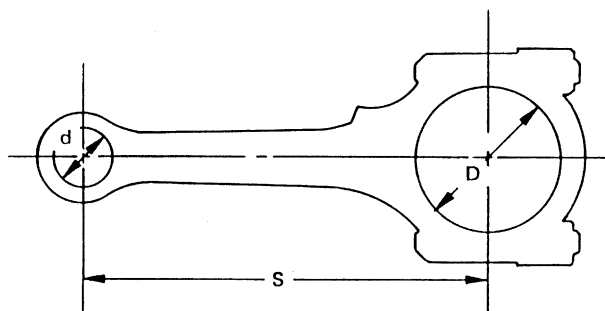
# SERVICE DATA AND SPECIFICATIONS (SDS)

**KA24DE**

Connecting Rod

## Connecting Rod

Unit: mm (in) NGEM0075



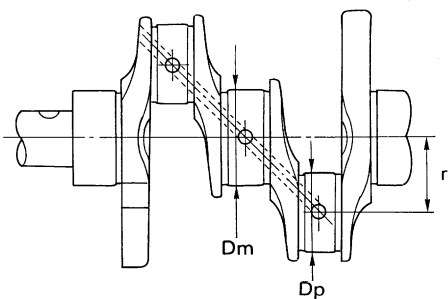
SEM570A

	Standard	Limit
Center distance (S)	164.95 - 165.05 (6.4941 - 6.4980)	—
Bend [per 100 mm (3.94 in)]	—	0.15 (0.0059)
Torsion [per 100 mm (3.94 in)]	—	0.30 (0.0118)
Connecting rod small end inner diameter (d)*	23.970 - 24.000 (0.9437 - 0.9449)	—
Piston pin bushing inner diameter	21.000 - 21.012 (0.8268 - 0.8272)	—
Connecting rod big end inner diameter (D)*	53.000 - 53.013 (2.0866 - 2.0871)	—
Side clearance	0.2 - 0.4 (0.008 - 0.016)	0.6 (0.024)

\* Without bearing

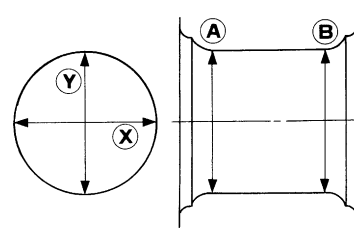
## Crankshaft

Unit: mm (in) NGEM0076



SEM394

Out-of-round  $\text{X} - \text{Y}$   
Taper  $\text{A} - \text{B}$



EM715

Main journal diameter (Dm)	Grade No. 0	59.967 - 59.975 (2.3609 - 2.3612)	
	Grade No. 1	59.959 - 59.967 (2.3606 - 2.3609)	
	Grade No. 2	59.951 - 59.959 (2.3603 - 2.3606)	
Pin journal diameter (Dp)	Grade No. 0	49.968 - 49.974 (1.9672 - 1.9675)	
	Grade No. 1	49.962 - 49.968 (1.9670 - 1.9672)	
	Grade No. 2	49.956 - 49.962 (1.9668 - 1.9670)	
Center distance (r)		47.95 - 48.05 (1.8878 - 1.8917)	
Taper of journal and pin [A - B]		Standard	Limit
	Journal	—	0.01 (0.0004)
	Pin	—	0.005 (0.0002)

# SERVICE DATA AND SPECIFICATIONS (SDS)

**KA24DE**

Crankshaft (Cont'd)

Out-of-round of journal and pin [X - Y]	Journal	—	0.01 (0.0004)
	Pin	—	0.005 (0.0002)
Runout [TIR]*		—	0.10 (0.0039)
Free end play		0.05 - 0.18 (0.0020 - 0.0071)	0.3 (0.012)
Fillet roil		More than 0.1 (0.004)	

\* Total indicator reading

## Bearing Clearance

NGEM0077  
Unit: mm (in)

	Standard	Limit
Main bearing clearance	0.020 - 0.047 (0.0008 - 0.0019)	0.1 (0.004)
Connecting rod bearing clearance	0.010 - 0.035 (0.0004 - 0.0014)	0.09 (0.0035)

## Available Main Bearing

NGEM0078

NGEM0078S01  
Unit: mm (in)

### STANDARD

Grade number	Thickness	Identification color
0	1.821 - 1.825 (0.0717 - 0.0719)	Black
1	1.825 - 1.829 (0.0719 - 0.0720)	Brown
2	1.829 - 1.833 (0.0720 - 0.0722)	Green
3	1.833 - 1.837 (0.0722 - 0.0723)	Yellow
4	1.837 - 1.841 (0.0723 - 0.0725)	Blue

### UNDERSIZE (SERVICE)

NGEM0078S02  
Unit: mm (in)

	Thickness	Main journal diameter "Dm"
0.25 (0.0098)	1.952 - 1.960 (0.0769 - 0.0772)	Grind so that bearing clearance is the specified value.

## Available Connecting Rod Bearing

NGEM0079

NGEM0079S01  
Unit: mm (in)

### STANDARD

Grade number	Thickness	Identification color
0	1.505 - 1.508 (0.0593 - 0.0594)	—
1	1.508 - 1.511 (0.0594 - 0.0595)	Brown
2	1.511 - 1.514 (0.0595 - 0.0596)	Green

### UNDERSIZE (SERVICE)

NGEM0079S02  
Unit: mm (in)

	Thickness	Crank pin journal diameter "Dp"
0.08 (0.0031)	1.540 - 1.548 (0.0606 - 0.0609)	Grind so that bearing clearance is the specified value.
0.12 (0.0047)	1.560 - 1.568 (0.0614 - 0.0617)	
0.25 (0.0098)	1.625 - 1.633 (0.0640 - 0.0643)	



# SERVICE DATA AND SPECIFICATIONS (SDS)

**KA24DE**

Miscellaneous Components

## Miscellaneous Components

Unit: mm (in) <sup>NGEM0080</sup>

Camshaft sprocket runout [TIR]*	Less than 0.15 (0.0059)
Flywheel runout [TIR]*	Less than 0.15 (0.006)
Drive plate runout [TIR]*	Less than 0.15 (0.006)

\* Total indicator reading

GI

MA

**EM**

LC

EC

FE

CL

MT

AT

TF

PD

AX

SU

BR

ST

RS

BT

HA

SC

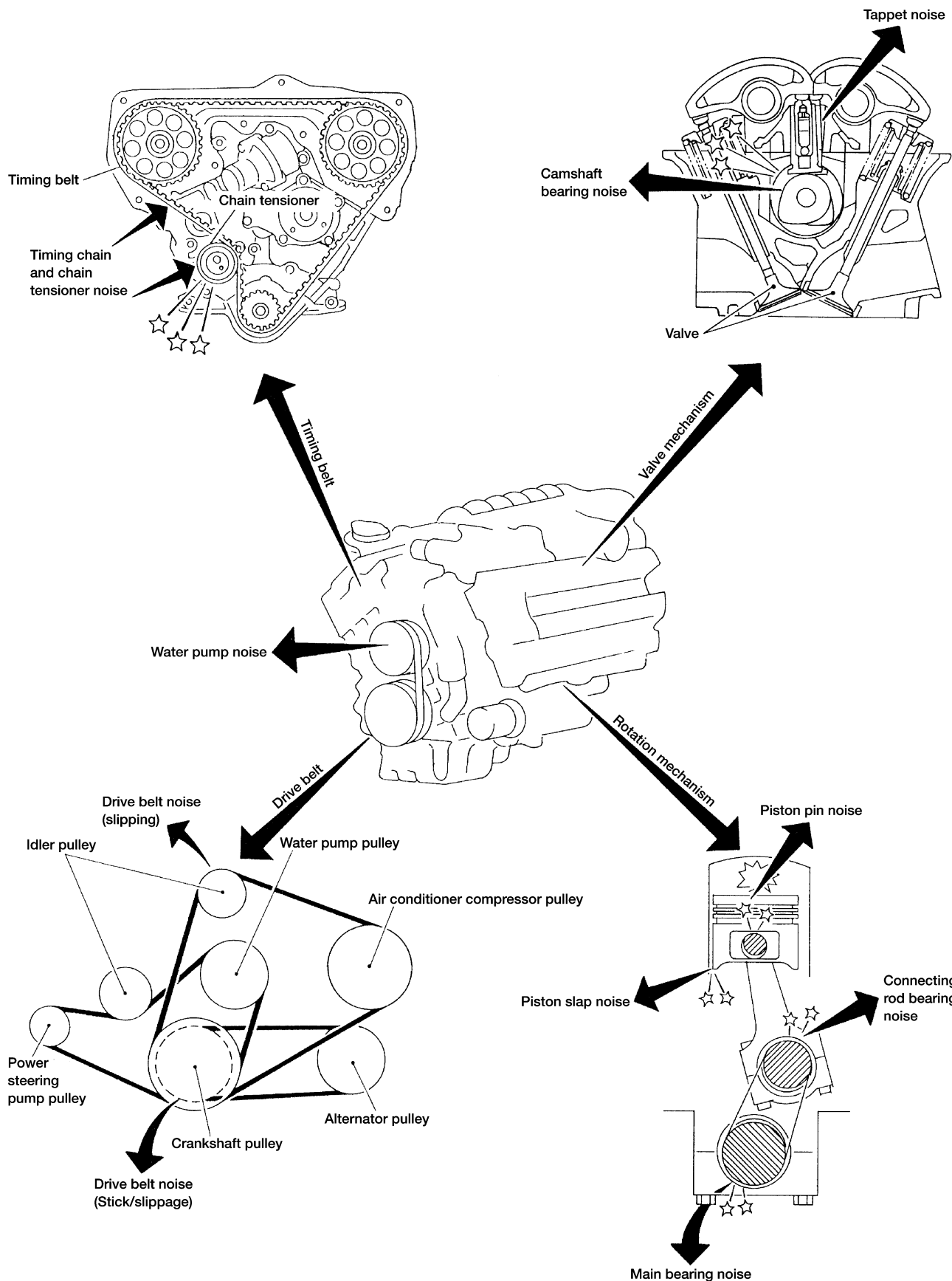
EL

IDX

# NOISE, VIBRATION AND HARSHNESS (NVH) TROUBLESHOOTING

NGEM0039

VG33E



AEM475

# NOISE, VIBRATION AND HARSHNESS (NVH) TROUBLESHOOTING

VG33E

NVH Troubleshooting Chart — Engine Noise

## NVH Troubleshooting Chart — Engine Noise

NGEM0039S01

Use the chart below to help you find the cause of the symptom.

1. Locate the area where noise occurs.
2. Confirm the type of noise.
3. Specify the operating condition of 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	—	Tapet noise	Hydraulic valve lifter	EM-95 *1
	Rattle	C	A	—	A	B	C	Camshaft bearing noise	Camshaft journal clearance Camshaft runout	EM-89, EM-88
Crank-shaft pulley Cylinder block (Side of engine) Oil pan	Slap or knock	—	A	—	B	B	—	Piston pin noise	Piston and piston pin clearance Connecting rod bushing clearance	EM-104, EM-110
	Slap or rap	A	—	—	B	B	A	Piston slap noise	Piston-to-bore clearance Piston ring side clearance Piston ring end gap Connecting rod bend and torsion	EM-106, EM-104, EM-104, EM-105
	Knock	A	B	C	B	B	B	Connect-ing rod bearing noise	Connecting rod bushing clearance (Small end) Connecting rod bearing clearance (Big end)	EM-110, EM-109
	Knock	A	B	—	A	B	C	Main bearing noise	Main bearing oil clearance Crankshaft runout	EM-108, EM-107
Timing belt cover	Whine or hissing	C	A	—	A	A	—	Timing belt noise (too tight)	Loose timing belt Belt contacting case	EM-75
	Clatter	A	B	—	C	A	—	Timing belt noise (too loose)		
Front of engine	Squeaking or fizzing	A	B	—	B	—	C	Other drive belts (Sticking or slipping)	Drive belts deflection	*2
	Creaking	A	B	A	B	A	B	Other drive belts (Slipping)	Idler pulley bearing operation	
	Squall Creak	A	B	—	B	A	B	Water pump noise	Water pump operation	*3

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

\*1: Step 19 in "Installation", "CYLINDER HEAD"

\*2: **MA-26**, ("Checking Drive Belts", "ENGINE MAINTENANCE")

\*3: **LC-29**, ("Water Pump Inspection", "ENGINE COOLING SYSTEM")

GI

MA

EM

LC

EC

FE

CL

MT

AT

TF

PD

AX

SU

BR

ST

RS

BT

HA

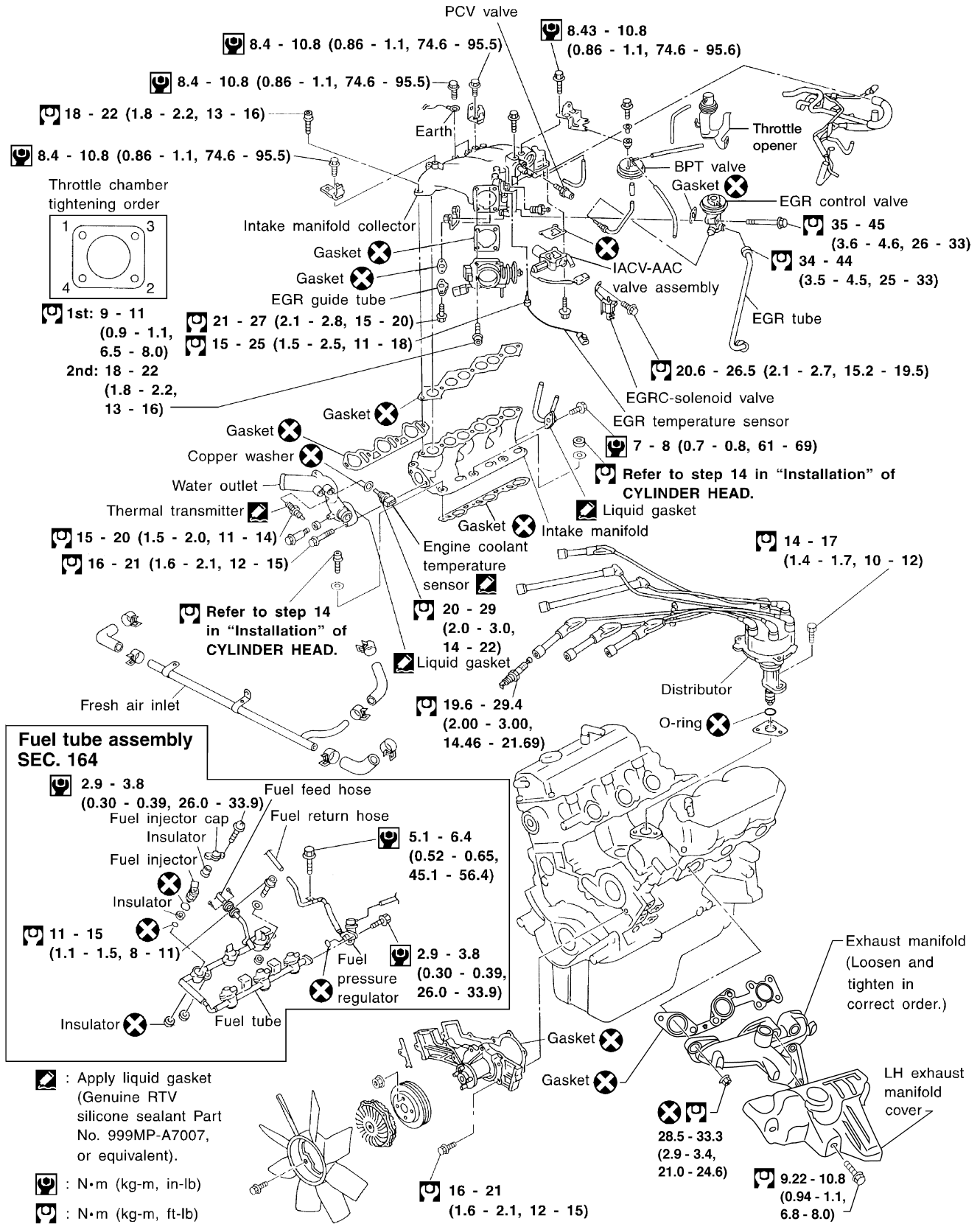
SC

EL

IDX

## Removal and Installation

NGEN0005

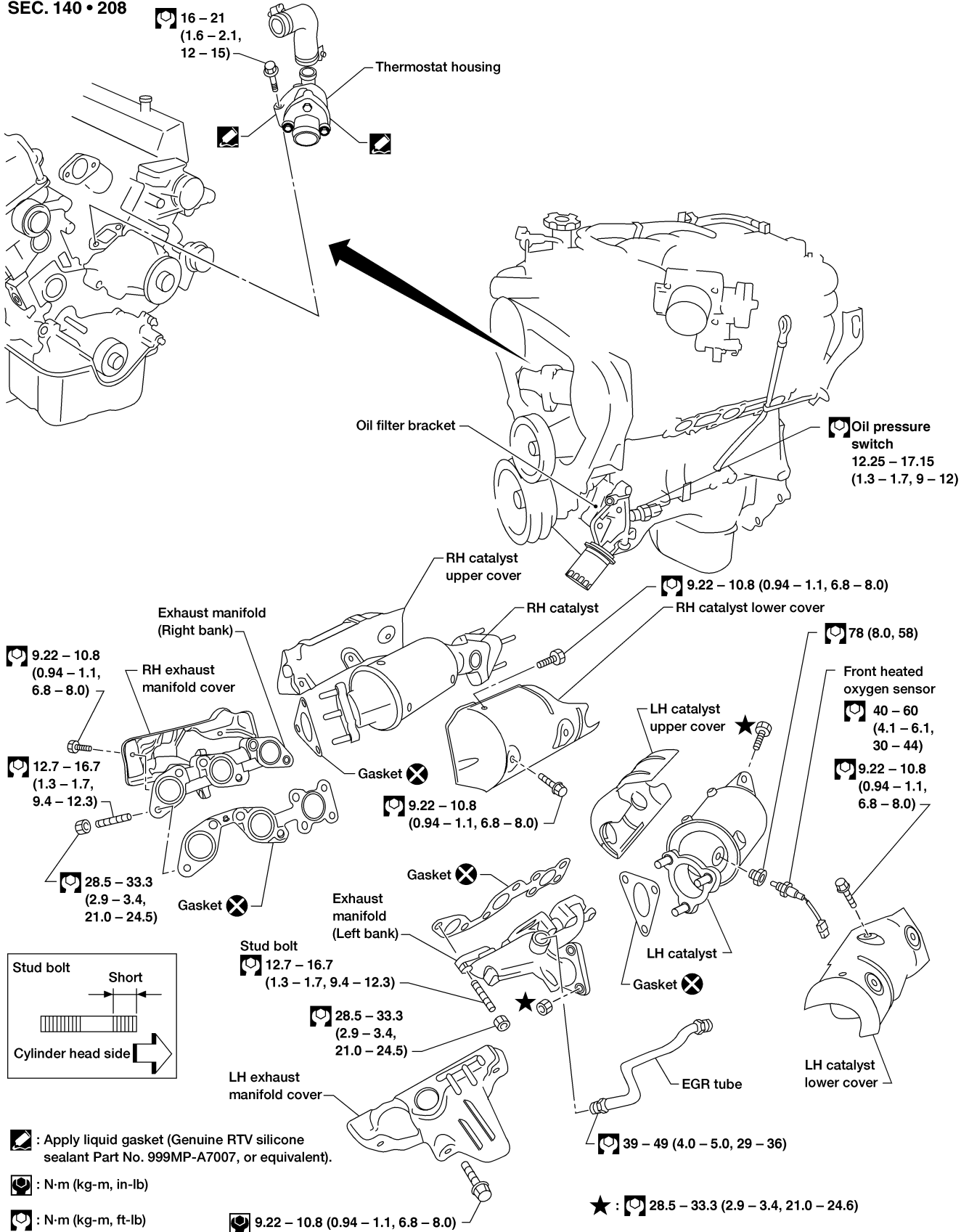
**SEC. 140•147•148•163•164•173•210•221**


# OUTER COMPONENT PARTS

**VG33E**

Removal and Installation (Cont'd)

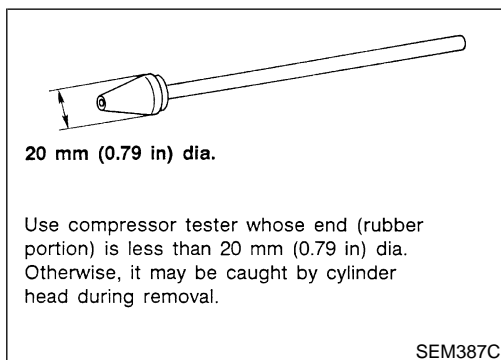
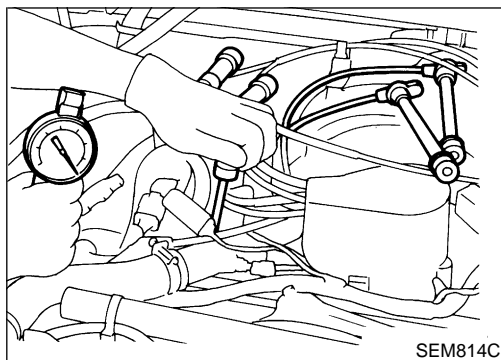
SEC. 140 • 208



GI  
MA  
EM  
LC  
EC  
FE  
CL  
MT  
AT  
TF  
PD  
AX  
SU  
BR  
ST  
RS  
BT  
HA  
SC  
EL  
IDX

AEM474

1. Warm up engine.
2. Turn ignition switch OFF.
3. Release fuel pressure.  
Refer to **EC-40**, "Releasing Fuel Pressure".
4. Remove all spark plugs.
  - **Clean area around plug with compressed air before removing the spark plugs.**
5. Disconnect camshaft position sensor harness connector at the distributor.
6. Remove fuel injector fuse **3** on FUSE BLOCK (J/B) behind the instrument lower panel.  
Refer to "FUSE BLOCK-Junction Box (J/B)".



7. Attach a compression tester to No. 1 cylinder.
8. Depress accelerator pedal fully to keep throttle valve wide open.
9. Crank engine and record highest gauge indication.
10. Repeat the measurement on each cylinder as shown above.
  - **Always use a fully-charged battery to obtain specified engine speed.**

**Compression pressure: kPa (kg/cm<sup>2</sup>, psi)/300 rpm**

**Standard**

**1,196 (12.2, 173)**

**Minimum**

**883 (9.0, 128)**

**Difference limit between cylinders**

**98 (1.0, 14)**

11. If cylinder compression in one or more cylinders is low, pour a small amount of engine oil into cylinders through spark plug holes and retest compression.
  - **If adding oil improves cylinder compression, piston rings may be worn or damaged. If so, replace piston rings after checking piston.**
  - **If pressure stays low, a valve may be sticking or seating improperly. Inspect and repair valve and valve seat. (Refer to SDS.) If valve or valve seat is damaged excessively, replace them.**
  - **If compression in any two adjacent cylinders is low and adding oil does not improve compression, there is leakage past the gasket surface. If so, replace cylinder head gasket.**
12. Reinstall spark plugs, fuel injector fuse, fuel pump fuse, and reconnect camshaft position sensor harness connector at the distributor.
13. Erase the DTC stored in the ECM.

**CAUTION:**

Always erase the DTC after checking compression.  
Refer to "HOW TO ERASE EMISSION-RELATED DIAGNOSTIC INFORMATION" in the EC section.

GI

MA

**EM**

LC

EC

FE

CL

MT

AT

TF

PD

AX

SU

BR

ST

RS

BT

HA

SC

EL

IDX

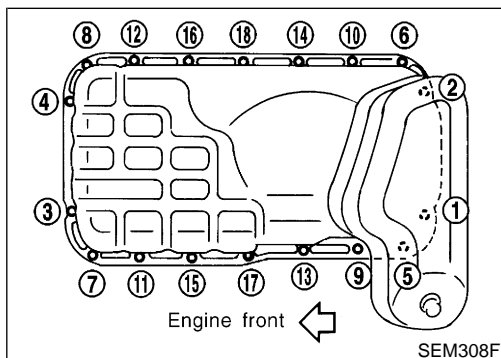
## Removal

### WARNING:

- Place vehicle on a flat and solid surface.
- Place chocks at front and rear of rear wheels.
- You should not remove oil pan until exhaust system and cooling system have completely cooled off. Otherwise, you may burn yourself and/or fire may break out in the fuel line.
- When removing front and/or rear engine mounting bolts or nuts, lift engine slightly to ensure safety.

### CAUTION:

- In lifting engine, be careful not to hit against adjacent parts, especially against accelerator wire casing end, brake tube and brake master cylinder.
  - For tightening torque, refer to *AT-261*, *MT-41* and *PD-7* sections.
1. Remove undercover.
  2. Drain engine oil.
  3. Remove stabilizer bracket bolts (RH & LH).
  4. Remove front propeller shaft from front differential carrier.
  5. Remove front drive shaft fixing bolts (RH & LH).
  6. Remove front differential carrier bleeder hose.
  7. Remove front suspension crossmember.
  8. Remove differential front mounting bolts (RH & LH) and rear mounting bolts.
  9. Remove front differential carrier.
  10. Remove front differential carrier mounting bracket.
  11. Remove starter motor.
  12. Remove transmission to rear engine mounting bracket nuts (RH & LH).
  13. Remove engine mounting bolts or nuts (RH & LH).
  14. Remove power steering mounting brackets (RH & LH).
  15. Lift up engine. If necessary, disconnect exhaust tube.
  16. Remove relay rod. It is not necessary to disconnect pitman arm.



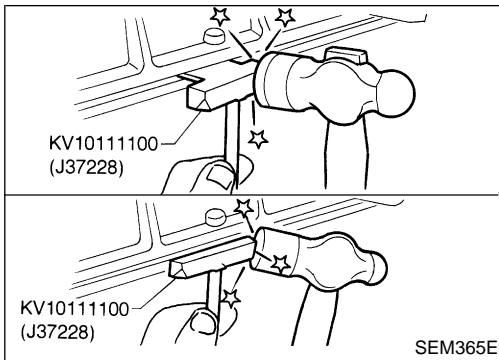
17. Remove oil pan bolts in numerical order.



# OIL PAN

VG33E

Removal (Cont'd)

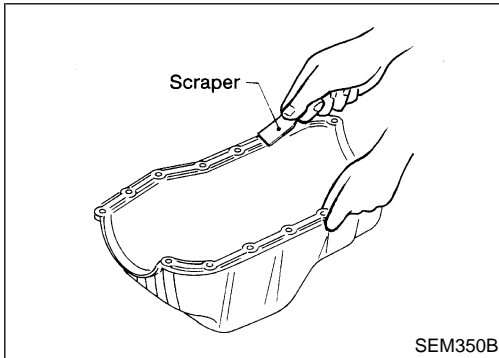


## 18. Remove oil pan.

a. Insert Tool between cylinder block and oil pan.

- Do not drive seal cutter into oil pump or rear oil seal retainer portion, or aluminum mating face will be damaged.
- Do not insert screwdriver, or oil pan flange will be deformed.

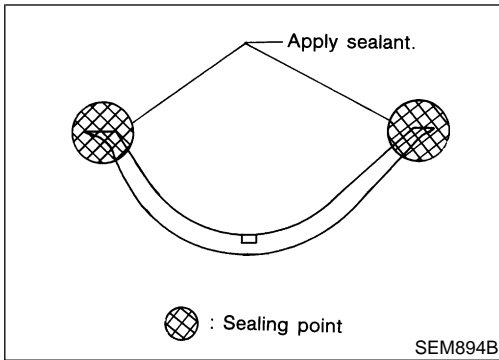
b. Slide Tool by tapping its side with a hammer, and remove oil pan.



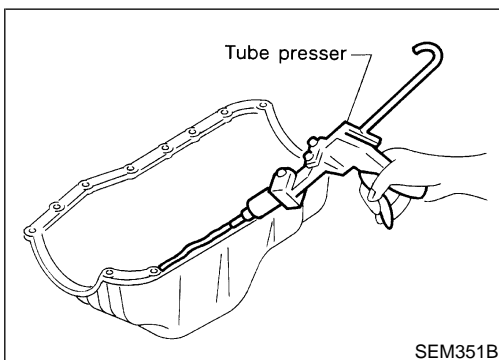
## Installation

1. Before installing oil pan, remove all traces of liquid gasket from mating surface using a scraper. NGEM0008

- Also remove traces of liquid gasket from mating surface of cylinder block.



2. Apply sealant to oil pump gasket and rear oil seal retainer gasket.



3. Apply a continuous bead of liquid gasket to mating surface of oil pan.

- Use Genuine RTV silicone sealant Part No. 999MP-A7007 or equivalent.

GI

MA

EM

LC

EC

FE

CL

MT

AT

TF

PD

AX

SU

BR

ST

RS

BT

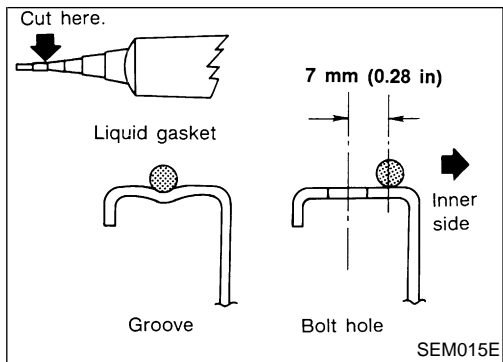
HA

SC

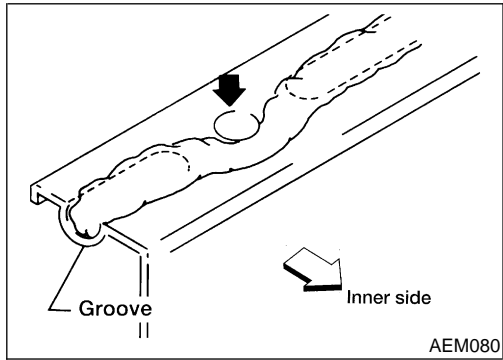
EL

IDX

## Installation (Cont'd)



- Be sure liquid gasket is 3.5 to 4.5 mm (0.138 to 0.177 in) wide.
- 4. Apply liquid gasket to inner sealing surface as shown in figure.
- **Attaching should be done within 5 minutes after coating.**
- 5. Install oil pan.
- **Install bolts/nuts in their reverse order of removal.**
- **Wait at least 30 minutes before refilling engine oil.**



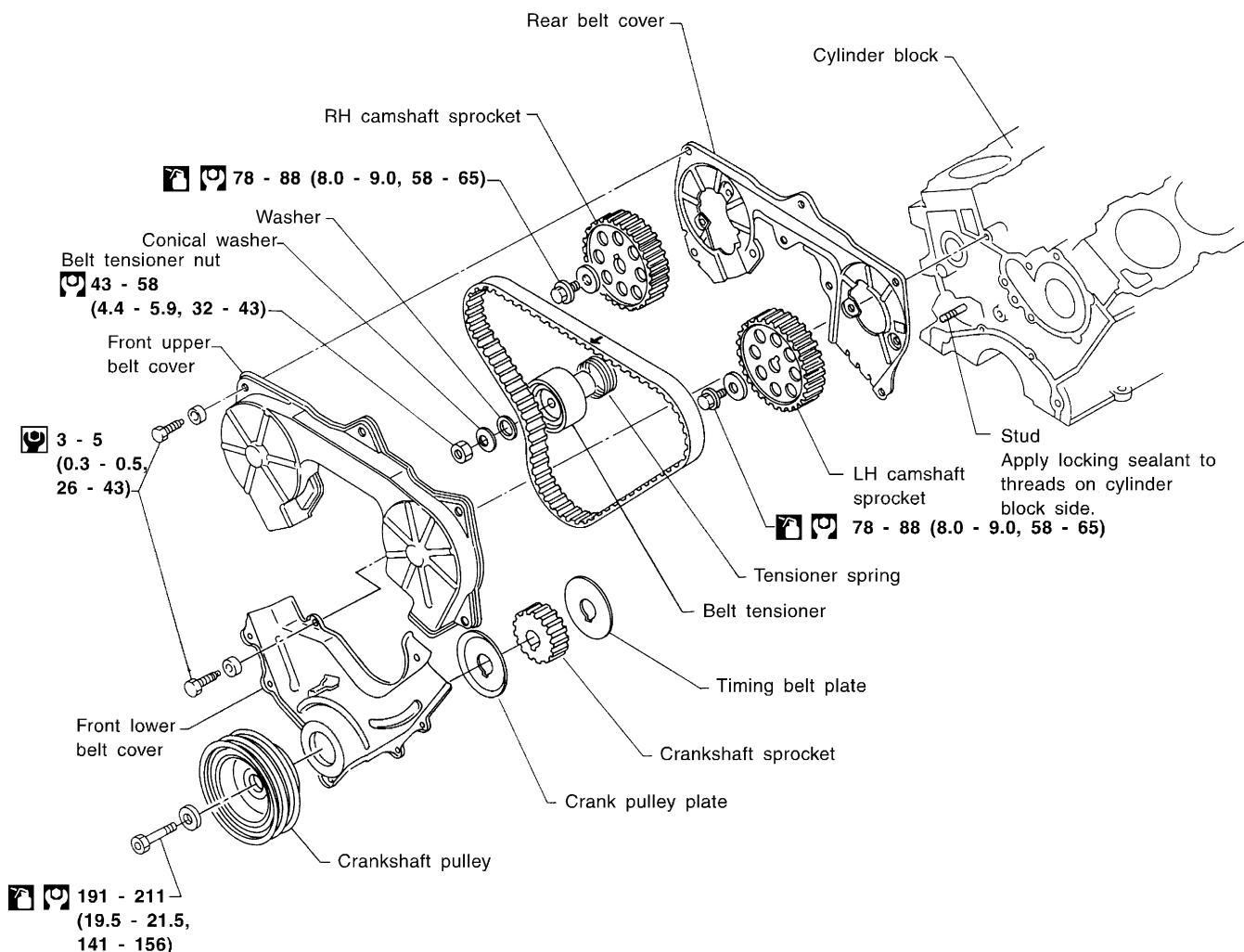
## Components

NGEM0009

### CAUTION:

- Do not bend or twist timing belt.
- After removing timing belt, do not turn crankshaft and camshaft separately because valves will strike piston heads.
- Make sure that timing belt, camshaft sprocket, crankshaft sprocket and belt tensioner are clean and free from oil and water.
- Installation should be carried out when engine is cold.

SEC. 120•130•135



: N•m (kg-m, in-lb)

: N•m (kg-m, ft-lb)

: Lubricate with new engine oil

SEM311FA

GI

MA

EM

LC

EC

FE

CL

MT

AT

TF

PD

AX

SU

BR

ST

RS

BT

HA

SC

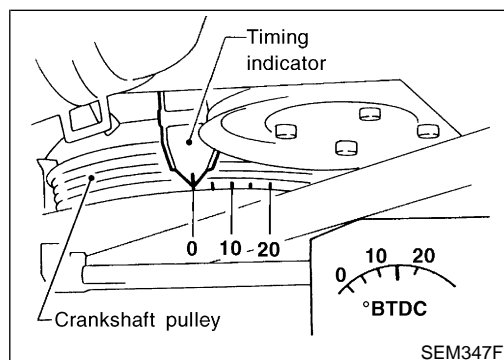
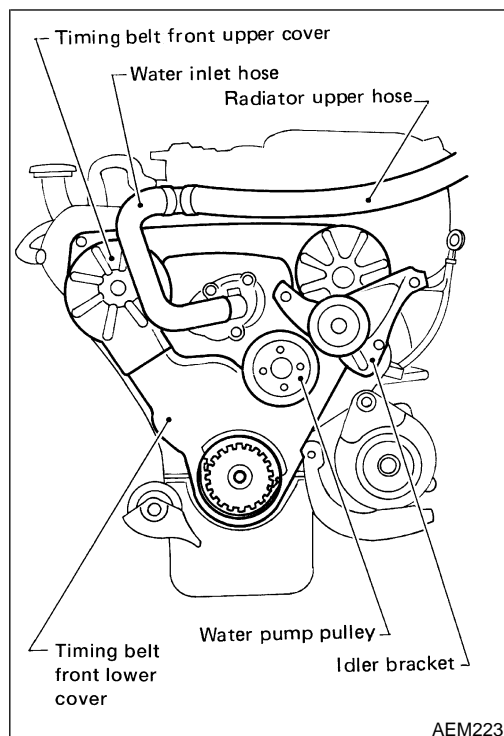
EL

IDX

## Removal

NGEM0010

1. Remove engine under cover.
2. Drain engine coolant from radiator. Refer to **MA-27**, ("Changing Engine Coolant", "ENGINE MAINTENANCE").  
**Be careful not to spill coolant on drive belts.**
3. Remove radiator. (Refer to **LC-31**.)
4. Remove engine cooling fan and water pump pulley.
5. Remove the following belts.
  - Power steering pump drive belt
  - Compressor drive belt
  - Alternator drive belt
6. Remove all spark plugs.
7. Remove distributor protector.

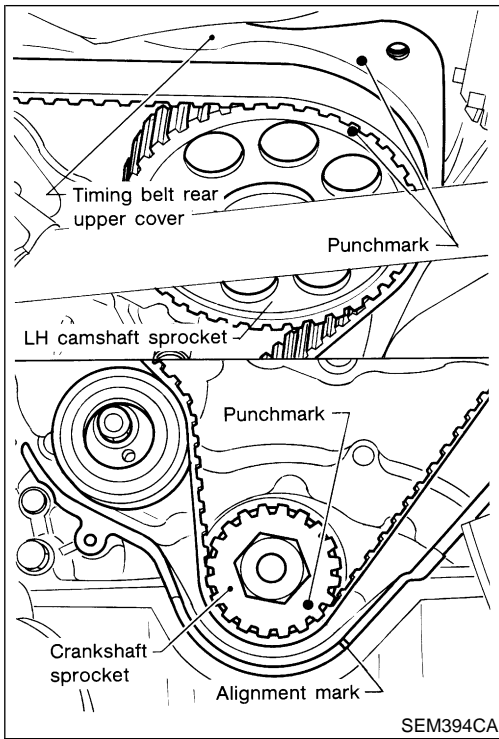


8. Remove compressor drive belt idler bracket.
  9. Remove fresh-air intake tube for rocker cover.
  10. Remove water hose for thermostat housing.
11. Set No. 1 piston at TDC on its compression stroke by rotating crankshaft.
  12. Remove crankshaft pulley bolt.
  13. Remove crankshaft pulley using a suitable puller.
  14. Remove front upper and lower belt covers.

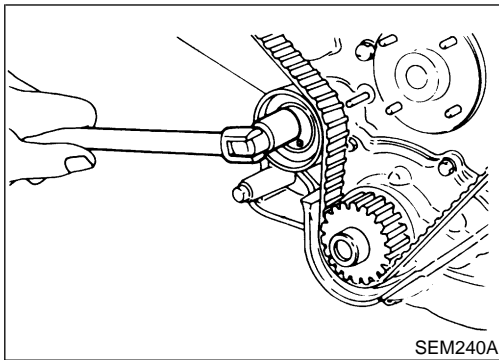
# TIMING BELT

**VG33E**

Removal (Cont'd)



- Align punchmark on LH camshaft sprocket with punchmark on timing belt rear cover.
- Align punchmark on crankshaft sprocket with alignment mark on oil pump housing.
- Temporarily install crankshaft pulley bolt on crankshaft so the crankshaft can be rotated.



15. Loosen timing belt tensioner nut, rotate tensioner, then remove timing belt.

## Inspection

Visually check the condition of timing belt.  
Replace if any abnormality is found.

NGEM0011

Item to check	Problem	Cause
Tooth is broken/tooth root is cracked.	<p>SEM394A</p>	<ul style="list-style-type: none"> <li>● Camshaft jamming</li> <li>● Distributor jamming</li> <li>● Damaged camshaft/crankshaft oil seal</li> </ul>
Back surface is cracked/worn.	<p>SEM395A</p>	<ul style="list-style-type: none"> <li>● Tensioner jamming</li> <li>● Overheated engine</li> <li>● Interference with belt cover</li> </ul>

GI  
MA

EM

LC

EC

FE

CL

MT

AT

TF

PD

AX

SU

BR

ST

RS

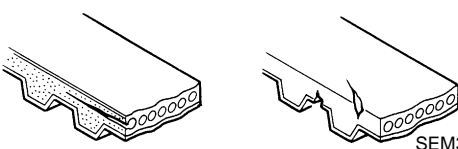
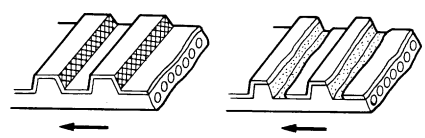
BT

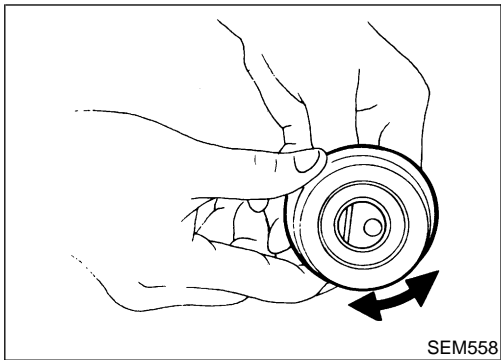
HA

SC

EL

IDX

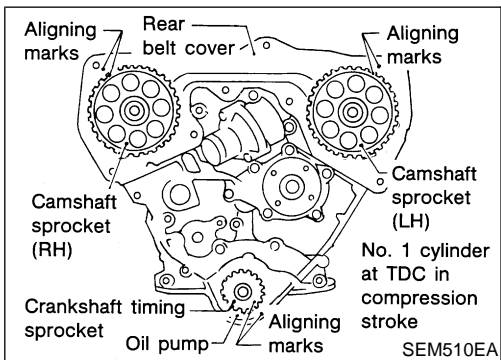
Item to check	Problem	Cause
Side surface is worn.	 <ul style="list-style-type: none"> <li>Belt corners are worn and round.</li> <li>Wicks are frayed and coming out.</li> </ul>	<ul style="list-style-type: none"> <li>Improper installation of belt</li> <li>Malfunctioning crankshaft pulley plate/timing belt plate</li> </ul>
Teeth are worn.	 <ul style="list-style-type: none"> <li>Canvas on tooth face is worn down.</li> <li>Canvas on tooth is fluffy, rubber layer is worn down and faded white, or weft is worn down and invisible.</li> </ul>	<ul style="list-style-type: none"> <li>Poor belt cover sealing</li> <li>Coolant leakage at water pump</li> <li>Camshaft not functioning properly</li> <li>Distributor not functioning properly</li> <li>Excessive belt tension</li> </ul>
Oil/Coolant or water is stuck to belt.	—	<ul style="list-style-type: none"> <li>Poor oil sealing of each oil seal</li> <li>Coolant leakage at water pump</li> <li>Poor belt cover sealing</li> </ul>



## BELT TENSIONER AND TENSIONER SPRING

NGEM0011S01

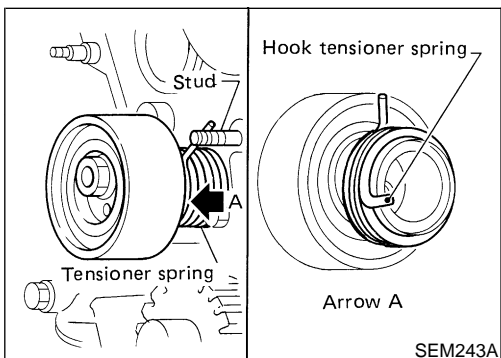
1. Check belt tensioner for smooth turning.
2. Check condition of tensioner spring.



## Installation

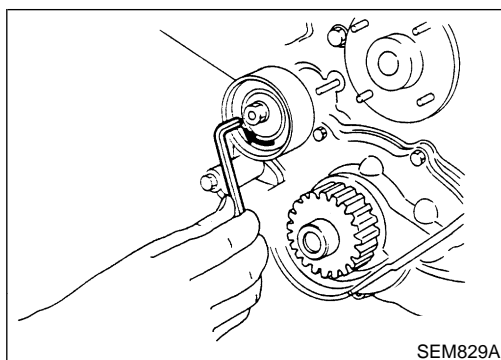
NGEM0012

1. Confirm that No. 1 piston is set at TDC on its compression stroke.



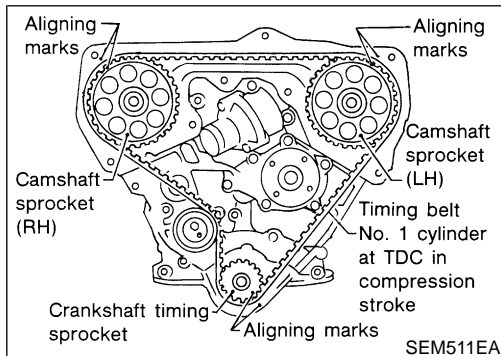
2. Install tensioner and tensioner spring.

**Once stud is removed, apply locking sealant to threads of stud on cylinder block side before installing.**



SEM829A

- Turn tensioner fully outward with hexagon wrench, and temporarily tighten lock nut.

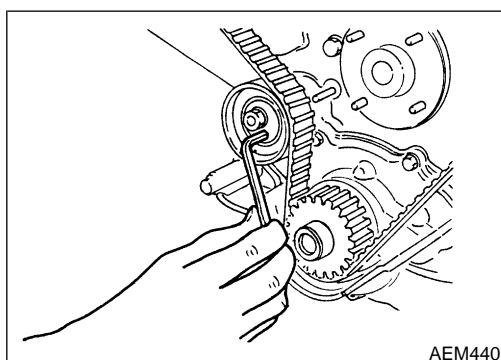


SEM511EA

- Set timing belt when engine is cold.
  - Align white lines on timing belt with punchmarks on camshaft sprockets and crankshaft sprocket.
  - Point arrow on timing belt toward front belt cover.

### Number of teeth (reference):

Number of timing belt teeth		133
Number of teeth between timing marks	Between LH and RH camshaft sprockets	40
	Between LH camshaft sprocket and crankshaft timing sprocket	43



AEM440

## Tension Adjustment AFTER BELT REPLACEMENT

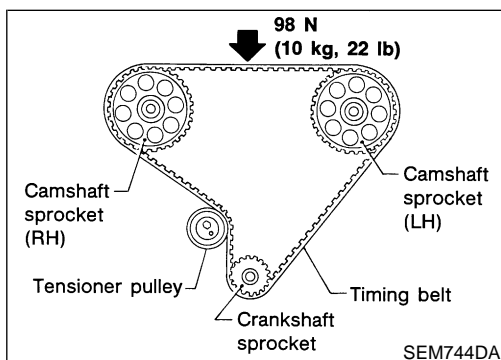
NGEN0040

NGEN0040S01

If the timing belt was replaced (or to adjust tension on a used belt), follow the steps below.

- Loosen tensioner lock nut, then turn tensioner clockwise and counterclockwise with hexagon wrench at least 2 times.
- Tighten tensioner lock nut.
- Turn crankshaft clockwise at least 2 times, then slowly set No. 1 piston at TDC on its compression stroke.
- Measure deflection of timing belt midway between camshaft pulleys while pushing with 98 N (10 kg, 22 lb) force.
 

**Belt deflection when engine is cold (Reference value):**  
**13 - 15 mm (0.51 - 0.59 in)/98 N (10 kg, 22 lb)**
- If NG, return to step 1.



SEM744DA

GI

MA

**EM**

LC

EC

FE

CL

MT

AT

TF

PD

AX

SU

BR

ST

RS

BT

HA

SC

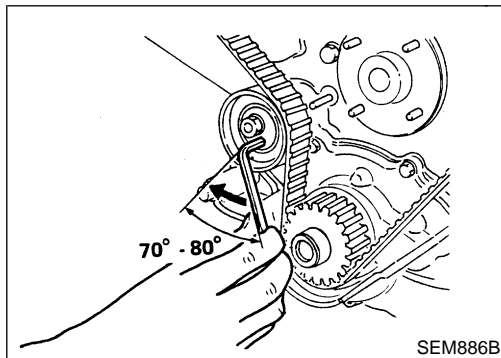
EL

IDX

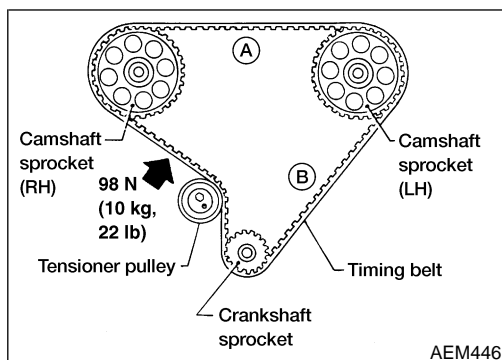
**AFTER ENGINE OVERHAUL OR ENGINE REASSEMBLY  
(WITH ROCKER COVERS REMOVED)**

If the engine was overhauled or previously disassembled (i.e. <sup>NGEM0040S02</sup> intake manifold and/or cylinder head were removed), follow the steps below.

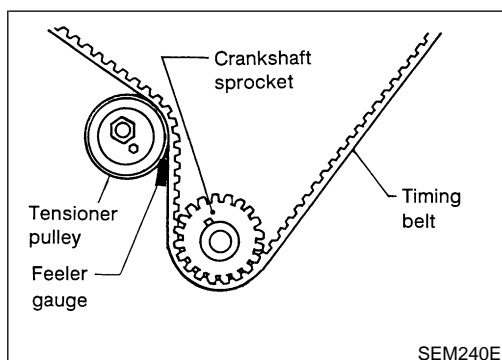
1. Loosen rocker shaft bolts to relieve belt tension caused by the cam shafts.



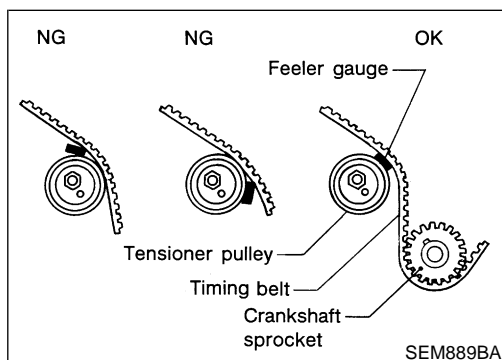
2. Loosen tensioner lock nut, keeping tensioner steady with hexagon wrench.
3. Turn tensioner 70 to 80 degrees clockwise with hexagon wrench to release belt tension, and temporarily tighten lock nut.
4. Turn crankshaft clockwise at least two times, then slowly set No. 1 piston at TDC on its compression stroke.



5. Push middle of timing belt between RH camshaft sprocket and tensioner pulley with force of 98 N (10 kg, 22 lb) to apply tensions on part A and part B.
6. Loosen tensioner lock nut, keeping tensioner steady with hexagon wrench.



7. Set feeler gauge as shown in figure which is 0.5 mm (0.0206 in) thick and 12.7 mm (0.500 in) wide.



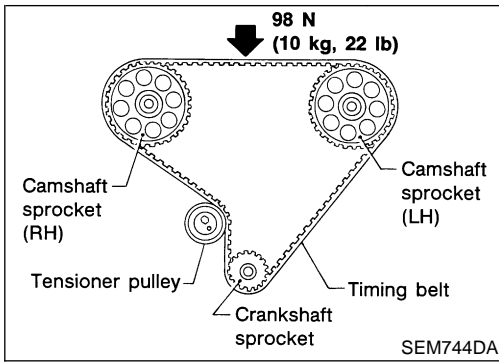
8. Turn crankshaft clockwise until feeler gauge is positioned as shown in figure.
  - Timing belt will move about 2.5 teeth.
9. Tighten tensioner lock nut, keeping tensioner steady with hexagon wrench.
10. Turn crankshaft clockwise or counterclockwise, and remove feeler gauge.
11. Turn crankshaft clockwise at least two times, then slowly set No. 1 piston at TDC on its compression stroke.



# TIMING BELT

**VG33E**

Tension Adjustment (Cont'd)

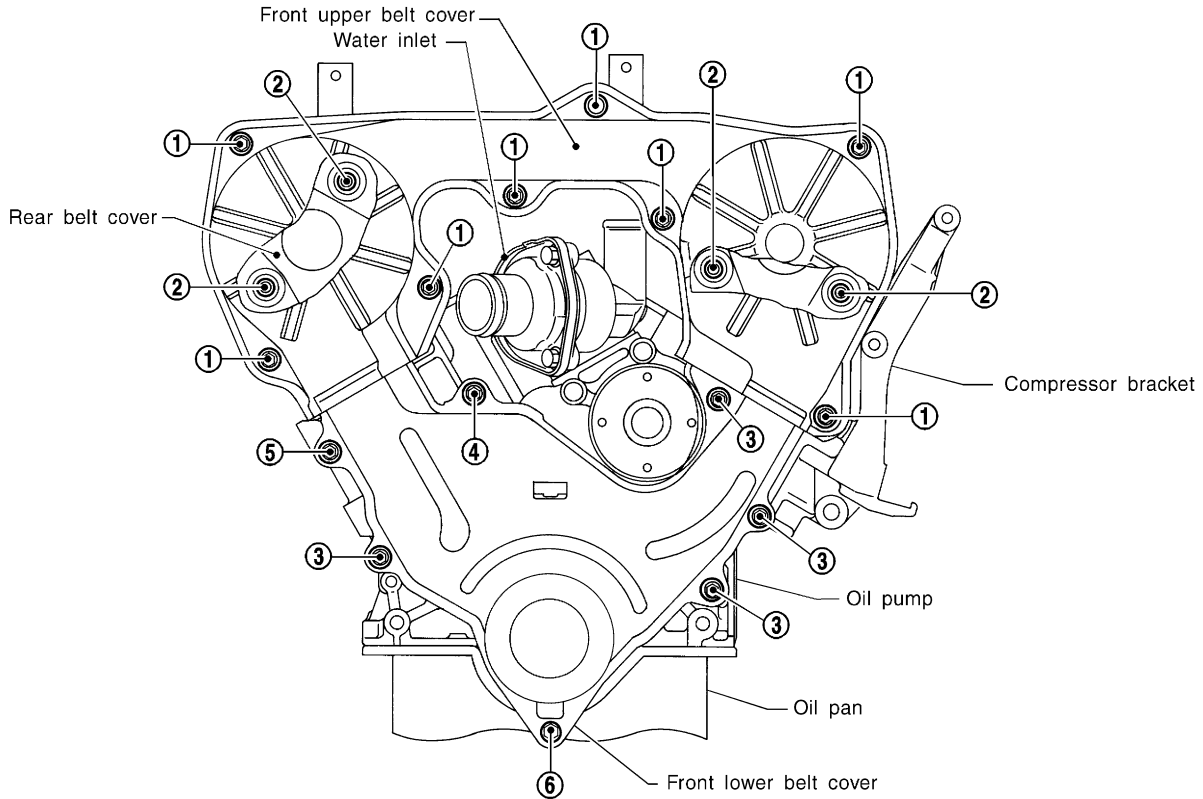


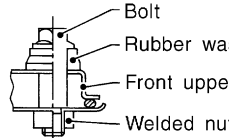
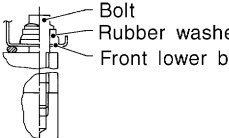
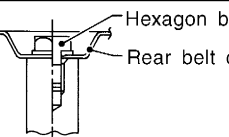
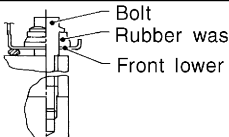
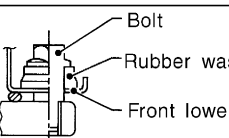
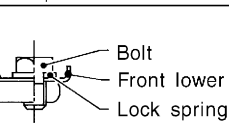
12. Measure deflection of timing belt midway between camshaft pulleys while pushing with 98 N (10 kg, 22 lb) force.

**Belt deflection when engine is cold (Reference value):**  
**13 - 15 mm (0.51 - 0.59 in)/98 N (10 kg, 22 lb)**

13. If NG, return to step 1.

14. Install lower and upper belt covers.



No.	Tightened parts	No.	Tightened parts		
①	 Bolt Rubber washer Front upper belt cover Welded nut	8 pcs.	④	 Bolt Rubber washer Front lower belt cover	1 pc.
②	 Hexagon bolt with washer Rear belt cover	4 pcs.	⑤	 Bolt Rubber washer Front lower belt cover	1 pc.
③	 Bolt Rubber washer Front lower belt cover	4 pcs.	⑥	 Bolt Front lower belt cover Lock spring washer	1 pc.

SEM313F

GI

MA

EM

LC

EC

FE

CL

MT

AT

TF

PD

AX

SU

BR

ST

RS

BT

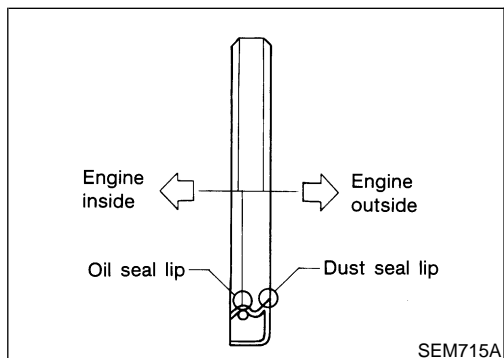
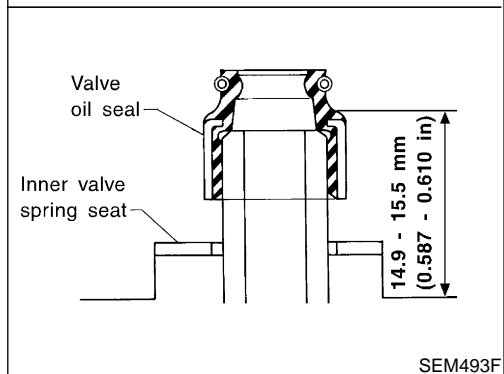
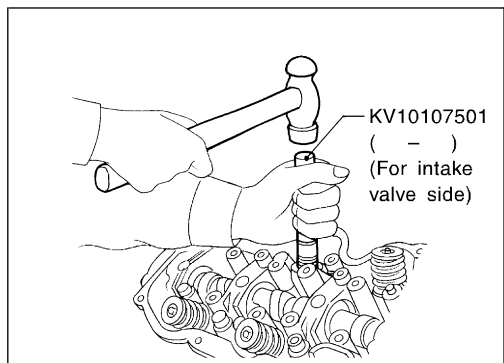
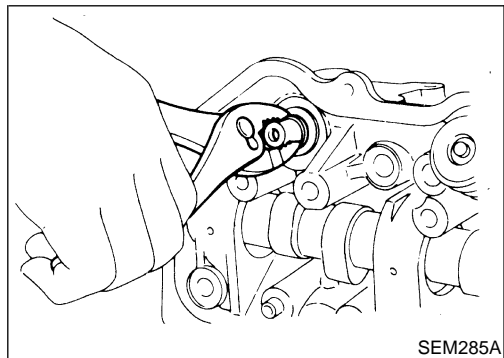
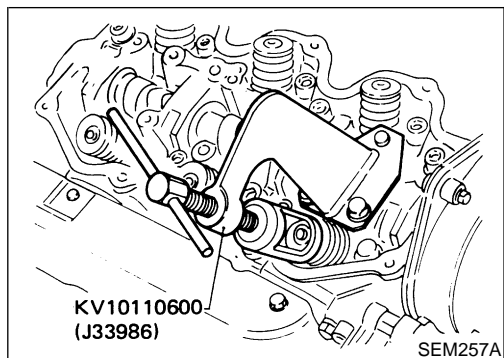
HA

SC

EL

IDX

## Replacement



## Replacement VALVE OIL SEAL

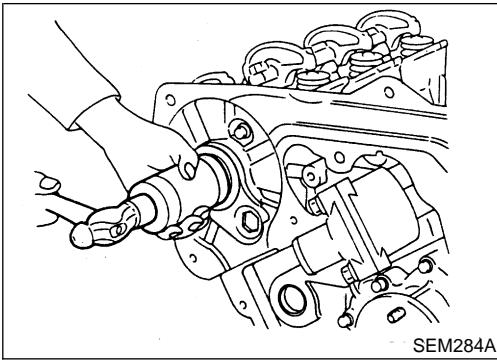
NGEM0013

NGEM0013S01

1. Remove rocker cover.
2. Remove rocker shaft assembly and valve lifters with valve lifter guide.
3. Remove valve springs and valve oil seal.
  - Piston concerned should be set at TDC to prevent valve from falling.
  - When removing intake side valve oil seal, use Tool or suitable tool.
  - When removing exhaust side valve oil seal, pull it out with suitable tool.
4. Apply engine oil to new valve oil seal and install it.
  - Before installing valve oil seal, install inner valve spring seat.
  - When installing intake side valve oil seal, use Tool.
  - When installing exhaust side valve oil seal, set it by hand.

## OIL SEAL INSTALLING DIRECTION

NGEM0013S02



## CAMSHAFT OIL SEAL

NGEM0013S03

1. Remove timing belt.
2. Remove camshaft sprocket.
3. Remove camshaft.
4. Remove camshaft oil seal.

**Be careful not to scratch camshaft.**

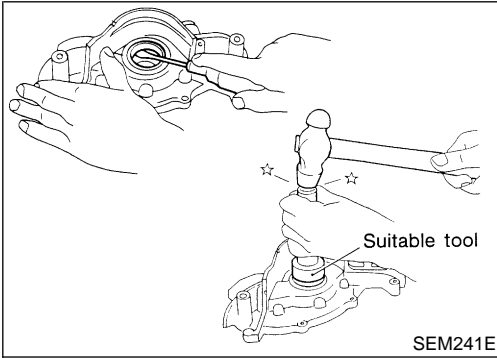
5. Apply engine oil to new camshaft oil seal.

GI

MA

**EM**

LC



## FRONT OIL SEAL

NGEM0013S04

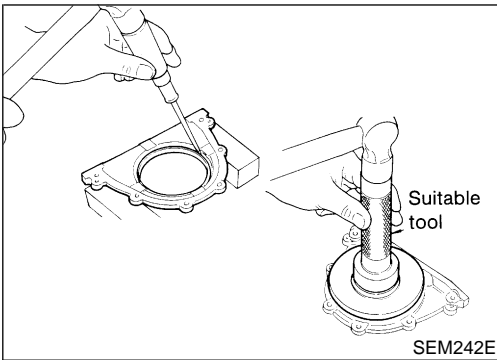
1. Remove timing belt and crankshaft sprocket.
2. Remove oil pump assembly.
3. Remove front oil seal from oil pump body.
4. Apply engine oil to new oil seal and install it using suitable tool.

EC

FE

CL

MT



## REAR OIL SEAL

NGEM0013S05

1. Remove drive plate.
2. Remove rear oil seal retainer.
3. Remove rear oil seal from retainer.
  - Be careful not to scratch rear oil seal retainer.
4. Apply engine oil to new oil seal and install it using suitable tool.
5. Install rear oil seal retainer with a new gasket to cylinder block.
  - Always use a new oil seal retainer to cylinder block gasket.

AT

TF

PD

AX

SU

BR

ST

RS

BT

HA

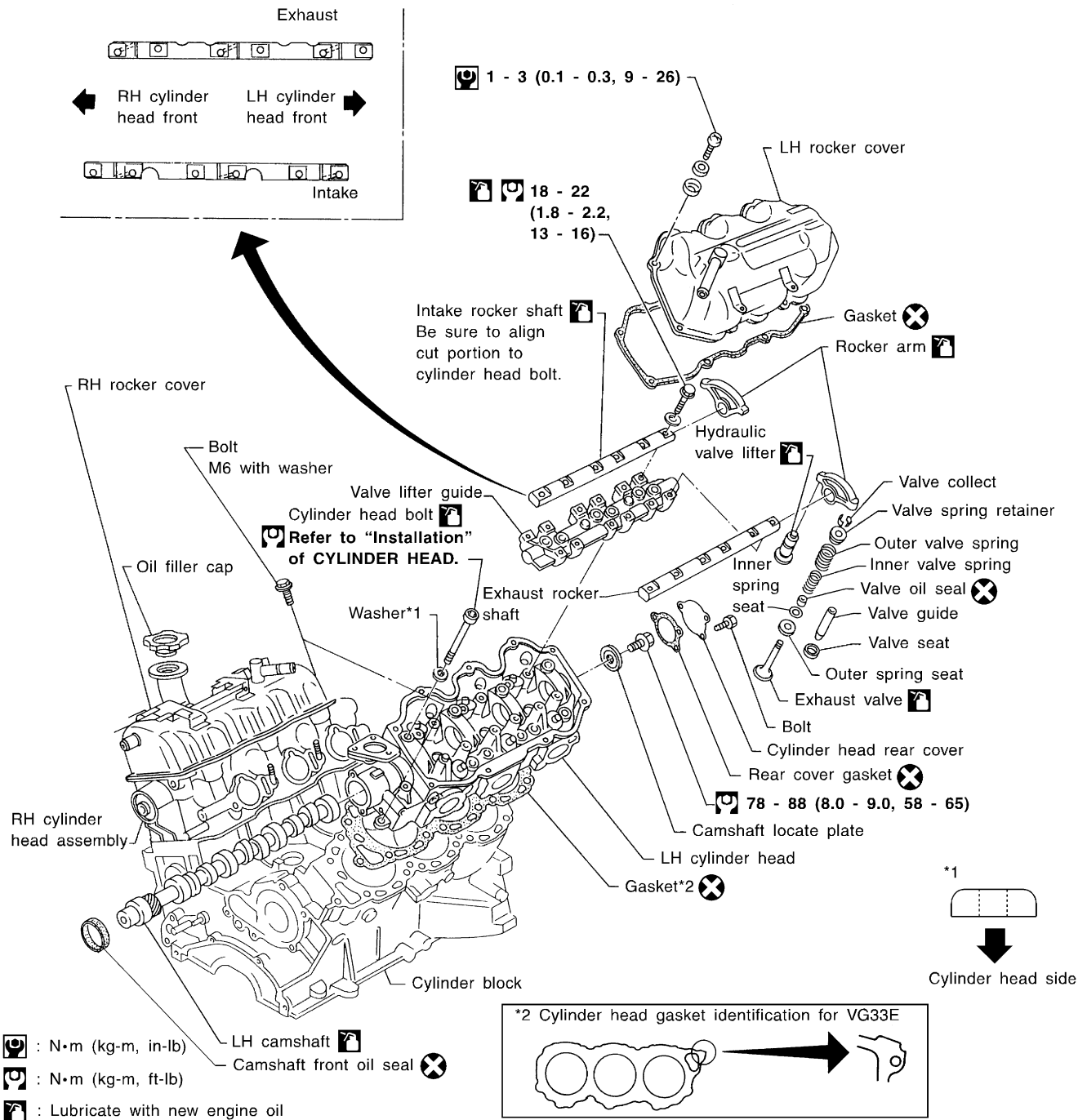
SC

EL

IDX

## Components

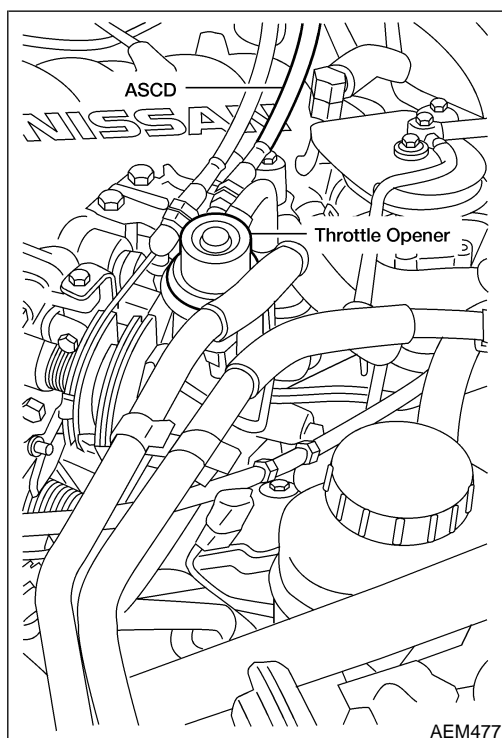
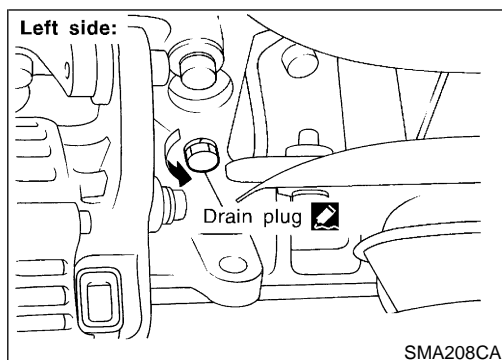
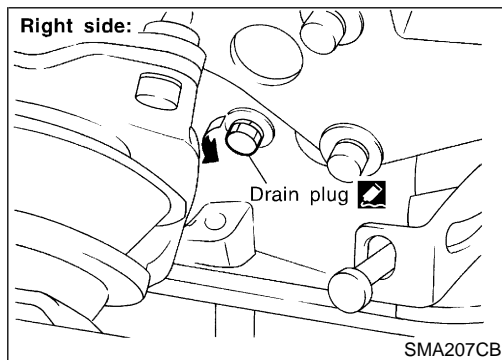
### SEC. 102•111•130



## Removal

NGEM0015

1. Release fuel pressure.  
Refer to **EC-40**, "Releasing Fuel Pressure".
2. Remove timing belt.  
Refer to "TIMING BELT — Removal" (EM-76).



3. Drain coolant by removing drain plugs from both sides of cylinder block.

4. Separate ASCD and accelerator control wire from intake manifold collector.
5. Remove intake manifold collector from engine. The following parts should be disconnected to remove intake manifold collector.
  - a. Harness connectors for:
    - IACV-AAC valve
    - Throttle position sensor
    - Throttle position switch
    - Ignition coil
    - Power transistor
    - EGRC-solenoid valve
    - EGR temperature sensor
  - b. Water hoses from collector
  - c. Heater hoses
  - d. PCV hose from RH rocker cover
  - e. Vacuum hoses for:
    - EVAP canister
    - Master brake cylinder
    - Pressure regulator
  - f. Purge hose from EVAP canister

GI

MA

**EM**

LC

EC

FE

CL

MT

AT

TF

PD

AX

SU

BR

ST

RS

BT

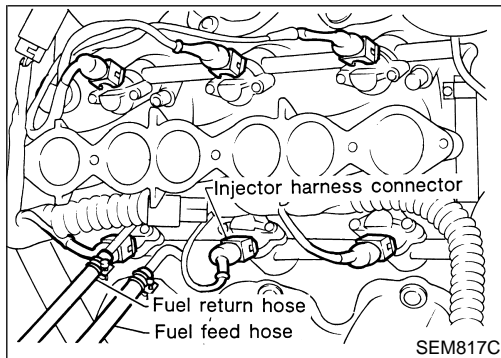
HA

SC

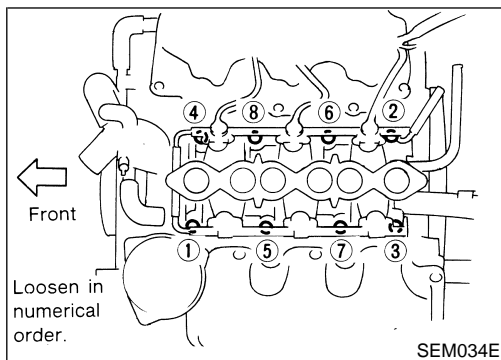
EL

IDX

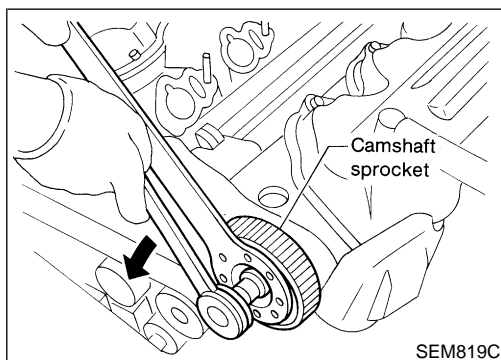
- g. EGR tube
- h. Spark plug wires
- i. Distributor cap
- j. 3 left bank injector connectors
- k. Thermal transmitter
- l. Ground harness
- m. Breather pipe



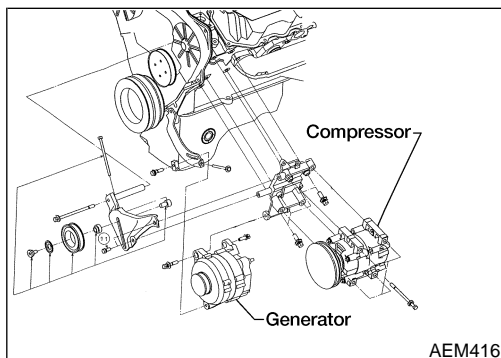
- 6. Remove fuel feed and fuel return hoses from injector fuel tube assembly.
- 7. Disconnect the right injector harness connectors.
- 8. Remove injector fuel tube assembly.



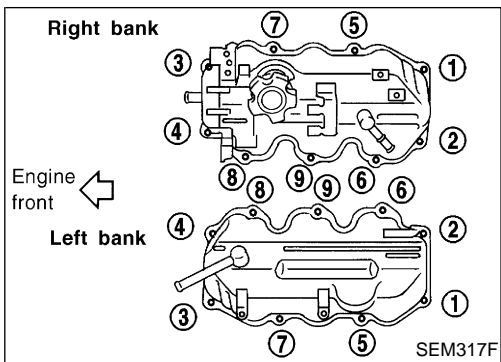
- 9. Remove intake manifold from engine. The following parts should be disconnected to remove intake manifold.
  - a. Engine coolant temperature switch harness connector
  - b. Thermal transmitter harness connector
  - c. Water hose from thermostat housing



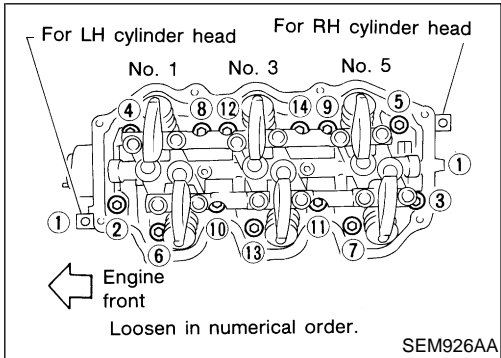
- 10. Remove both camshaft sprockets.
  - 11. Remove rear timing belt cover.
  - 12. Remove distributor and ignition wires.
- After pulling out distributor from cylinder head, do not rotate distributor rotor.**
- 13. Remove harness clamp from RH rocker cover.
  - 14. Remove exhaust tube from exhaust manifold.



- 15. Remove compressor and generator.
- 16. Remove power steering pump.
- 17. Remove the compressor, generator and power steering pump brackets.



18. Remove both rocker covers.



19. Remove cylinder head with exhaust manifold.

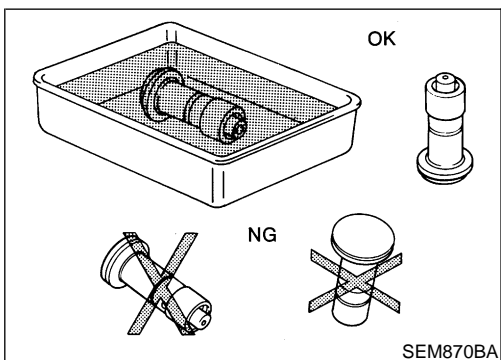
- A warped or cracked cylinder head could result from removing in incorrect order.
- Cylinder head bolts should be loosened in two or three steps.

## Disassembly

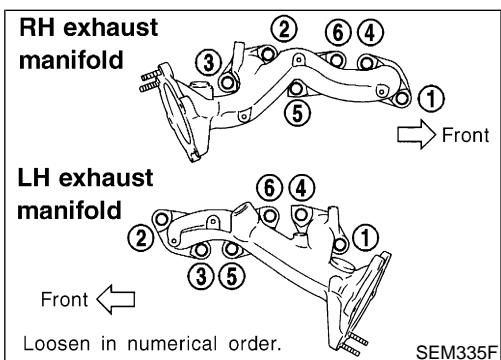
NGEM0016

### CAUTION:

- When installing sliding parts such as rocker arms, camshaft and oil seal, be sure to apply new engine oil on their sliding surfaces.
- When tightening cylinder head bolts and rocker shaft bolts, apply new engine oil to thread portions and seat surfaces of bolts.

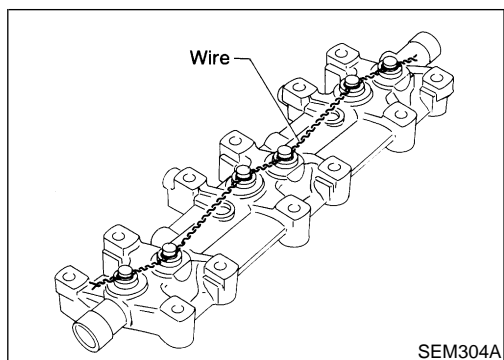


- If hydraulic valve lifter is kept on its side, there is a risk of air entering it. After removal, always set hydraulic valve lifter straight up, or when laying it on its side, have it soak in new engine oil.
- Do not disassemble hydraulic valve lifter.
- Attach tags to valve lifters so as not to mix them up.

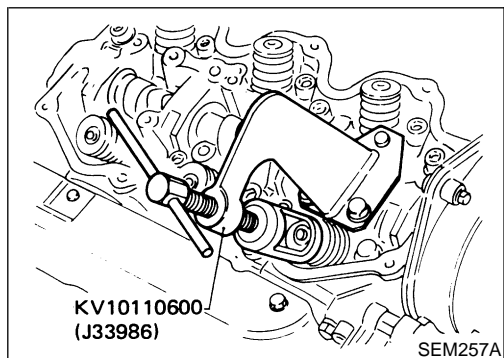


1. Remove exhaust manifolds from cylinder head.

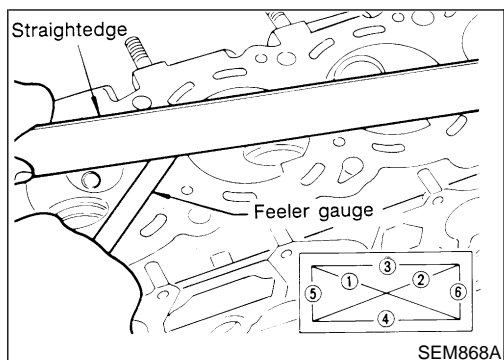
GI  
MA  
EM  
LC  
EC  
FE  
CL  
MT  
AT  
TF  
PD  
AX  
SU  
BR  
ST  
RS  
BT  
HA  
SC  
EL  
IDX



2. Remove rocker shafts with rocker arms.  
**Bolts should be loosened in two or three steps.**
3. Remove hydraulic valve lifters and lifter guide.
  - **Hold hydraulic valve lifters with wire so that they will not drop from lifter guide.**
4. Remove oil seal and camshaft.
  - **Before removing camshaft, measure camshaft end play.**



5. Remove valve components with Tool.
6. Remove valve oil seals with Tool or suitable tool.



## Inspection

### CYLINDER HEAD DISTORTION

**Head surface flatness:**

**Less than 0.1 mm (0.004 in)**

If beyond the specified limit, resurface it or replace it.

**Resurfacing limit:**

**The resurfacing limit of cylinder head is determined by the cylinder block resurfacing in an engine.**

**Amount of cylinder head resurfacing is "A".**

**Amount of cylinder block resurfacing is "B".**

**The maximum limit is as follows:**

**$A + B = 0.2 \text{ mm (0.008 in)}$**

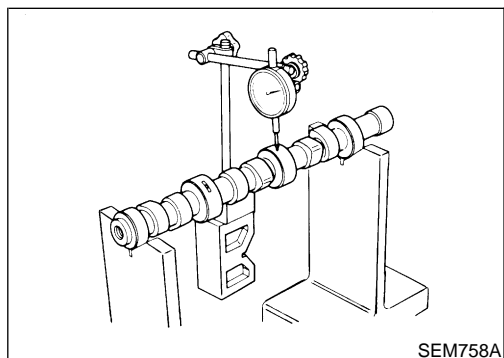
After resurfacing cylinder head, check that camshaft rotates freely by hand. If resistance is felt, cylinder head must be replaced.

**Nominal cylinder head height:**

**106.8 - 107.2 mm (4.205 - 4.220 in)**

### CAMSHAFT VISUAL CHECK

Check camshaft for scratches, seizure and wear.



### CAMSHAFT RUNOUT

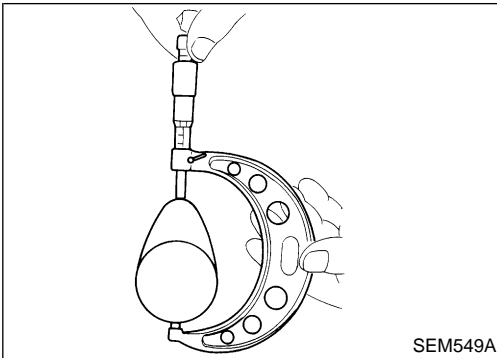
1. Measure camshaft runout at the center journal.

**Runout (Total indicator reading):**

**Limit 0.1 mm (0.004 in)**

2. If it exceeds the limit, replace camshaft.





## CAMSHAFT CAM HEIGHT

NGEM0017S04

1. Measure camshaft cam height.

**Standard cam height:**

**Intake and exhaust:**

**38.943 - 39.133 mm (1.5332 - 1.5407 in)**

**Cam wear limit:**

**0.15 mm (0.0059 in)**

2. If wear is beyond the limit, replace camshaft.

GI

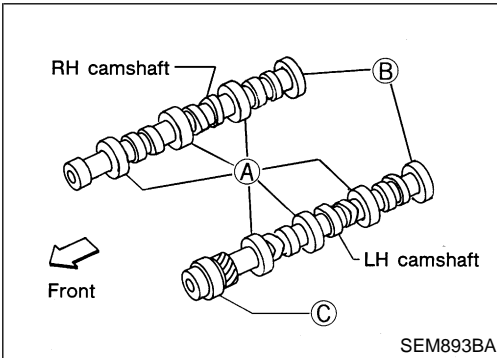
MA

**EM**

LC

## CAMSHAFT JOURNAL CLEARANCE

NGEM0017S05

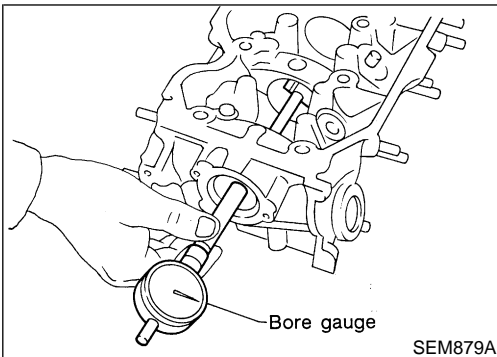


EC

FE

CL

MT



1. Measure inner diameter of camshaft bearing.

**Standard inner diameter:**

**A 47.000 - 47.025 mm (1.8504 - 1.8514 in)**

**B 42.500 - 42.525 mm (1.6732 - 1.6742 in)**

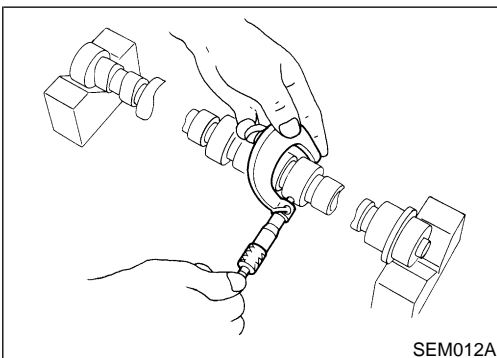
**C 48.000 - 48.025 mm (1.8898 - 1.8907 in)**

AT

TF

PD

AX



2. Measure outer diameter of camshaft journal.

**Standard outer diameter:**

**A 46.920 - 46.940 mm (1.8472 - 1.8480 in)**

**B 42.420 - 42.440 mm (1.6701 - 1.6709 in)**

**C 47.920 - 47.940 mm (1.8866 - 1.8874 in)**

SU

BR

3. If clearance exceeds the limit, replace camshaft and/or cylinder head.

**Camshaft journal clearance limit:**

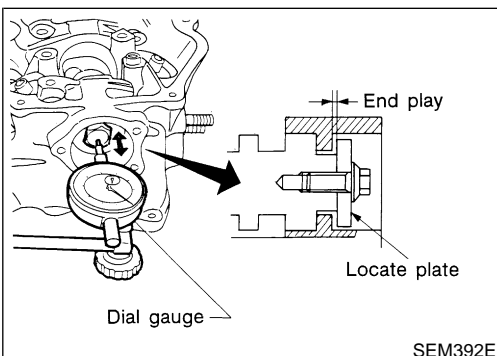
**0.15 mm (0.0059 in)**

ST

RS

## CAMSHAFT END PLAY

NGEM0017S06



1. Install camshaft and locate plate in cylinder head.

2. Measure camshaft end play.

**Camshaft end play:**

**Standard:**

**0.03 - 0.06 mm (0.0012 - 0.0024 in)**

BT

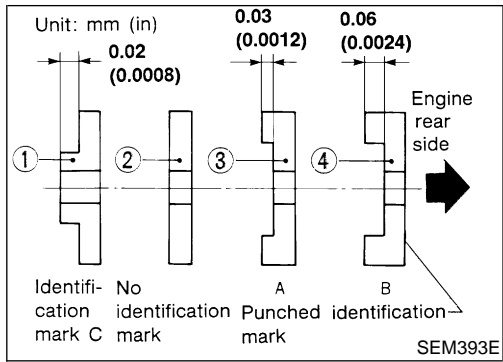
HA

SC

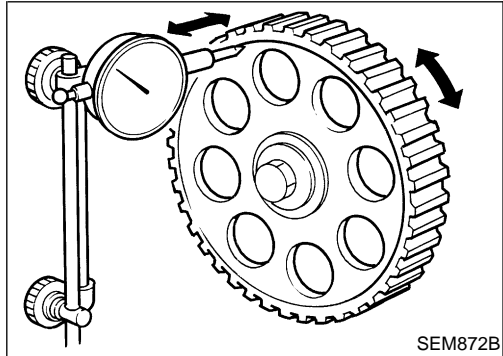
EL

IDX

Inspection (Cont'd)



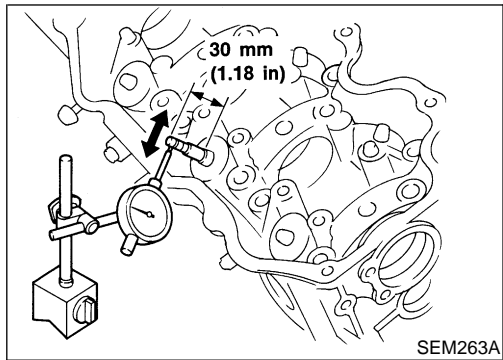
- If it is out of the specified range, select thickness of camshaft locate plate to obtain standard specified end play.  
Example:  
When camshaft end play is 0.08 mm (0.0031 in) with camshaft locate plate 2, replace camshaft locate plate 2 with camshaft locate plate 3 to set the end play at 0.05 mm (0.0020 in).



### CAMSHAFT SPROCKET RUNOUT

NGEM0017S07

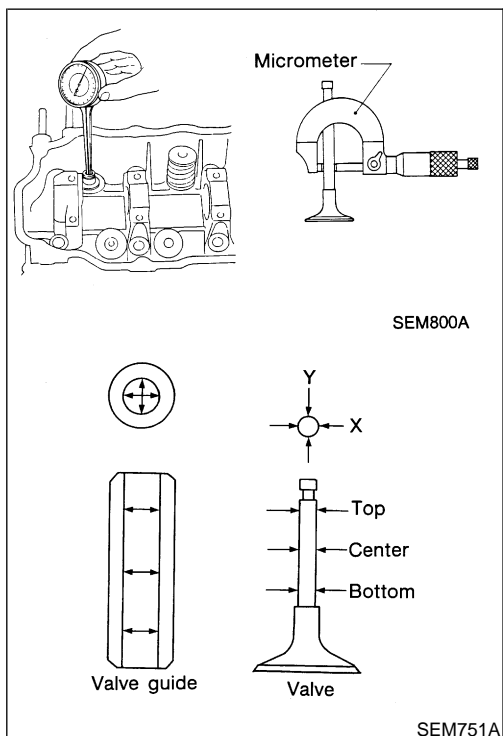
- Install sprocket on camshaft.
- Measure camshaft sprocket runout.  
**Runout (Total indicator reading):**  
**Limit:**  
**0.1 mm (0.004 in)**
- If it exceeds the limit, replace camshaft sprocket.



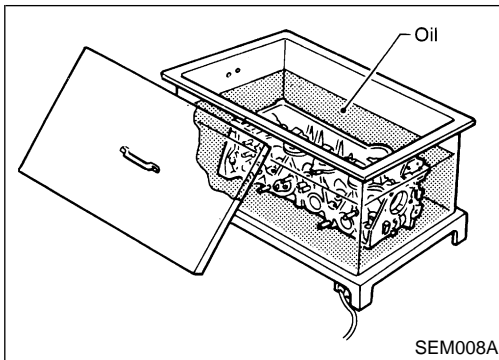
### VALVE GUIDE CLEARANCE

NGEM0017S08

- Measure valve deflection in a right-angled direction with camshaft. (Valve and valve guide mostly wear in this direction.)  
**Valve deflection limit (Dial gauge reading):**  
**0.20 mm (0.0079 in)**



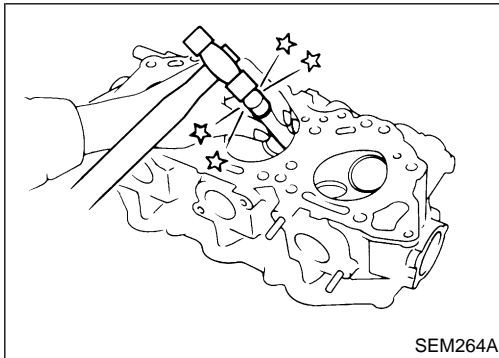
- If it exceeds the limit, check valve to valve guide clearance.
  - Measure valve stem diameter and valve guide inner diameter.
  - Check that clearance is within specification.  
**Valve to valve guide clearance:**  
**Intake:**  
**0.020 - 0.053 mm (0.0008 - 0.0021 in)**  
**Exhaust:**  
**0.030 - 0.049 mm (0.0012 - 0.0019 in)**  
**Limit:**  
**0.10 mm (0.0039 in)**
- If it exceeds the limit, replace valve or valve guide.



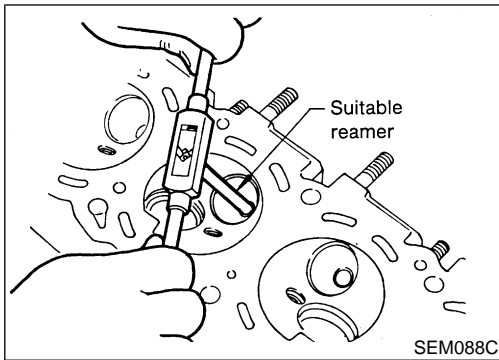
## VALVE GUIDE REPLACEMENT

NGEM0017S09

1. To remove valve guide, heat cylinder head to 150 to 160°C (302 to 320°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.



3. Ream cylinder head valve guide hole.

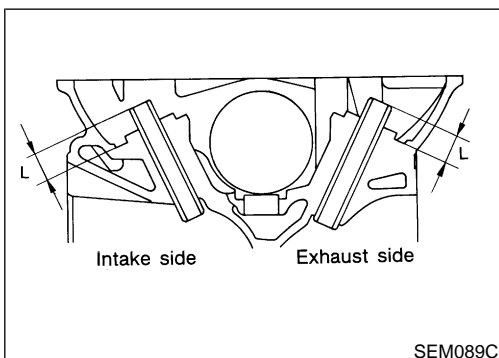
**Valve guide hole diameter (for service parts):**

**Intake:**

**11.175 - 11.196 mm (0.4400 - 0.4408 in)**

**Exhaust:**

**12.175 - 12.196 mm (0.4793 - 0.4802 in)**



4. Heat cylinder head to 150 to 160°C (302 to 320°F) and press service valve guide onto cylinder head.

**Projection "L":**

**13.2 - 13.4 mm (0.520 - 0.528 in)**

5. Ream valve guide.

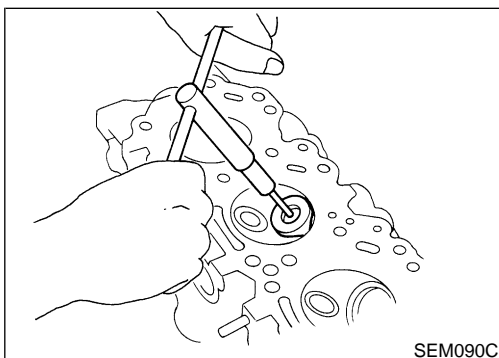
**Finished size:**

**Intake:**

**7.000 - 7.018 mm (0.2756 - 0.2763 in)**

**Exhaust:**

**8.000 - 8.011 mm (0.3150 - 0.3154 in)**

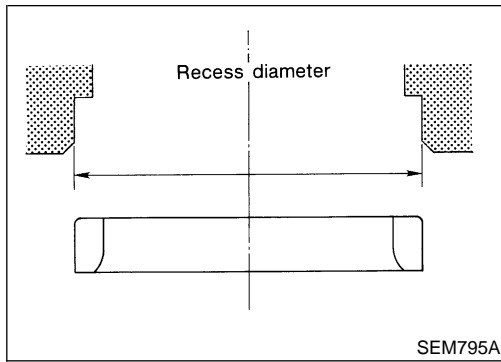


## VALVE SEATS

NGEM0017S10

Check valve seats for any evidence of pitting at valve contact surface, and reseat or replace if it has worn out excessively.

- **Before repairing valve seats, check valve and valve guide for wear. If they have worn, replace them. Then correct valve seat.**
- **Use both hands to cut uniformly.**



SEM795A

**REPLACING VALVE SEAT FOR SERVICE PARTS**

-NGEM0017S11

1. Bore out old seat until it collapses. The machine depth stop should be set so that boring cannot continue beyond the bottom face of the seat recess in cylinder head.
2. Ream cylinder head recess.

**Reaming bore for service valve seat:**

**Oversize [0.5 mm (0.020 in)]:**

**Intake:**

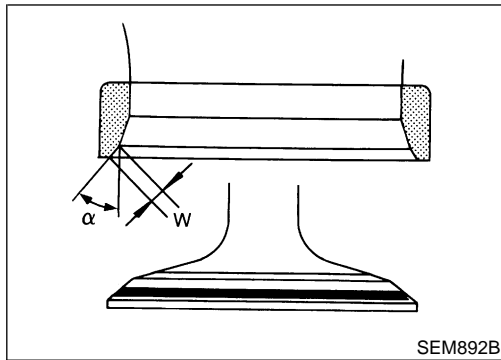
**44.500 - 44.516 mm (1.7520 - 1.7526 in)**

**Exhaust:**

**37.500 - 37.516 mm (1.4764 - 1.4770 in)**

**Reaming should be done in circles concentric to the valve guide center so that valve seat will have the correct fit.**

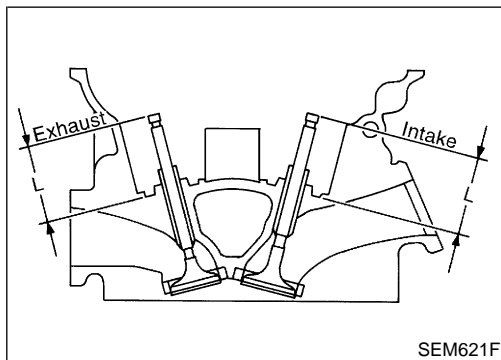
3. Heat cylinder head to 150 to 160°C (302 to 320°F) by soaking in heated oil.
4. Press fit valve seat until it seats on the bottom.



SEM892B

5. Cut or grind valve seat using suitable tool at the specified dimensions as shown in SDS (EM-115).
6. After cutting, lap valve seat with abrasive compound.
7. Check valve seating condition.

	Intake	Exhaust
Seat face angle "α" degree	45	45
Contacting width "W" mm (in)	1.75 (0.0689)	1.7 (0.067)



SEM621F

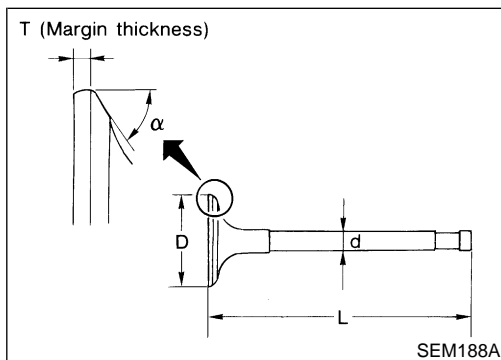
8. Use a depth gauge to measure the distance between the mounting surface of the cylinder head spring seat and the valve stem end. If the distance is shorter than specified, repeat step 5 above to adjust it. If it is longer, replace the valve seat with a new one.

**Intake:**

**44.7 - 44.9 mm (1.760 - 1.768 in)**

**Exhaust:**

**45.4 - 45.6 mm (1.787 - 1.795 in)**



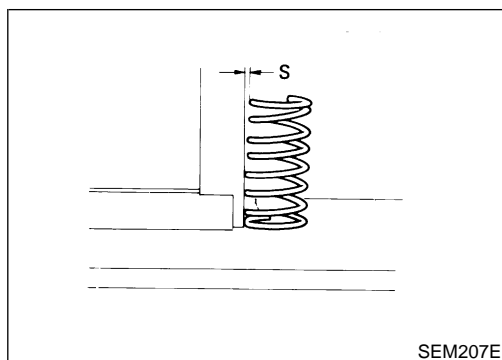
SEM188A

**VALVE DIMENSIONS**

NGEM0017S12

Check dimensions in each valve. For dimensions, refer to SDS. When valve head has been worn down to 0.5 mm (0.020 in) in margin thickness, replace valve.

**Grinding allowance for valve stem tip is 0.2 mm (0.008 in) or less.**



SEM207E

## VALVE SPRING

### Squareness

NGEM0017S13

NGEM0017S1301

1. Measure "S" dimension.

#### Out-of-square:

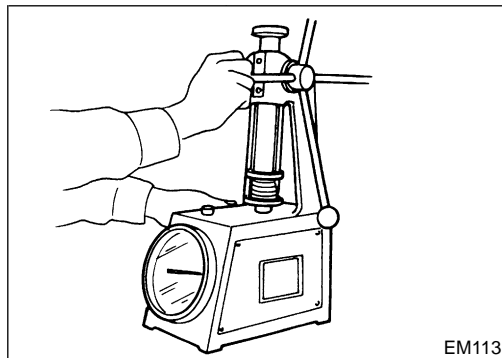
##### Outer:

Less than 2.2 mm (0.087 in)

##### Inner:

Less than 1.9 mm (0.075 in)

2. If it exceeds the limit, replace spring.



EM113

### Pressure

NGEM0017S1302

Check valve spring pressure.

#### Standard pressure: N (kg, lb) at height mm (in)

##### Outer:

523.7 (53.4, 117.7) at 30.0 (1.181)

##### Inner:

255.0 (26.0, 57.3) at 25.0 (0.984)

#### Limit pressure: N (kg, lb) at height mm (in)

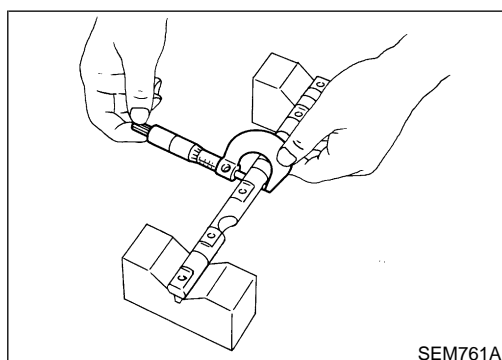
##### Outer:

More than 228.5 (23.3, 51.4) at 25.0 (0.984)

##### Inner:

More than 225.6 (23.0, 50.7) at 25.0 (0.984)

If it exceeds the limit, replace spring.



SEM761A

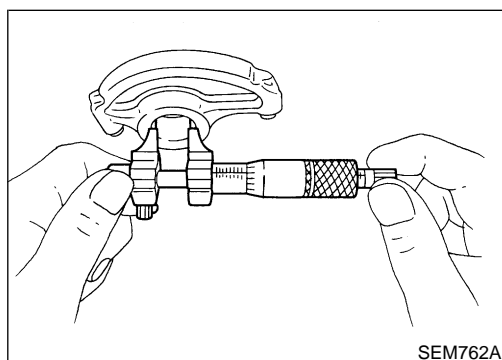
## ROCKER SHAFT AND ROCKER ARM

NGEM0017S14

1. Check rocker shafts for scratches, seizure and wear.
2. Check outer diameter of rocker shaft.

#### Diameter:

17.979 - 18.000 mm (0.7078 - 0.7087 in)



SEM762A

3. Check inner diameter of rocker arm.

#### Diameter:

18.007 - 18.028 mm (0.7089 - 0.7098 in)

#### Rocker arm to shaft clearance:

0.007 - 0.049 mm (0.0003 - 0.0019 in)

- Keep rocker arm with hydraulic valve lifter standing to prevent air from entering hydraulic valve lifter when checking.

GI

MA

**EM**

LC

EC

FE

CL

MT

AT

TF

PD

AX

SU

BR

ST

RS

BT

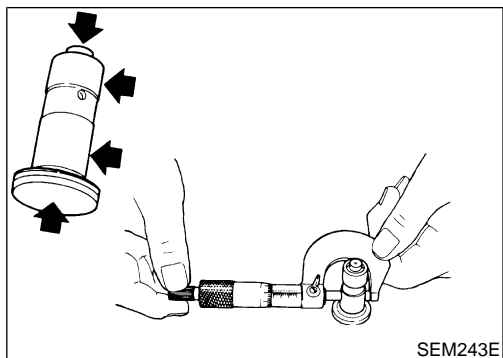
HA

SC

EL

IDX

Inspection (Cont'd)

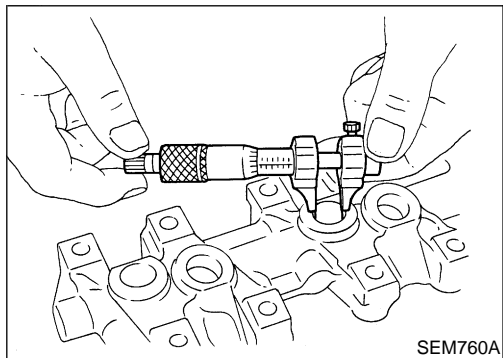


SEM243E

**HYDRAULIC VALVE LIFTER**

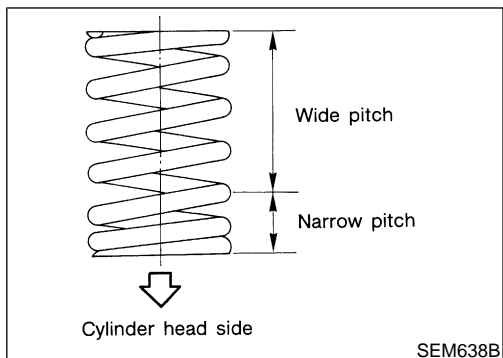
NGEM0017S15

1. Check contact and sliding surfaces for wear or scratches.
2. Check diameter of valve lifter.

**Outer diameter:****15.947 - 15.957 mm (0.6278 - 0.6282 in)**

SEM760A

3. Check valve lifter guide inner diameter.

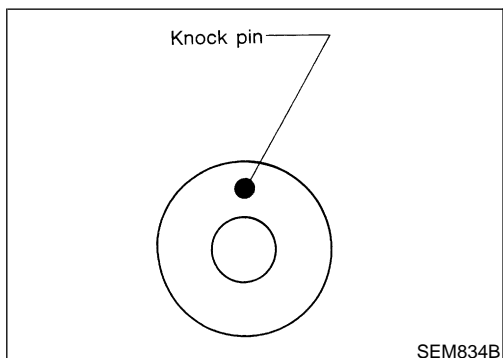
**Inner diameter:****16.000 - 16.013 mm (0.6299 - 0.6304 in)****Standard clearance between valve lifter and lifter guide:****0.043 - 0.066 mm (0.0017 - 0.0026 in)**

SEM638B

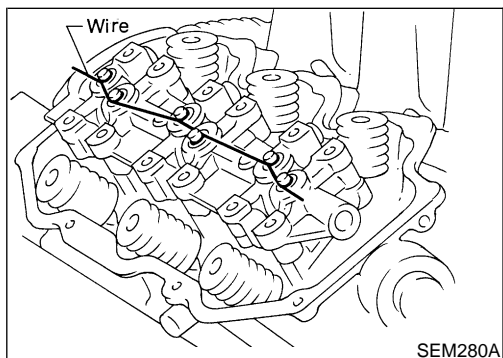
**Assembly**

NGEM0018

1. Install valve component parts.
  - **Always use new valve oil seal. Refer to OIL SEAL REPLACEMENT (EM-82).**
  - **Before installing valve oil seal, install inner valve spring seat.**
  - **Install outer valve spring (uneven pitch type) with its narrow pitch side toward cylinder head side.**
  - **After installing valve component parts, use plastic hammer to lightly tap valve stem tip to assure a proper fit.**
2. Install camshafts, locate plates and cylinder head rear covers.
  - **Set knock pin of camshaft at the top.**

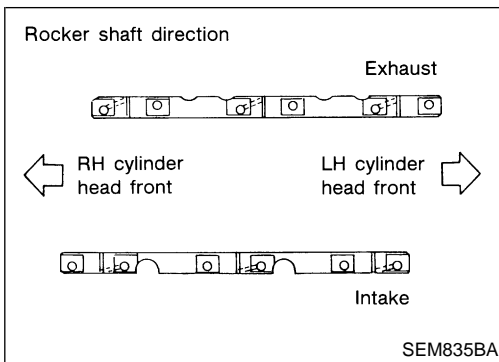


SEM834B

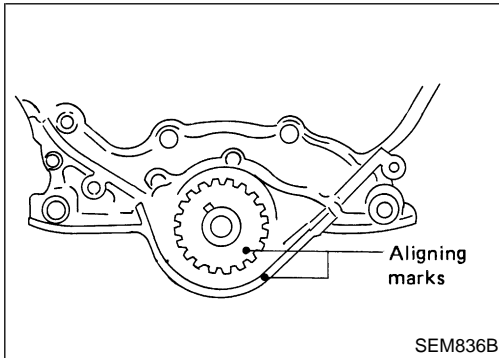


SEM280A

3. Install valve lifters into valve lifter guide.
  - **Assemble valve lifters to their original position and hold all valve lifters with wire to prevent lifters from falling off.**
  - **After installing, remove the wire.**

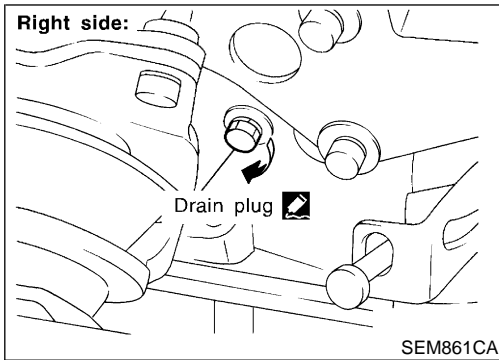


4. Install rocker shafts with rocker arms.
  - **Tighten bolts gradually in two or three stages.**
  - **Before tightening, be sure to set camshaft the lobe at the position where lobe is not lifted.**
- a. Set No. 1 piston at TDC on its compression stroke and tighten rocker shaft bolts for No. 2, No. 4 and No. 6 cylinders.
- b. Set No. 4 piston at TDC on its compression stroke and tighten rocker shaft bolts for No. 1, No. 3 and No. 5 cylinders.
5. Install exhaust manifold to cylinder head in reverse order of removal.

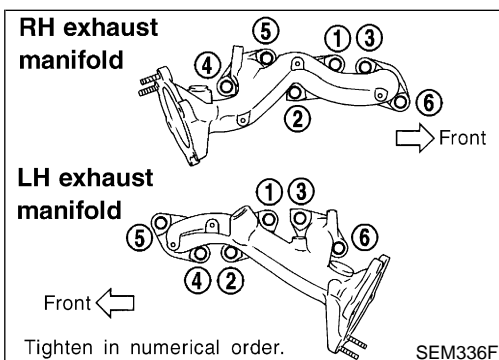
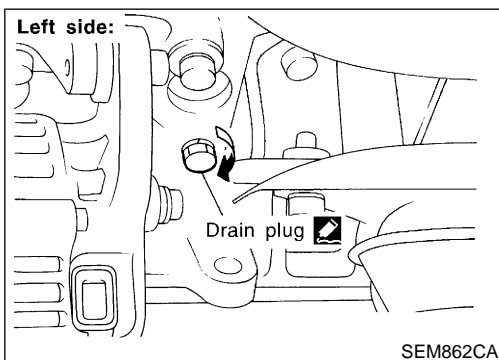


## Installation

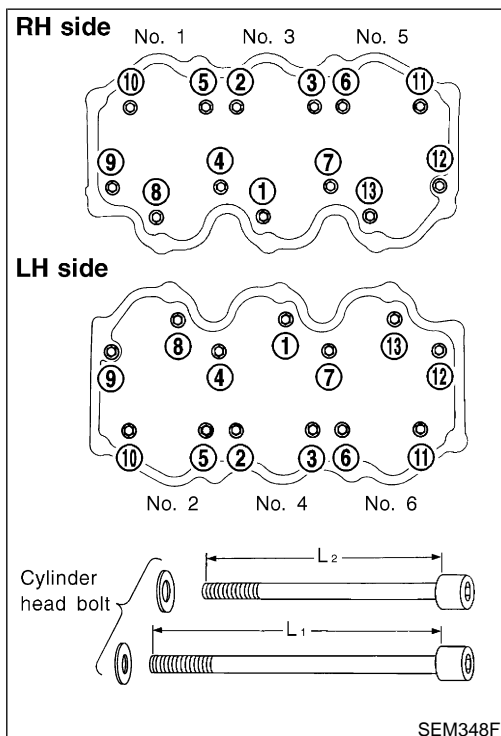
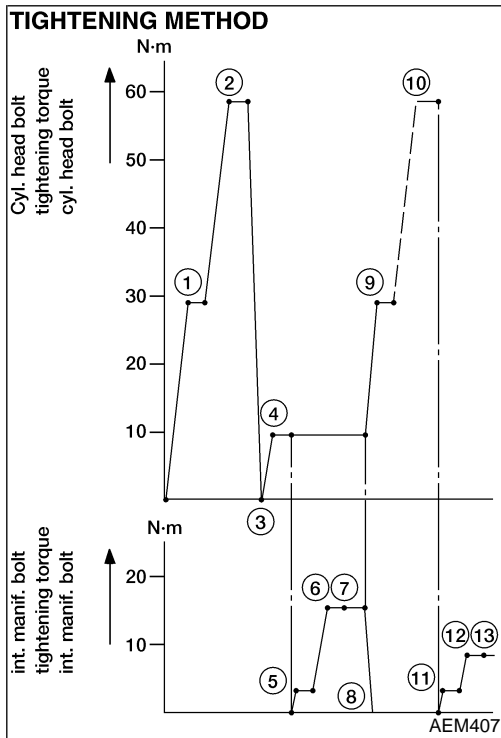
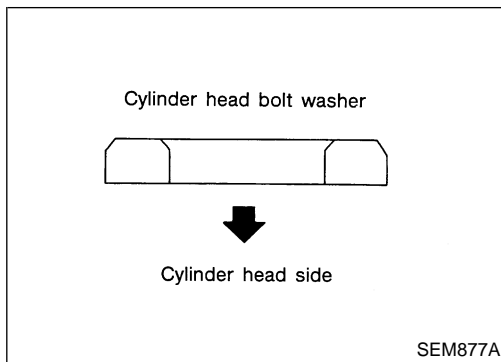
1. Set No. 1 piston at TDC on its compression stroke as follows:
  - a. Align crankshaft sprocket aligning mark with mark on oil pump body.
  - b. Confirm that knock pin on camshaft is set at the top.



2. Install both drain plugs.
  - Use Genuine RTV silicone sealant Part No. 999MP-A7007 or equivalent.



3. Install exhaust manifolds to cylinder head.



- Install cylinder head with new gasket.
  - Be sure to install washers between bolts and cylinder head.
  - Do not rotate crankshaft and camshaft separately, or valves will hit piston heads.

- Tighten cylinder head bolts in numerical order using angle wrench [ST10120000 (J24239-01)].

Apply engine oil to threads and seating surfaces of cylinder head bolts before installing them.

- Cylinder head bolts for 4, 7, 9 and 12 are longer than the others.

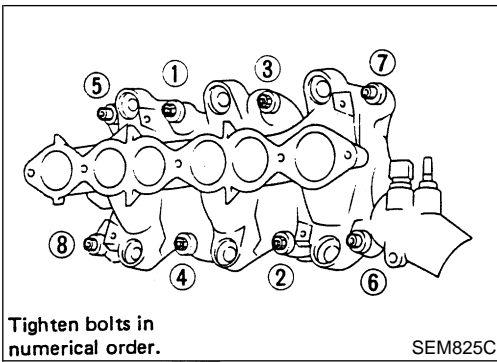
$L_1$ : 127 mm (5.00 in) for 4, 7, 9 and 12

$L_2$ : 106 mm (4.17 in) for others

- Install intake manifold and cylinder head at the same time using the following procedure:

- Tighten cylinder head bolts to 29 N-m (3.0 kg-m, 22 ft-lb).
- Tighten cylinder head bolts to 59 N-m (6.0 kg-m, 43 ft-lb).
- Loosen cylinder head bolts completely.
- Tighten cylinder head bolts to 10 N-m (1.0 kg-m, 7 ft-lb).
- Tighten intake manifold bolts and nuts to 4 N-m (0.4 kg-m, 2.9 ft-lb).
- Tighten intake manifold bolts and nuts to 18 N-m (1.8 kg-m, 13 ft-lb).
- Tighten intake manifold bolts and nuts to 16 to 20 N-m (1.6 to 2.0 kg-m, 12 to 14 ft-lb).
- Loosen intake manifold bolts and nuts completely.
- Tighten cylinder head bolts to 29 N-m (3.0 kg-m, 2.2 ft-lb).
- Turn cylinder head bolts to 60 to 65 degrees clockwise. If an angle wrench is not available, tighten cylinder head bolts to 54 to 64 N-m (5.5 to 6.5 kg-m, 40 to 47 ft-lb).
- Tighten cylinder head sub-bolts to 9.0 to 11.8 N-m (0.92 to 1.20 kg-m, 6.7 to 8.7 ft-lb).
- Tighten intake manifold bolts and nuts to 4 N-m (0.4 kg-m, 2.9 ft-lb).
- Tighten intake manifold bolts and nuts to 9 N-m (0.9 kg-m, 6.5 ft-lb).
- Tighten intake manifold bolts and nuts to 8 to 10 N-m (0.8 to 1.0 kg-m, 5.8 to 7 ft-lb).



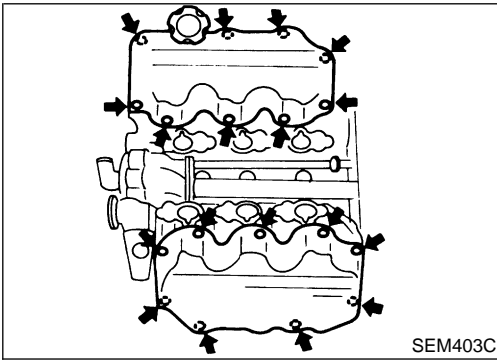


- If only intake manifold is removed and to be used again, install it using the following procedure:

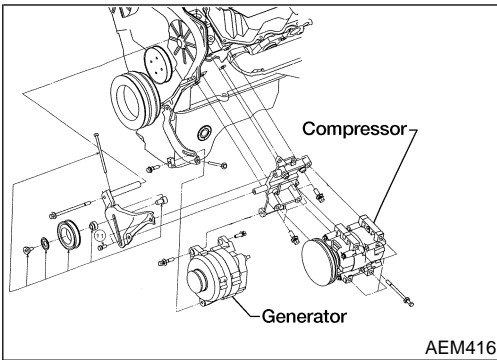
- 1) Tighten all bolts and nuts to 4 N·m (0.4 kg-m, 2.9 ft-lb).
- 2) Tighten all bolts and nuts to 9 N·m (0.9 kg-m, 6.5 ft-lb).
- 3) Tighten all bolts and nuts to 8 to 10 N·m (0.8 to 1.0 kg-m, 5.8 to 7 ft-lb).

**CAUTION:**

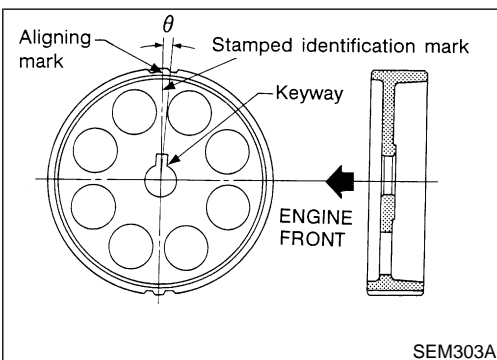
If replacing intake manifold with a new one, cylinder head gasket must also be replaced with a new one. Refer to step 4.



6. Install both rocker covers.



7. Install compressor, generator and power steering pump brackets.
8. Install power steering pump.
9. Install compressor and generator.
10. Install exhaust front tube to exhaust manifold.



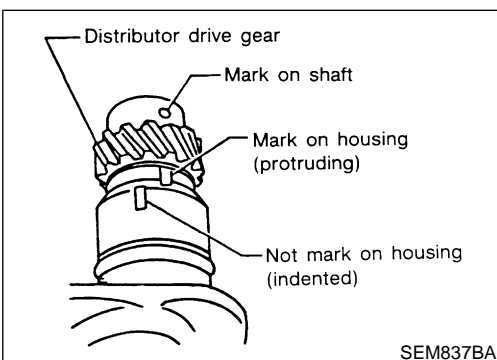
11. Install rear belt cover and camshaft sprocket.

- RH camshaft sprocket and LH camshaft sprocket are different parts. Be sure to install them in the correct location.

	Identification mark	$\theta$
RH camshaft sprocket	R3	$0^{\circ}53'$
LH camshaft sprocket	L3	$-3^{\circ}27'$

12. Install timing belt and adjust belt tension.

Refer to "TIMING BELT — Installation" (EM-78).

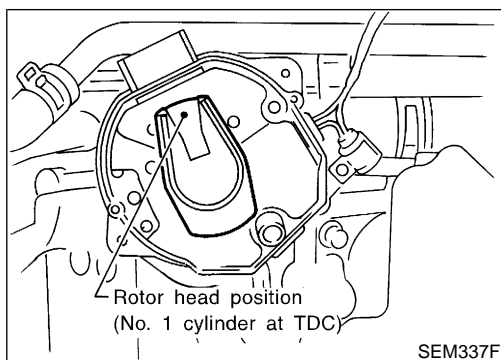


13. Install distributor.

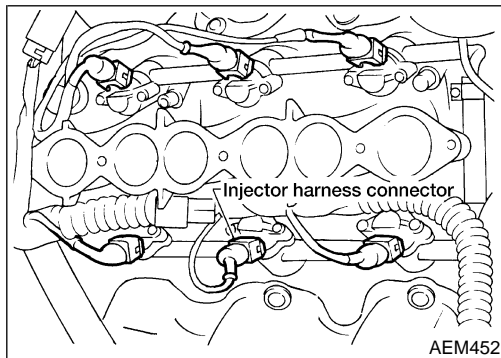
- 1) Align mark on shaft with protruding mark on housing.

GI  
MA  
EM  
LC  
EC  
FE  
CL  
MT  
AT  
TF  
PD  
AX  
SU  
BR  
ST  
RS  
BT  
HA  
SC  
EL  
IDX

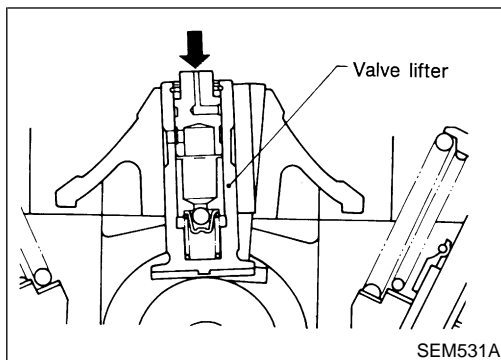
## Installation (Cont'd)



- 2) After installing, confirm that distributor rotor head is set as shown in figure.



14. Install injector fuel tube assembly.
15. Connect all injector harness connectors.
16. Install fuel feed and fuel return hoses to injector fuel tube assembly.
17. Install intake manifold collector. Install all parts which were removed in step 5 under "CYLINDER HEAD — Removal" (EM-85).
18. Install ASCD and accelerator control wire.



19. Check hydraulic valve lifter.
  - a. Push plunger forcefully with your finger.
    - **Be sure to check it with rocker arm in its free position (not on the lobe).**
  - b. If valve lifter moves more than 1 mm (0.04 in), air may be inside it.
  - c. Bleed air off by running engine at 1,000 rpm under no load for about 10 minutes.
  - d. If hydraulic valve lifters are still noisy, replace them and bleed air off again in the same manner as in step 19 (c).

## Removal and Installation

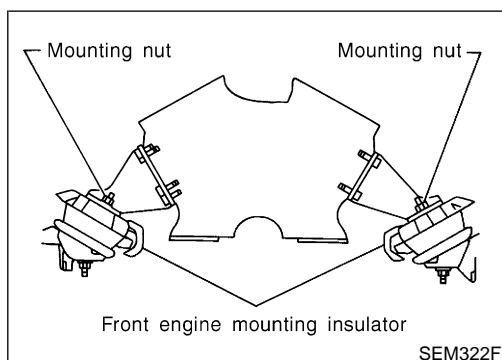
NGEM0020

**WARNING:**

- Situate vehicle on a flat and solid surface.
- Place chocks at front and back of rear wheels.
- Do not remove engine until exhaust system has completely cooled off. Otherwise, you may burn yourself and/or fire may break out in fuel line.
- For safety during subsequent steps, the tension of wires should be slacked against the engine.
- Before disconnecting fuel hose, release fuel pressure from fuel line.  
Refer to *EC-40* "Releasing Fuel Pressure".
- Before removing front axle from transmission, place safety stands under designated front supporting points. Refer to GI section for lifting points and towing.
- Be sure to hoist engine and transmission in a safe manner.
- For engines not equipped with engine slingers, attach proper slingers and bolts described in PARTS CATALOG.

**CAUTION:**

- When lifting engine, be careful not to strike adjacent parts, especially accelerator wire casing, brake lines, and brake master cylinder.
- In hoisting the engine, always use engine slingers in a safe manner.
- Before separating engine and transmission, remove crankshaft position sensor (OBD) from the assembly.
- Always take extra care not to damage edge of crankshaft position sensor (OBD), or ring gear teeth.



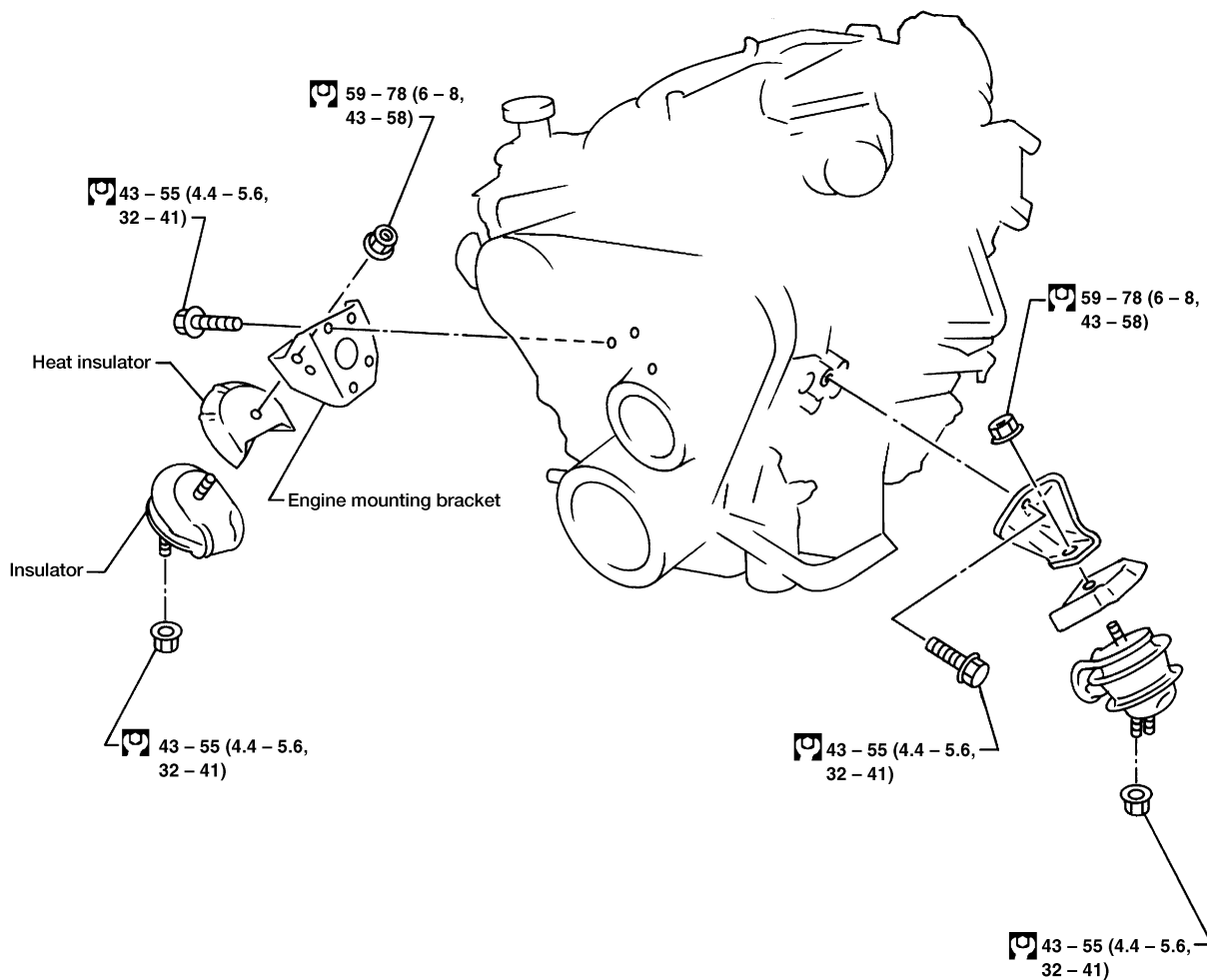
- Do not loosen front engine mounting insulator cover securing bolts.
- When cover is removed, damper oil flows out and mounting insulator will not function.
- For tightening torque, refer to *AT-261*, *MT-41* and *PD-7*. Sealant should be applied between engine and transmission.

## REMOVAL Engine Mounting

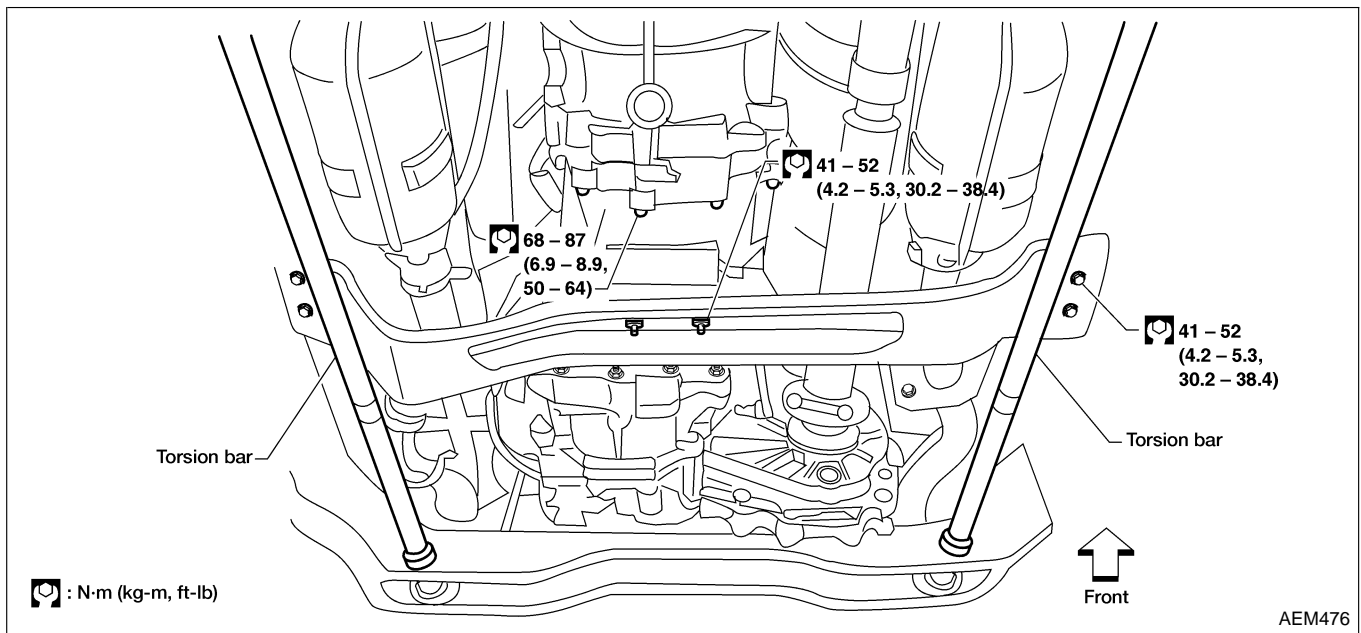
NGEM0020S01

NGEM0020S0101

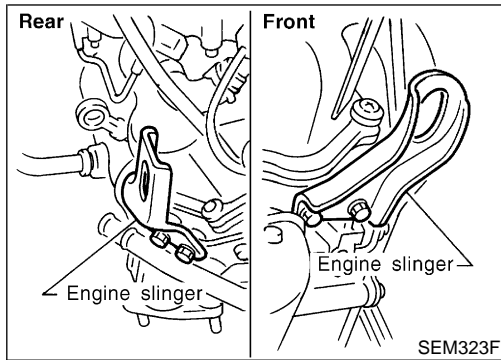
SEC. 112



: N•m (kg-m, ft-lb)



AEM476



SEM323F

1. Remove engine undercover and hood.
2. Drain coolant from cylinder block and radiator. Refer to **MA-27**, ("Changing Engine Coolant", "ENGINE MAINTENANCE").
3. Remove vacuum hoses, fuel tubes, wires, harnesses and connectors.
4. Remove radiator with shroud and cooling fan.
5. Remove drive belts.
6. Discharge refrigerant, refer to **HA-61**, " R-134a Service Procedure", "SERVICE PROCEDURES".
7. Remove A/C compressor manifold.
8. Remove power steering oil pump from engine.
9. Remove front exhaust tubes.
10. Remove transmission from vehicle.

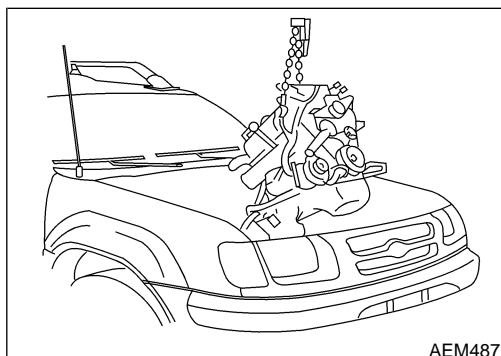
Refer to "Removal" in **MT-41** and **AT-261** sections.

11. Install engine slingers.

**Slinger bolts:**

**⊛ : 20 – 26 N-m (2.1 – 2.7 kg-m, 15 – 20 ft-lb)**

12. Hoist engine with engine slingers and remove engine mounting nuts from both sides.

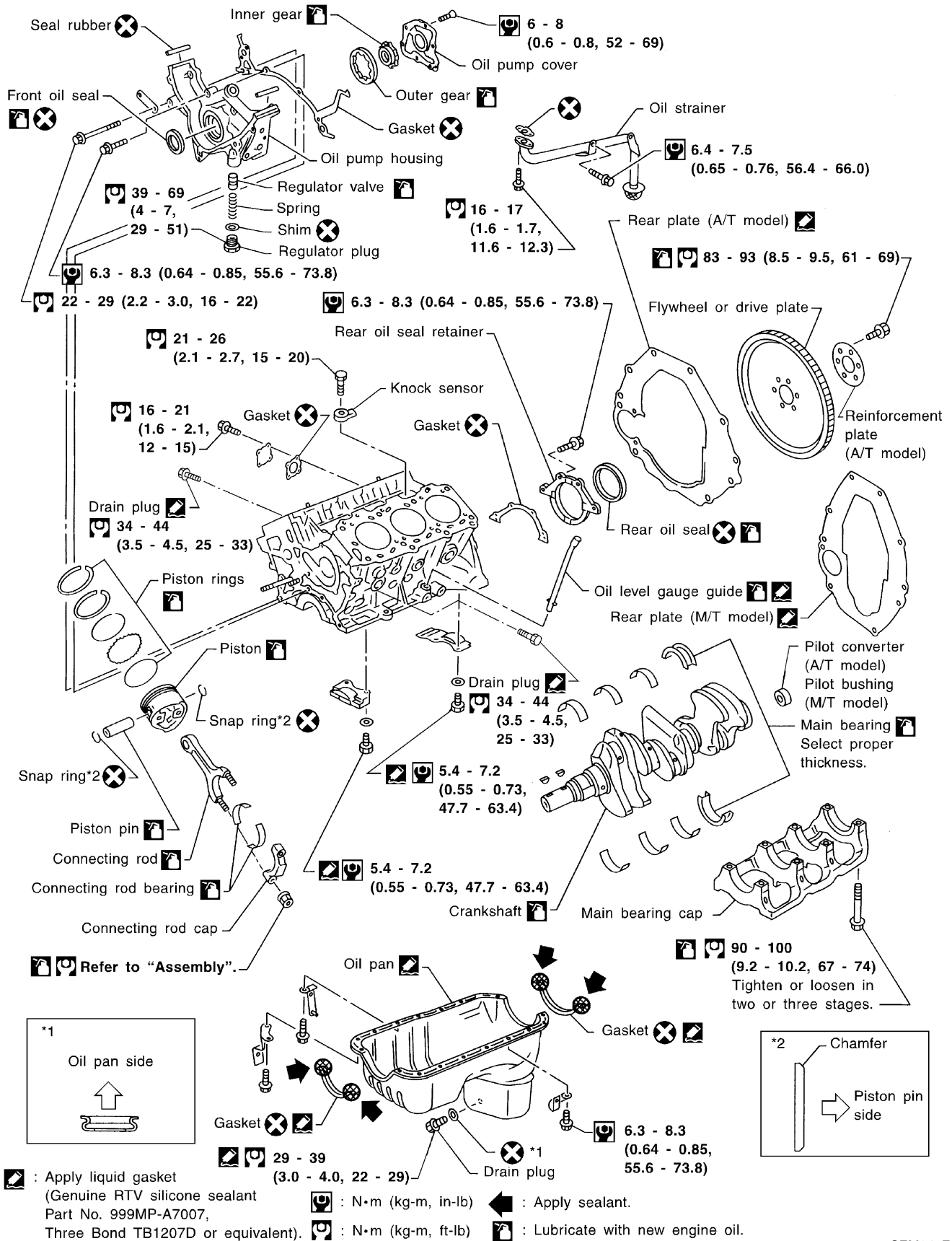


AEM487

13. Remove engine from vehicle

## Components

### SEC. 110•120•150•313



## Removal and Installation

NGEN0022

### CAUTION:

- When installing sliding parts such as bearings and pistons, be sure to apply engine oil on the sliding surfaces.
- Place removed parts such as bearings and bearing caps in their proper order and direction.
- When installing connecting rod bolts and main bearing cap bolts, apply new engine oil to threads and seating surfaces.
- Do not allow any magnetic materials to contact the ring gear teeth on drive plate and rear plate.

GI

MA

**EM**

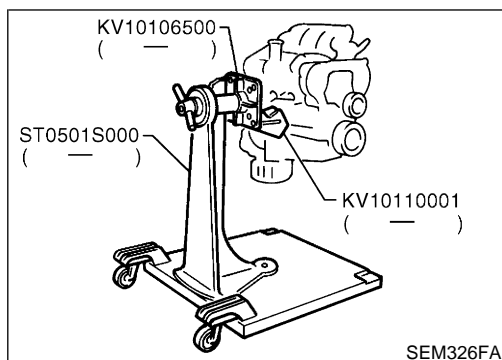
LC

EC

FE

CL

MT



## Disassembly

### PISTON AND CRANKSHAFT

NGEN0023

NGEN0023S01

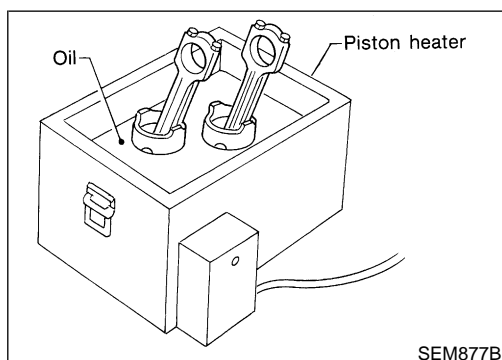
1. Place engine on a work stand.
2. Drain coolant and oil.
3. Remove timing belt.
4. Remove oil pan and oil pump.
5. Remove water pump.
6. Remove cylinder head.

AT

TF

PD

AX



7. Remove pistons with connecting rods.

- When disassembling piston and connecting rod, remove snap ring first, then heat piston to 60 to 70°C (140 to 158°F) or use piston pin press stand at room temperature.

SU

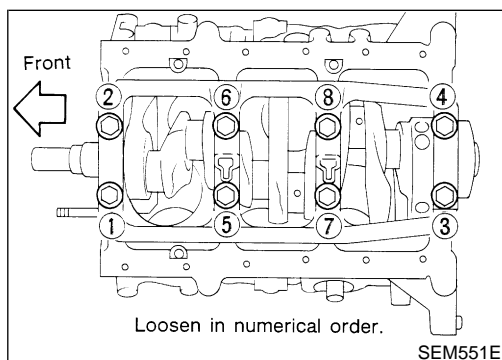
BR

### CAUTION:

- When piston rings are not replaced, make sure that piston rings are mounted in their original positions.
- When replacing piston rings, if there is no punchmark, install with either side up.

ST

RS



8. Remove bearing cap and crankshaft.

- Before removing bearing cap, measure crankshaft end play.
- Bolts should be loosened in two or three steps.

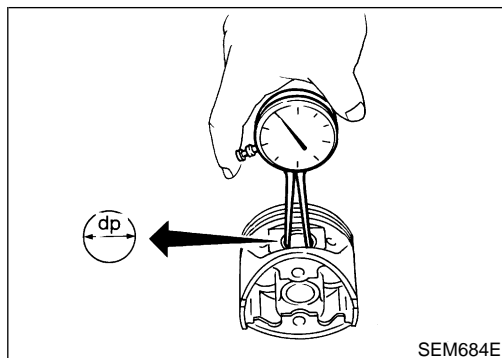
BT

HA

SC

EL

IDX



SEM684E

**Inspection****PISTON AND PISTON PIN CLEARANCE**

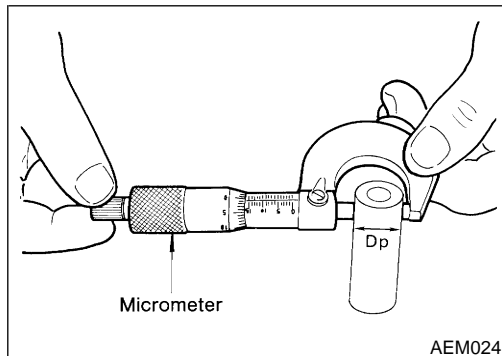
NGEM0024

NGEM0024S01

1. Measure inner diameter of piston pin hole "dp".

**Standard diameter "dp":**

**20.969 - 20.981 mm (0.8255 - 0.8260 in)**



AEM024

2. Measure outer diameter of piston pin "Dp".

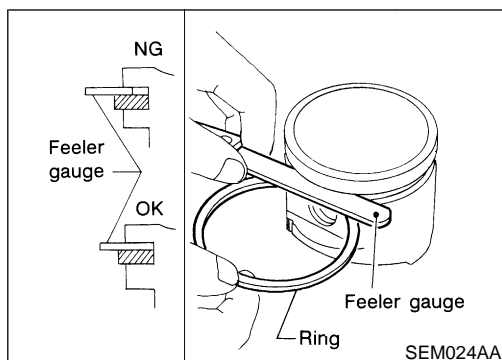
**Standard diameter "Dp":**

**20.971 - 20.983 mm (0.8256 - 0.8261 in)**

3. Calculate piston pin clearance.

**$dp - Dp = 0 - 0.004 \text{ mm (0 - 0.0002 in)}$**

If it exceeds the above value, replace piston assembly with pin.



SEM024AA

**PISTON RING SIDE CLEARANCE**

NGEM0024S02

**Side clearance:**

**Top ring: 0.024 - 0.076 mm (0.0009 - 0.0030 in)**

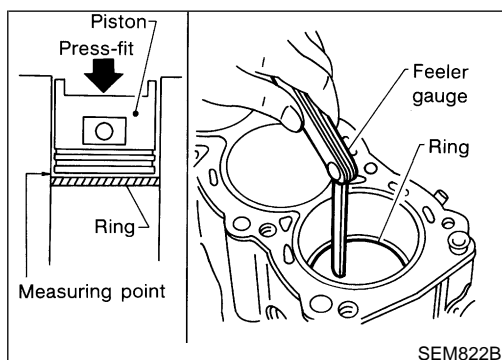
**2nd ring: 0.030 - 0.070 mm (0.0012 - 0.0028 in)**

**Max. limit of side clearance:**

**Top ring: 0.11 mm (0.0043 in)**

**2nd ring: 0.1 mm (0.004 in)**

If out of specification, replace piston and/or piston ring assembly.



SEM822B

**PISTON RING END GAP**

NGEM0024S03

**End gap:**

**Top ring: 0.21 - 0.40 mm (0.0083 - 0.0157 in)**

**2nd ring: 0.50 - 0.69 mm (0.0197 - 0.0272 in)**

**Oil ring: 0.20 - 0.69 mm (0.0079 - 0.0272 in)**

**Max. limit of ring gap:**

**Top ring: 0.54 mm (0.0213 in)**

**2nd ring: 0.80 mm (0.0315 in)**

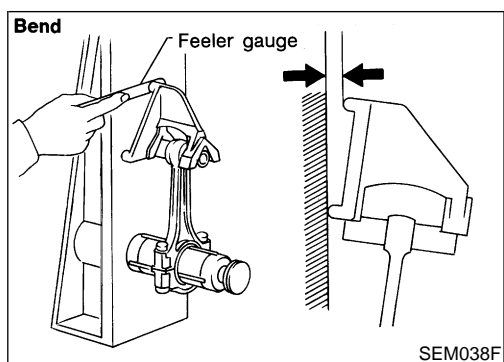
**Oil ring: 0.95 mm (0.0374 in)**

If out of specification, replace piston ring. If gap still exceeds the limit even with a new ring, rebore cylinder and use oversized piston and piston rings.

**Refer to SDS (EM-122).**

- When replacing the piston, check the cylinder block surface for scratches or seizure. If scratches or seizure are found, hone or replace the cylinder block.





## CONNECTING ROD BEND AND TORSION

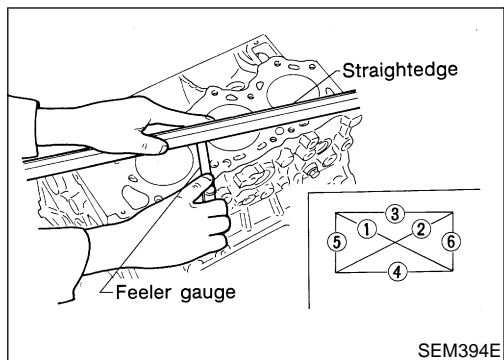
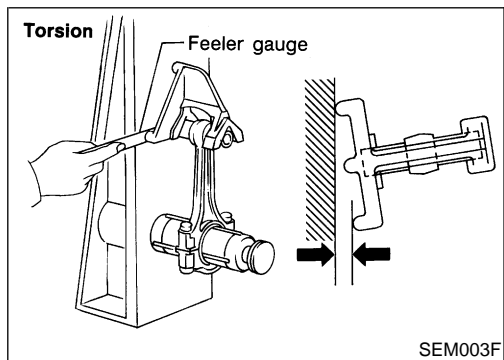
NGEM0024S04
**Bend:**

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.



## CYLINDER BLOCK DISTORTION AND WEAR

NGEM0024S05

1. Clean upper face of cylinder block and measure the distortion.

**Limit:**

0.10 mm (0.0039 in)

2. If out of specification, resurface it.  
The resurfacing limit is determined by cylinder head resurfacing in engine.

**Amount of cylinder head resurfacing is "A".**  
**Amount of cylinder block resurfacing is "B".**

**The maximum limit is as follows:**

**$A + B = 0.2 \text{ mm (0.008 in)}$**

**Nominal cylinder block height from crankshaft center:**

**227.60 - 227.70 mm (8.9606 - 8.9645 in)**

3. If necessary, replace cylinder block.

GI

MA

EM

LC

EC

FE

CL

MT

AT

TF

PD

AX

SU

BR

ST

RS

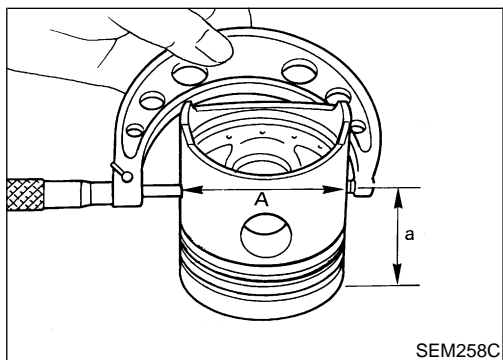
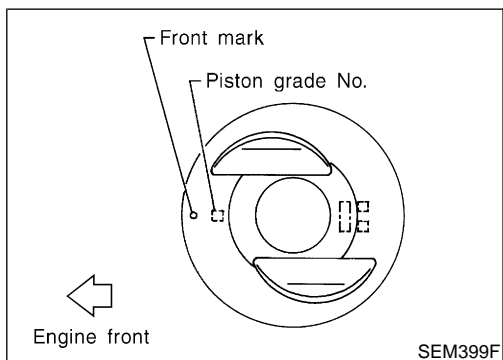
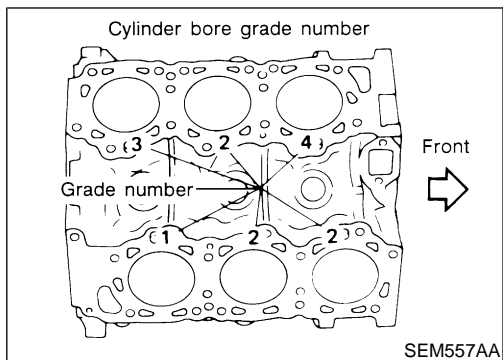
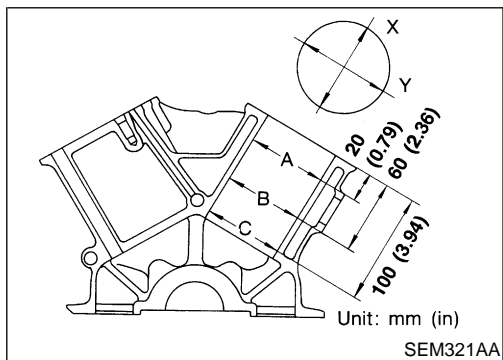
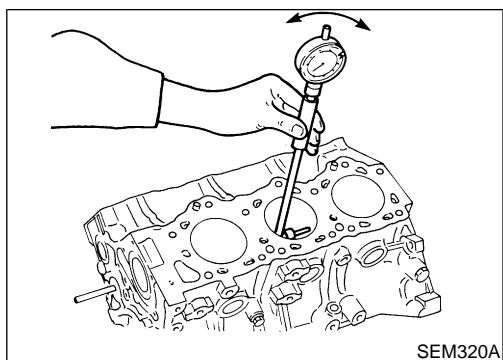
BT

HA

SC

EL

IDX



## PISTON-TO-BORE CLEARANCE

NGE00024S06

- Using a bore gauge, measure cylinder bore for wear, out-of-round and taper.

### Standard inner diameter:

**Engine serial number before VG33-424355**

**91.500 - 91.530 mm (3.6024 - 3.6035 in)**

**Engine serial number from VG33-424355**

**Except for No. 5 cylinder**

**91.500 - 91.530 mm (3.6024 - 3.6035 in)**

**For No. 5 cylinder**

**91.515 - 91.545 mm (3.6029 - 3.6041 in)**

**Refer to "CYLINDER BLOCK" in SDS.**

### Wear limit:

**0.20 mm (0.0079 in)**

If it exceeds the limit, rebore all cylinders. Replace cylinder block if necessary.

### Out-of-round (X - Y) standard:

**0.015 mm (0.0006 in)**

### Taper (A - B or A - C) standard:

**0.015 mm (0.0006 in)**

- Check for scratches and seizure. If seizure is found, hone it.
  - If both cylinder block and piston are replaced with new ones, select piston of the same grade number according to the following table. These numbers are punched on cylinder block and piston in either Arabic or Roman numerals.

### Combination of grade number for cylinder bore and piston

#### Engine serial number before VG33-424355

Cylinder bore grade No.	For No. 3 and 4 cylinders						Except for No. 3 and 4 cylinders		
	1	2	3	4	5	6	1	2	3
Piston grade No.	2-1	3-2	3-3	4-4	4-5	5-6	1	2	3

#### Engine serial number from VG33-424355

Cylinder bore grade No.	For No. 3, 4 and 5 cylinders						For No. 1, 2 and 6 cylinders		
	1	2	3	4	5	6	1	2	3
Piston grade No.	2-1	3-2	3-3	4-4	4-5	5-6	1	2	3

- Measure piston skirt diameter.

### Piston diameter "A":

**Refer to SDS (EM-122).**

### Measuring point "a" (Distance from the top):

**49.0 mm (1.929 in)**

- Check that piston-to-bore clearance is within specification.

### Piston-to-bore clearance "B":

**Engine serial number before VG33-424355**

**0.015 - 0.025 mm (0.0006 - 0.0010 in) for No. 3 and 4 cylinders**

**0.025 - 0.045 mm (0.0010 - 0.0018 in) except for No. 3 and 4 cylinders**

**Engine serial number from VG33-424355**

**0.015 - 0.025 mm (0.0006 - 0.0010 in) for No. 3 and 4 cylinders**

**0.025 - 0.045 mm (0.0010 - 0.0018 in) for No. 1, 2 and 6 cylinders**

**0.030 - 0.040 mm (0.0012 - 0.0016 in) for No. 5 cylinder**

- Determine piston oversize according to amount of cylinder wear.

**Oversize pistons are available for service. Refer to SDS (EM-122).**

- Cylinder bore size is determined by adding piston-to-bore clearance to piston diameter "A".

**Rebored size calculation:**

$$D = A + B - C$$

where,

**D: Bored diameter**

**A: Piston diameter as measured**

**B: Piston-to-bore clearance**

**C: Honing allowance 0.02 mm (0.0008 in)**

- Install main bearing caps, and tighten to the specified torque to prevent distortion of cylinder bores in final assembly.

- Cut cylinder bores.

- 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-bore clearance.

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

- Measurement should be done after cylinder bore cools down.**

## CRANKSHAFT

- Check crankshaft main and pin journals for score, wear or cracks.

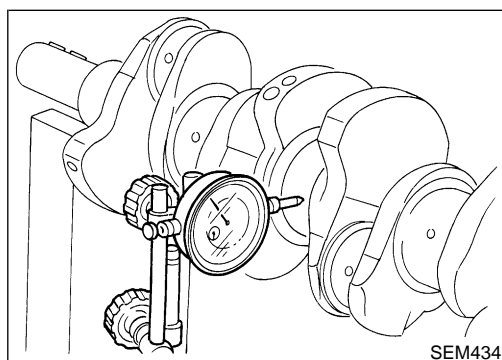
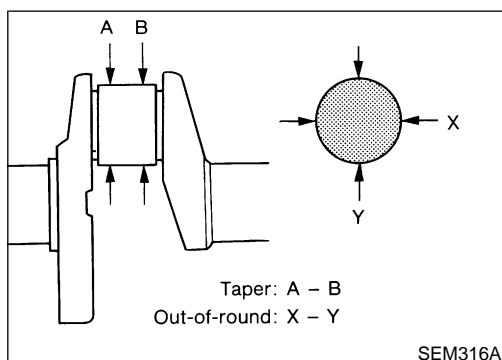
- With a micrometer, measure journals for taper and out-of-round.

**Out-of-round (X - Y):**

**Less than 0.005 mm (0.0002 in)**

**Taper (A - B):**

**Less than 0.005 mm (0.0002 in)**



- Measure crankshaft runout.

**Runout (Total indicator reading):**

**Less than 0.10 mm (0.0039 in)**

GI

MA

EM

LC

EC

FE

CL

MT

AT

TF

PD

AX

SU

BR

ST

RS

BT

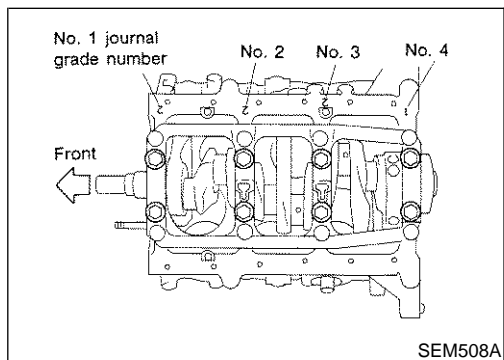
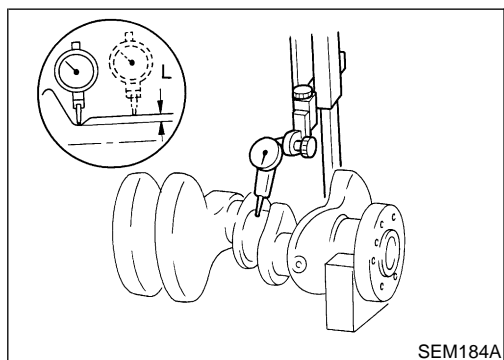
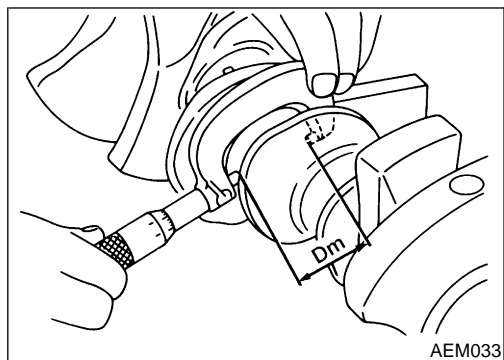
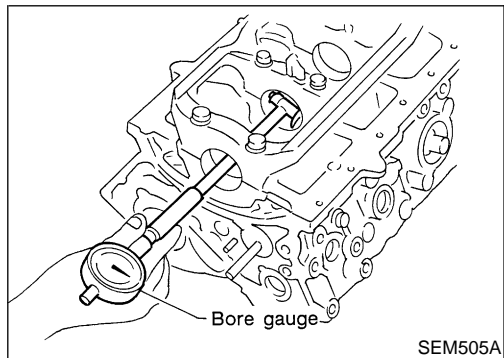
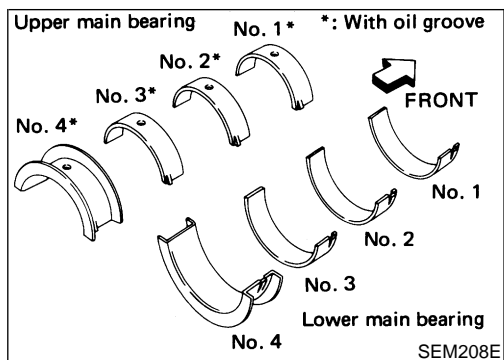
HA

SC

EL

IDX

Inspection (Cont'd)



## BEARING CLEARANCE

NGEM0024S08

- Either of the following two methods may be used, however, method A gives more reliable results and is preferable.

### Method A (Using bore gauge & micrometer)

#### Main Bearing

NGEM0024S0801

- Set main bearings in their proper positions on cylinder block and main bearing cap.

- Install main bearing cap to cylinder block.

**Tighten all bolts in correct order in two or three stages.**

- Measure inner diameter "A" of each main bearing.

- Measure outer diameter "Dm" of each crankshaft main journal.
- Calculate main bearing clearance.

**Main bearing clearance (A – Dm):**

**Standard**

**0.028 - 0.055 mm (0.0011 - 0.0022 in)**

**Limit**

**0.090 mm (0.0035 in)**

- If it exceeds the limit, replace bearing.
- If clearance cannot be adjusted within the standard of any bearing, grind crankshaft journal and use undersized bearing.

- When grinding crankshaft journal, confirm that "L" dimension in fillet roll is more than the specified limit.

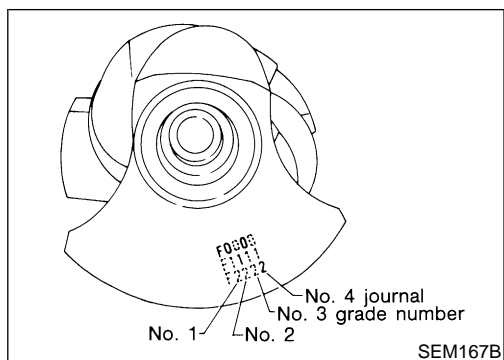
**"L": 0.1 mm (0.004 in)**

- Refer to SDS for grinding crankshaft and available service parts.

- If crankshaft is reused, measure main bearing clearances and select thickness of main bearings.

If crankshaft is replaced with a new one, it is necessary to select thickness of main bearings as follows:

- Grade number of each cylinder block main journal is punched on the respective cylinder block. These numbers are punched in either Arabic or Roman numerals.



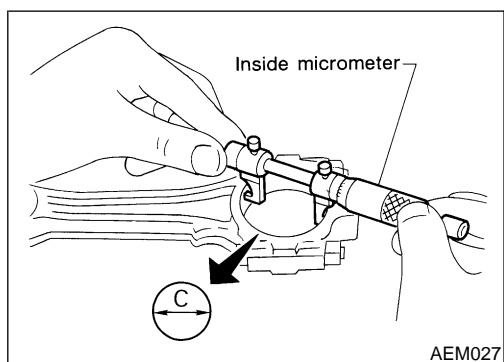
- b. Grade number of each crankshaft main journal is punched on the respective crankshaft. These numbers are punched in either Arabic or Roman numerals.
- c. Select main bearing with suitable thickness according to the following example or table.

### No. 1 main bearing grade number (Identification color):

		Main journal grade number			
		"3"	"4"	"5"	"6"
"3"	A (Black)	B (Brown)	C (Green)	D (Yellow)	
"4"	B (Brown)	C (Green)	D (Yellow)	E (Blue)	
"5"	C (Green)	D (Yellow)	E (Blue)	F (Pink)	
"6"	D (Yellow)	E (Blue)	F (Pink)	G (Purple)	

### Except No. 1 main bearing grade number (Identification color):

		Main journal grade number		
		"0"	"1"	"2"
Crankshaft journal grade number	"0"	A (Black)	B (Brown)	C (Green)
	"1"	B (Brown)	C (Green)	D (Yellow)
	"2"	C (Green)	D (Yellow)	E (Blue)

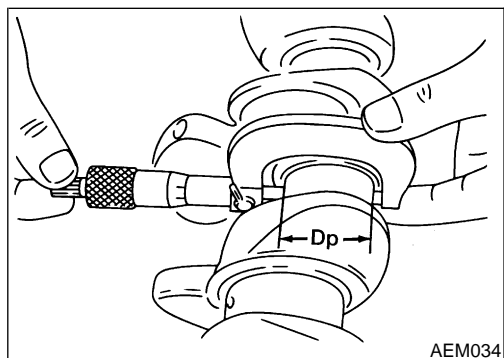


### Connecting Rod Bearing (Big end)

1. Install connecting rod bearing to connecting rod and cap.
2. Install connecting rod cap to connecting rod.

#### Tighten bolts to the specified torque.

3. Measure inner diameter "C" of each bearing.



4. Measure outer diameter "Dp" of each crankshaft pin journal.
5. Calculate connecting rod bearing clearance.

#### Connecting rod bearing clearance (C – Dp):

##### Standard

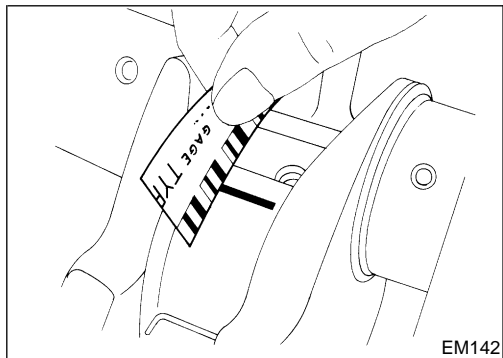
**0.014 - 0.054 mm (0.0006 - 0.0021 in)**

##### Limit

**0.090 mm (0.0035 in)**

6. If it exceeds the limit, replace bearing.
7. If clearance cannot be adjusted within the standard of any bearing, grind crankshaft journal and use undersized bearing.

Refer to step 7 of "BEARING CLEARANCE — Main bearing" (EM-108).

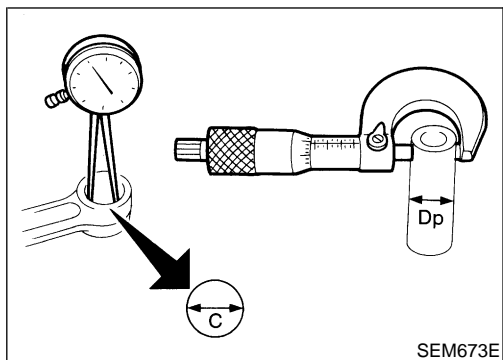


EM142

### Method B (Using plastigage)

#### CAUTION:

- Do not turn crankshaft or connecting rod while plastigage is being inserted.
- When bearing clearance exceeds the specified limit, ensure that the proper bearing has been installed. Then if excessive bearing clearance exists, use a thicker main bearing or undersized bearing so that the specified bearing clearance is obtained.



SEM673E

### CONNECTING ROD BUSHING CLEARANCE (SMALL END)

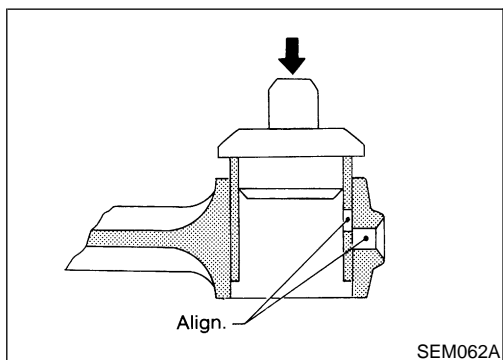
NGEM0024S09

1. Measure inner diameter "C" of bushing.
2. Measure outer diameter "Dp" of piston pin.
3. Calculate connecting rod bushing clearance.

$$\text{Connecting rod bushing clearance} = C - D_p$$

**Standard: 0.005 - 0.017 mm (0.0002 - 0.0007 in)**  
**Limit: 0.023 mm (0.0009 in)**

If it exceeds the limit, replace connecting rod assembly or connecting rod bushing and/or piston set with pin.



SEM062A

### REPLACEMENT OF CONNECTING ROD BUSHING (SMALL END)

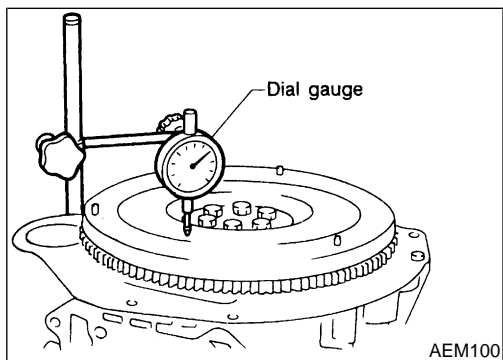
NGEM0024S10

1. Drive in small end bushing until it is flush with end surface of rod.

**Be sure to align the oil holes.**

2. After driving in small end bushing, ream the bushing so that clearance between connecting rod bushing and piston pin is the specified value.

**Clearance between connecting rod bushing and piston pin:**  
**0.005 - 0.017 mm (0.0002 - 0.0007 in)**



AEM100

### FLYWHEEL/DRIVE PLATE RUNOUT

NGEM0024S11

**Runout (Total indicator reading):**  
**Flywheel (M/T model)**  
**Less than 0.15 mm (0.0059 in)**  
**Drive plate (A/T model)**  
**Less than 0.15 mm (0.0059 in)**

#### CAUTION:

- Be careful not to damage the ring gear teeth.
- Check the drive plate for deformation or cracks.

- Do not allow any magnetic materials to contact the ring gear teeth.
- Do not surface flywheel or drive plate. Replace as necessary.

GI

MA

EM

LC

EC

FE

CL

MT

AT

TF

PD

AX

SU

BR

ST

RS

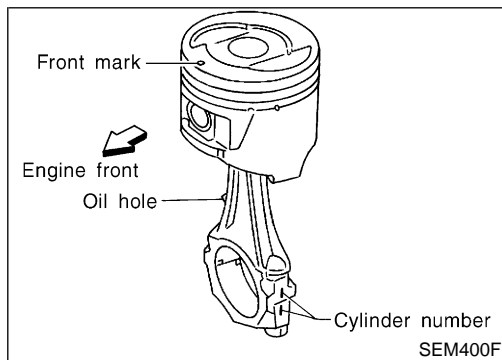
BT

HA

SC

EL

IDX



## Assembly

### PISTON

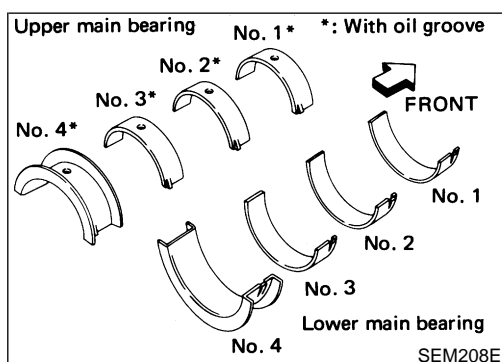
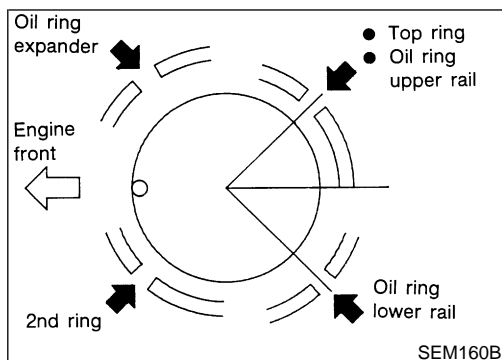
NGEM0025

NGEM0025S01

1. Install new snap ring on one side of piston pin hole.
2. Heat piston to 60 to 70°C (140 to 158°F) and assemble piston, piston pin, connecting rod and new snap ring.

- Align the direction of piston and connecting rod.
- Numbers stamped on connecting rod and cap correspond to each cylinder.
- After assembly, make sure connecting rod swings smoothly.

3. Set piston rings as shown.



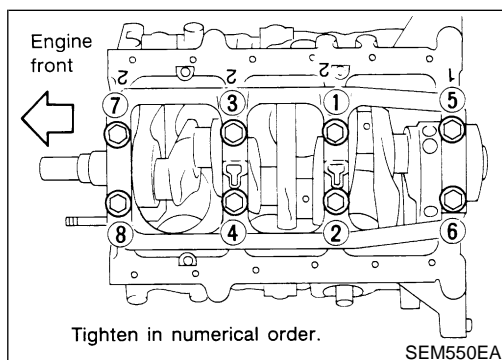
### CRANKSHAFT

NGEM0025S02

1. Set main bearings in their proper positions on cylinder block and main bearing cap.

- Confirm that correct main bearings are used.
- Apply new engine oil to bearing surfaces.

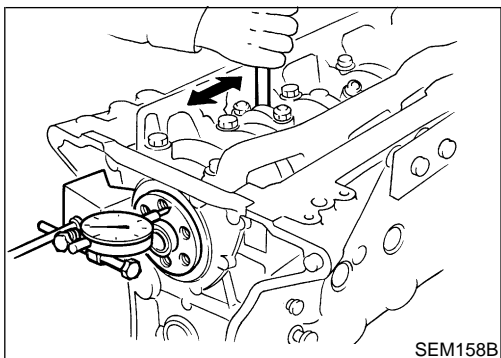
Refer to "BEARING CLEARANCE" (EM-108).



2. Install crankshaft and main bearing caps and tighten bolts to the specified torque.

- Prior to tightening bearing cap bolts, place bearing cap in its proper position by shifting crankshaft in the axial direction.
- Tighten bearing cap bolts gradually in two or three stages. Start with center bearing and move outward sequentially.
- After securing bearing cap bolts, make sure crankshaft turns smoothly by hand.
- Lubricate threads and seat surfaces of the bolts with new engine oil.

## Assembly (Cont'd)



3. Measure crankshaft end play.

### Crankshaft end play:

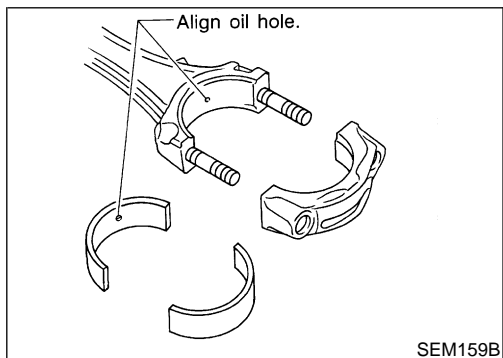
#### Standard

**0.050 - 0.170 mm (0.0020 - 0.0067 in)**

#### Limit

**0.30 mm (0.0118 in)**

If beyond the limit, replace bearing with a new one.

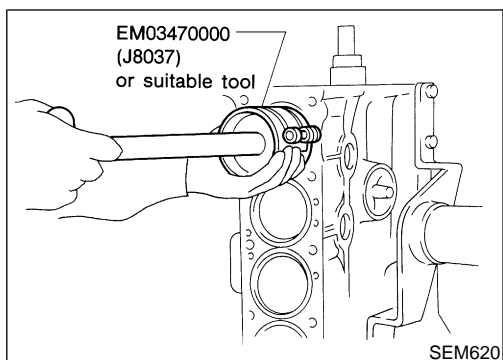


4. Install connecting rod bearings in connecting rods and connecting rod caps.

- **Confirm that correct bearings are used.**

Refer to "Inspection".

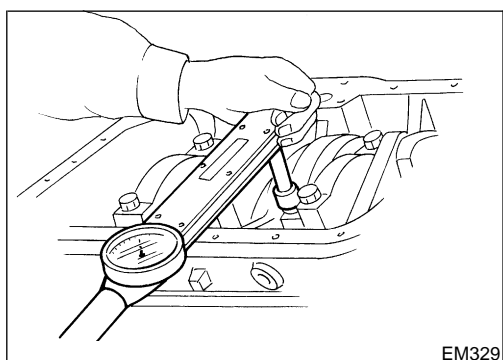
- Install bearings so that oil hole in connecting rod aligns with oil hole of bearing.



5. Install pistons with connecting rods.

a. Install them into corresponding cylinders with Tool.

- **Be careful not to scratch cylinder wall by connecting rod.**
- **Arrange so that front mark on piston head faces toward front of engine.**



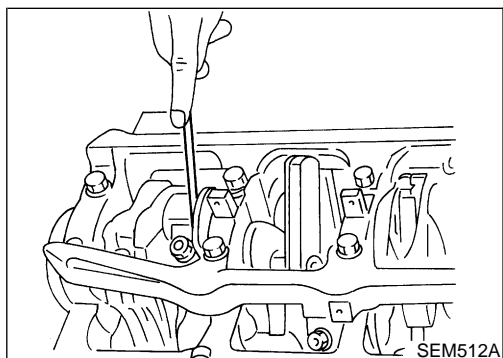
b. Install connecting rod bearing caps.

- **Lubricate threads and seat surfaces with new engine oil.** Tighten connecting rod bearing cap nuts to the specified torque.

### : Connecting rod bearing nut

(1) Tighten to 14 to 16 N-m (1.4 to 1.6 kg-m, 10 to 12 ft-lb).

(2) Turn nuts 60 to 65 degrees clockwise. If an angle wrench is not available, tighten nuts to 38 to 44 N-m (3.9 to 4.5 kg-m, 28 to 33 ft-lb).



6. Measure connecting rod side clearance.

### Connecting rod side clearance:

#### Standard

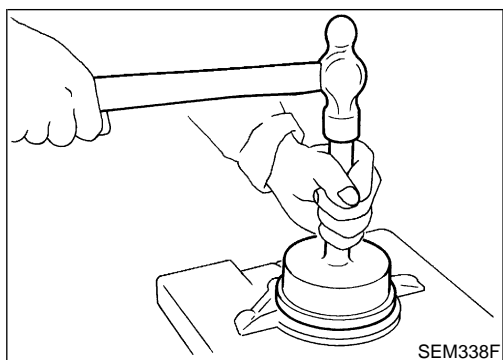
**0.20 - 0.35 mm (0.0079 - 0.0138 in)**

#### Limit

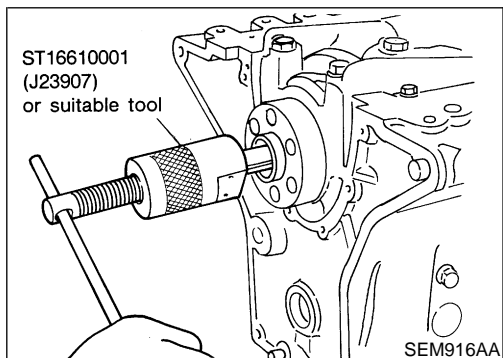
**0.40 mm (0.0157 in)**

If beyond the limit, replace connecting rod and/or crankshaft.





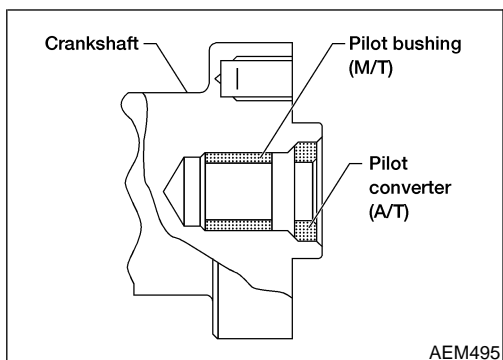
7. Install rear oil seal retainer.



## REPLACING PILOT BUSHING (M/T) OR PILOT CONVERTER (A/T)

NGEM0025S03

1. Remove pilot bushing (M/T) or pilot converter (A/T).



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

GI

MA

**EM**

LC

EC

FE

CL

MT

AT

TF

PD

AX

SU

BR

ST

RS

BT

HA

SC

EL

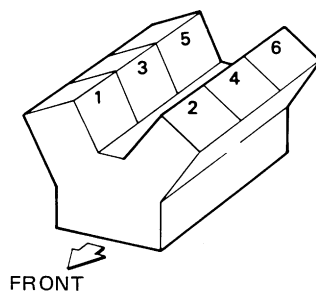
IDX

## General Specifications

=NGEM0026

Cylinder arrangement		V-6
Displacement		3,275 cm <sup>3</sup> (199.84 cu in)
Bore and stroke		91.5 x 83 mm (3.602 x 3.27 in)
Valve arrangement		OHC
Firing order		1-2-3-4-5-6
Number of piston rings	Compression	2
	Oil	1
Number of main bearings		4
Compression ratio		8.9

Cylinder number



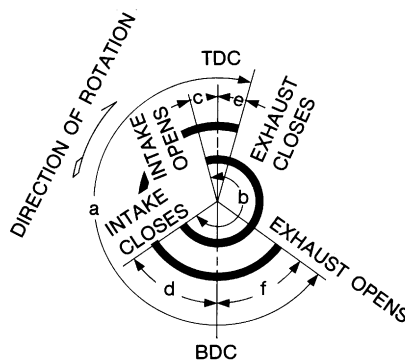
SEM713A

 Unit: kPa (kg/cm<sup>2</sup>, psi)/300 rpm

Compression pressure	Standard	1,196 (12.2, 173)
	Minimum	883 (9.0, 128)
	Differential limit between cylinders	98 (1.0, 14)

Unit: degree

Valve timing



EM120

a	b	c	d	e	f
240	244	4	60	9	51

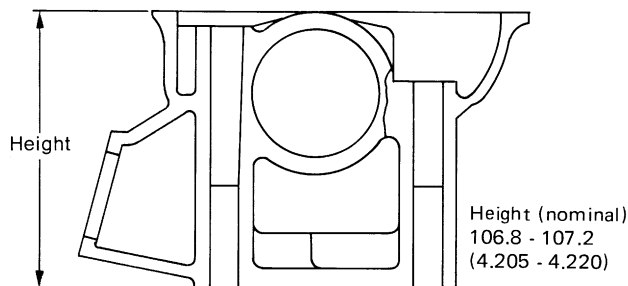
# SERVICE DATA AND SPECIFICATIONS (SDS)

**VG33E**  
Cylinder Head

## Cylinder Head

NGEM0027  
Unit: mm (in)

	Standard	Limit
Head surface distortion	Less than 0.03 (0.0012)	0.1 (0.004)



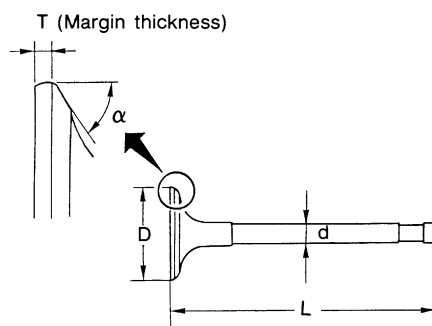
SEM082B

## Valve

### VALVE

NGEM0028

NGEM0028S01  
Unit: mm (in)



SEM188

Valve head diameter "D"	Intake	42.0 - 42.2 (1.654 - 1.661)
	Exhaust	34.95 - 35.25 (1.376 - 1.388)
Valve length "L"	Intake	125.3 - 125.9 (4.933 - 4.957)
	Exhaust	124.2 - 124.8 (4.890 - 4.913)
Valve stem diameter "d"	Intake	6.965 - 6.980 (0.2742 - 0.2748)
	Exhaust	7.962 - 7.970 (0.3135 - 0.3138)
Valve seat angle "α"	Intake	45°15' - 45°45'
	Exhaust	
Valve margin "T"	Intake	1.15 - 1.45 (0.0453 - 0.0571)
	Exhaust	1.35 - 1.65 (0.0531 - 0.0650)
Valve margin "T" limit		More than 0.5 (0.020)
Valve stem end surface grinding limit		Less than 0.2 (0.008)
Valve clearance	Intake	0 (0)
	Exhaust	0 (0)

# SERVICE DATA AND SPECIFICATIONS (SDS)

**VG33E**

Valve (Cont'd)

## VALVE SPRING

NGEM0028S02

Free height	Outer	51.2 mm (2.016 in)
	Inner	44.1 mm (1.736 in)
Pressure	Outer	523.7 N (53.4 kg, 117.7 lb) at 30.0 mm (1.181 in)
	Inner	255.0 N (26.0 kg, 57.3 lb) at 25.0 mm (0.984 in)
Out-of-square	Outer	2.2 mm (0.087 in)
	Inner	1.9 mm (0.075 in)

## HYDRAULIC VALVE LIFTER

NGEM0028S03  
Unit: mm (in)

Lifter outside diameter	15.947 - 15.957 (0.6278 - 0.6282)
Lifter guide inside diameter	16.000 - 16.013 (0.6299 - 0.6304)
Clearance between lifter and lifter guide	0.043 - 0.066 (0.0017 - 0.0026)

## VALVE GUIDE

NGEM0028S04  
Unit: mm (in)

			Standard	Service
Valve guide	Outer diameter	Intake	11.023 - 11.034 (0.4340 - 0.4344)	11.223 - 11.234 (0.4418 - 0.4423)
		Exhaust	12.023 - 12.034 (0.4733 - 0.4738)	12.223 - 12.234 (0.4812 - 0.4817)
	Inner diameter (Finished size)	Intake	7.000 - 7.018 (0.2756 - 0.2763)	
		Exhaust	8.000 - 8.011 (0.3150 - 0.3154)	
Cylinder head valve guide hole diameter	Intake	10.975 - 10.996 (0.4321 - 0.4329)	11.175 - 11.196 (0.4400 - 0.4408)	
	Exhaust	11.975 - 11.996 (0.4715 - 0.4723)	12.175 - 12.196 (0.4793 - 0.4802)	
Interference fit of valve guide	Intake	0.027 - 0.059 (0.0011 - 0.0023)		
	Exhaust			
			Standard	Max. tolerance
Stem to guide clearance	Intake	0.020 - 0.053 (0.0008 - 0.0021)	0.10 (0.0039)	
	Exhaust	0.030 - 0.049 (0.0012 - 0.0019)		
Valve deflection limit			—	0.20 (0.0079)

## ROCKER SHAFT AND ROCKER ARM

NGEM0028S05  
Unit: mm (in)

Rocker shaft	Outer diameter	17.979 - 18.000 (0.7078 - 0.7087)
Rocker arm	Inner diameter	18.007 - 18.028 (0.7089 - 0.7098)
Clearance between rocker arm and rocker shaft		0.007 - 0.049 (0.0003 - 0.0019)

Valve Seat

NGEM0029

NGEM0029S01

INTAKE VALVE SEAT

GI

MA

**EM**

LC

EC

FE

CL

MT

AT

TF

PD

AX

SU

BR

ST

RS

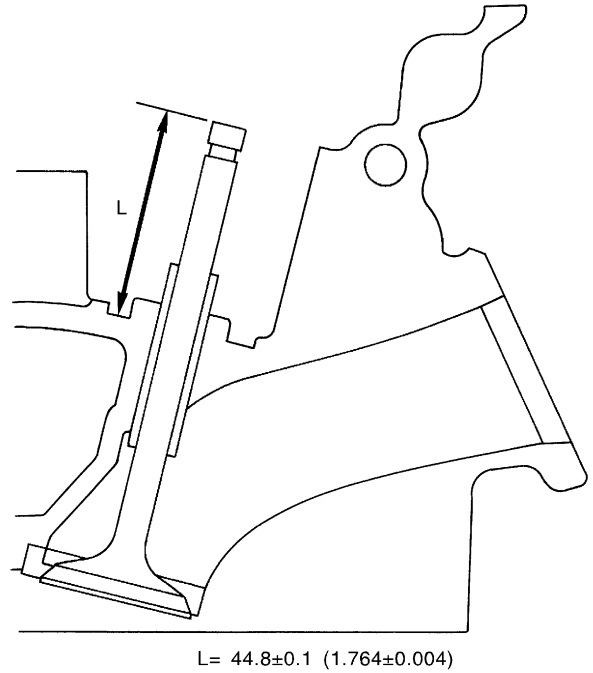
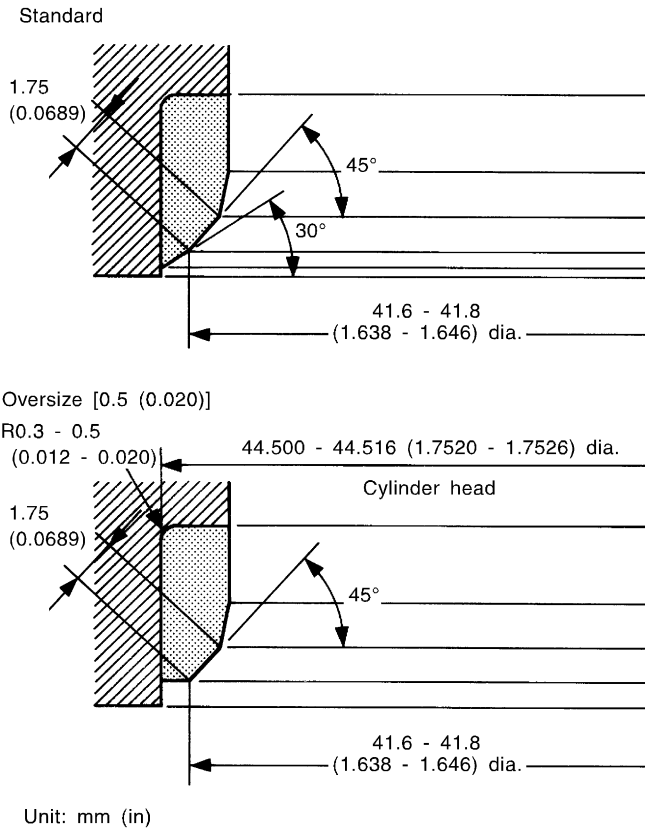
BT

HA

SC

EL

IDX

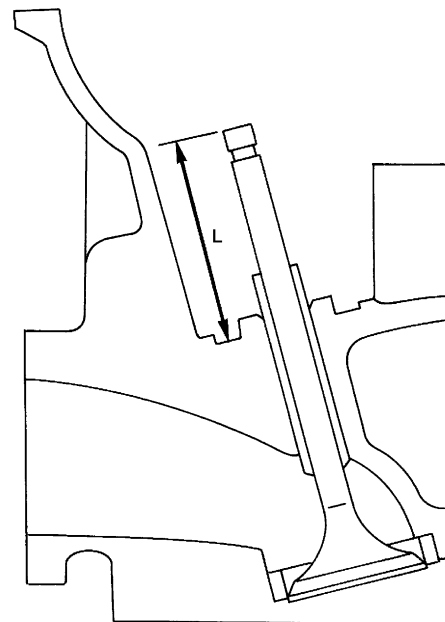
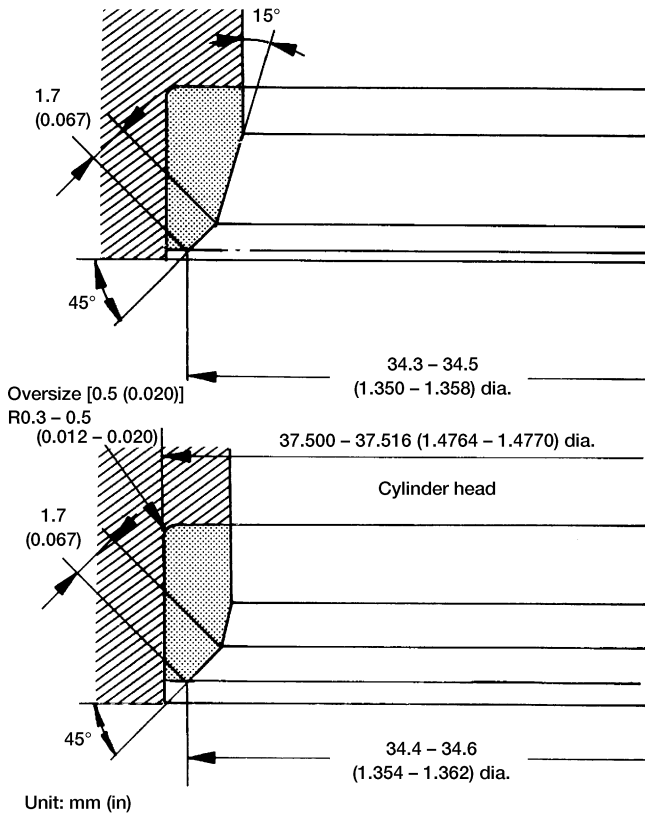


SEM639F

EXHAUST VALVE SEAT

NGEM0029S02

Standard

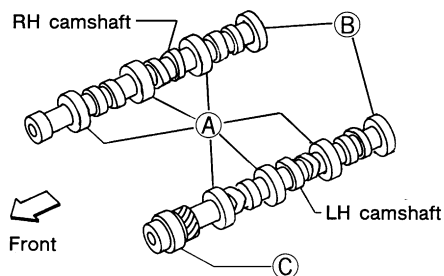


L = 45.4 ± 0.1 (1.79 ± 0.004)

AEM455

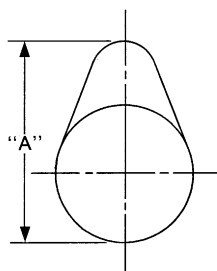
Camshaft and Camshaft Bearing

Unit: mm (in) NGEM0030



SEM893BA

	Standard	Max. tolerance
Camshaft journal to bearing clearance	0.060 - 0.105 (0.0024 - 0.0041)	0.15 (0.0059)
Inner diameter of camshaft bearing	A: 47.000 - 47.025 (1.8504 - 1.8514)	—
	B: 42.500 - 42.525 (1.6732 - 1.6742)	—
	C: 48.000 - 48.025 (1.8898 - 1.8907)	—
Outer diameter of camshaft journal	A: 46.920 - 46.940 (1.8472 - 1.8480)	—
	B: 42.420 - 42.440 (1.6701 - 1.6709)	—
	C: 47.920 - 47.940 (1.8866 - 1.8874)	—
Camshaft runout [TIR*]	Less than 0.04 (0.0016)	0.1 (0.004)
Camshaft end play	0.03 - 0.06 (0.0012 - 0.0024)	—



EM671

Cam height "A"	Intake	38.943 - 39.133 (1.5332 - 1.5407)
	Exhaust	38.943 - 39.133 (1.5332 - 1.5407)
Wear limit of cam height		0.15 (0.0059)

\*Total indicator reading

# SERVICE DATA AND SPECIFICATIONS (SDS)

**VG33E**

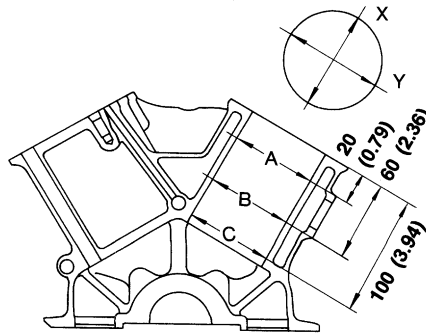
Cylinder Block

## Cylinder Block

=NGEM0031

Engine serial number before VG33-424355

Unit: mm (in)



SEM321A

Surface flatness		Standard		Less than 0.03 (0.0012)
		Limit		0.10 (0.0039)
Cylinder bore	Inner diameter	Standard (for No. 3 and 4 cylinders)	Grade No. 1	91.500 - 91.505 (3.6024 - 3.6026)
			Grade No. 2	91.505 - 91.510 (3.6026 - 3.6027)
			Grade No. 3	91.510 - 91.515 (3.6027 - 3.6029)
			Grade No. 4	91.515 - 91.520 (3.6029 - 3.6031)
			Grade No. 5	91.520 - 91.525 (3.6031 - 3.6033)
			Grade No. 6	91.525 - 91.530 (3.6033 - 3.6035)
		Standard (except No. 3 and 4 cylinders)	Grade No. 1	91.500 - 91.510 (3.6024 - 3.6027)
			Grade No. 2	91.510 - 91.520 (3.6027 - 3.6031)
			Grade No. 3	91.520 - 91.530 (3.6031 - 3.6035)
		Wear limit		0.20 (0.0079)
Out-of-round (X - Y)				Less than 0.015 (0.0006)
Taper (A - B or A - C)				Less than 0.015 (0.0006)
Main journal inner diameter		No. 1 main journal	Grade No.3	66.645 - 66.651 (2.6238 - 2.6240)
			Grade No. 4	66.651 - 66.657 (2.6240 - 2.6243)
			Grade No. 5	66.657 - 62.663 (2.6243 - 2.6245)
			Grade No. 6	66.663 - 66.669 (2.6245 - 2.6248)
		Except No. 1 main journal	Grade No. 0	66.645 - 66.654 (2.6238 - 2.6242)
			Grade No. 1	66.654 - 66.663 (2.6242 - 2.6245)
Difference in inner diameter between cylinders		Standard		Less than 0.05 (0.0020)



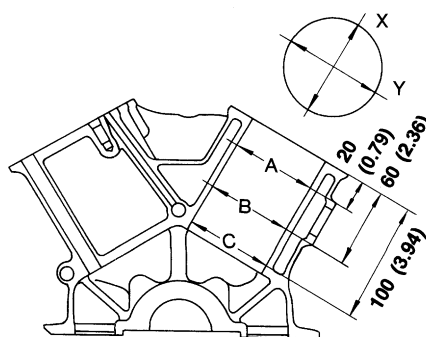
# SERVICE DATA AND SPECIFICATIONS (SDS)

**VG33E**

Cylinder Block (Cont'd)

Engine serial number from VG33-424355

Unit: mm (in)



SEM321A

Surface flatness		Standard	Less than 0.03 (0.0012)	
		Limit	0.10 (0.0039)	
Cylinder bore	Inner diameter	Standard (for No. 3 and 4 cylinders)	Grade No. 1	91.500 - 91.505 (3.6024 - 3.6026)
			Grade No. 2	91.505 - 91.510 (3.6026 - 3.6027)
			Grade No. 3	91.510 - 91.515 (3.6027 - 3.6029)
			Grade No. 4	91.515 - 91.520 (3.6029 - 3.6031)
			Grade No. 5	91.520 - 91.525 (3.6031 - 3.6033)
			Grade No. 6	91.525 - 91.530 (3.6033 - 3.6035)
		Standard (for No. 1, 2 and 6 cylinders)	Grade No. 1	91.500 - 91.510 (3.6024 - 3.6027)
			Grade No. 2	91.510 - 91.520 (3.6027 - 3.6031)
			Grade No. 3	91.520 - 91.530 (3.6031 - 3.6035)
		Standard (for No. 5 cylinder)	Grade No. 1	91.515 - 91.520 (3.6029 - 3.6031)
			Grade No. 2	91.520 - 91.525 (3.6031 - 3.6033)
			Grade No. 3	91.525 - 91.530 (3.6033 - 3.6035)
			Grade No. 4	91.530 - 91.535 (3.6035 - 3.6037)
			Grade No. 5	91.535 - 91.540 (3.6037 - 3.6039)
			Grade No. 6	91.540 - 91.545 (3.6039 - 3.6041)
		Wear limit	0.20 (0.0079)	
Out-of-round (X - Y)		Less than 0.015 (0.0006)		
Taper (A - B or A - C)		Less than 0.015 (0.0006)		
Main journal inner diameter	No. 1 main journal	Grade No.3	66.645 - 66.651 (2.6238 - 2.6240)	
		Grade No. 4	66.651 - 66.657 (2.6240 - 2.6243)	
		Grade No. 5	66.657 - 62.663 (2.6243 - 2.6245)	
	Except No. 1 main journal	Grade No. 6	66.663 - 66.669 (2.6245 - 2.6248)	
		Grade No. 0	66.645 - 66.654 (2.6238 - 2.6242)	
		Grade No. 1	66.654 - 66.663 (2.6242 - 2.6245)	
	Grade No. 2	66.663 - 66.672 (2.6245 - 2.6249)		
	Difference in inner diameter between cylinders		Standard	Less than 0.05 (0.0020)

# SERVICE DATA AND SPECIFICATIONS (SDS)

**VG33E**

Piston, Piston Ring and Piston Pin

## Piston, Piston Ring and Piston Pin

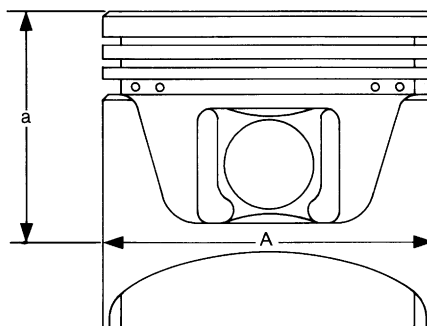
=NGEM0032

NGEM0032S01

### AVAILABLE PISTON

Engine serial number before VG33-424355

Unit: mm (in)



SEM882E

Piston skirt diameter "A"	Standard (for No. 3 and 4 cylinders)	Grade No. 2-1	91.480 - 91.485 (3.6016 - 3.6018)
		Grade No. 3-2	91.485 - 91.490 (3.6018 - 3.6020)
		Grade No. 3-3	91.490 - 91.495 (3.6020 - 3.6022)
		Grade No. 4-4	91.495 - 91.500 (3.6022 - 3.6024)
		Grade No. 4-5	91.500 - 91.505 (3.6024 - 3.6026)
		Grade No. 5-6	91.506 - 91.510 (3.6026 - 3.6027)
	Standard (except No. 3 and 4 cylinders)	Grade No. 1	91.465 - 91.475 (3.6010 - 3.6014)
		Grade No. 2	91.475 - 91.485 (3.6014 - 3.6018)
		Grade No. 3	91.485 - 91.495 (3.6018 - 3.6022)
	0.25 (0.0098) oversize (Service)		91.715 - 91.745 (3.6108 - 3.6120)
0.50 (0.0197) oversize (Service)		91.965 - 91.995 (3.6207 - 3.6218)	
"a" dimension			49.0 (1.929)
Piston pin hole diameter			20.969 - 20.981 (0.8255 - 0.8260)
Piston clearance to cylinder block	Standard	For No. 3 and 4 cylinders	0.015 - 0.025 (0.0006 - 0.0010)
		Except for No. 3 and 4 cylinders	0.025 - 0.045 (0.0010 - 0.0018)

### PISTON RING

NGEM0032S02  
Unit: mm (in)

		Standard	Limit
Side clearance	Top	0.024 - 0.076 (0.0009 - 0.0030)	0.11 (0.0043)
	2nd	0.030 - 0.070 (0.0012 - 0.0028)	0.10 (0.004)
	Oil	0.015 - 0.185 (0.0006 - 0.0073)	—
Ring gap	Top	0.21 - 0.40 (0.0083 - 0.0157)	0.54 (0.0213)
	2nd	0.50 - 0.69 (0.0197 - 0.0272)	0.80 (0.0315)
	Oil (rail ring)	0.20 - 0.69 (0.0079 - 0.0272)	0.95 (0.0374)

# SERVICE DATA AND SPECIFICATIONS (SDS)

**VG33E**

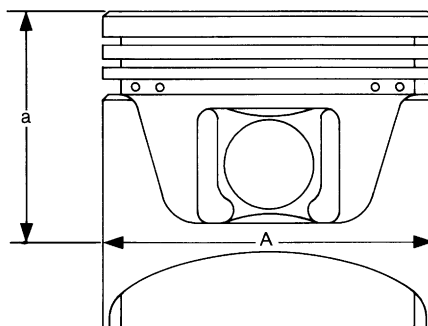
Piston, Piston Ring and Piston Pin (Cont'd)

## AVAILABLE PISTON

Engine serial number from VG33-424355

-NGEM0032S04

Unit: mm (in)



SEM882E

Piston skirt diameter "A"	Standard (for No. 3, 4 and 5 cylinders)	Grade No. 2-1	91.480 - 91.485 (3.6016 - 3.6018)
		Grade No. 3-2	91.485 - 91.490 (3.6018 - 3.6020)
		Grade No. 3-3	91.490 - 91.495 (3.6020 - 3.6022)
		Grade No. 4-4	91.495 - 91.500 (3.6022 - 3.6024)
		Grade No. 4-5	91.500 - 91.505 (3.6024 - 3.6026)
		Grade No. 5-6	91.506 - 91.510 (3.6026 - 3.6027)
	Standard (except for No. 1, 2 and 6 cylinders)	Grade No. 1	91.465 - 91.475 (3.6010 - 3.6014)
		Grade No. 2	91.475 - 91.485 (3.6014 - 3.6018)
		Grade No. 3	91.485 - 91.495 (3.6018 - 3.6022)
	0.25 (0.0098) oversize (Service)		91.715 - 91.745 (3.6108 - 3.6120)
0.50 (0.0197) oversize (Service)		91.965 - 91.995 (3.6207 - 3.6218)	
"a" dimension		49.0 (1.929)	
Piston pin hole diameter		20.969 - 20.981 (0.8255 - 0.8260)	
Piston clearance to cylinder block	Standard	For No. 3 and 4 cylinders	0.015 - 0.025 (0.0006 - 0.0010)
		Except for No. 3 and 4 cylinders	0.025 - 0.045 (0.0010 - 0.0018)

## PISTON RING

NGEM0032S05  
Unit: mm (in)

		Standard	Limit
Side clearance	Top	0.024 - 0.076 (0.0009 - 0.0030)	0.11 (0.0043)
	2nd	0.030 - 0.070 (0.0012 - 0.0028)	0.10 (0.004)
	Oil	0.015 - 0.185 (0.0006 - 0.0073)	—
Ring gap	Top	0.21 - 0.40 (0.0083 - 0.0157)	0.54 (0.0213)
	2nd	0.50 - 0.69 (0.0197 - 0.0272)	0.80 (0.0315)
	Oil (rail ring)	0.20 - 0.69 (0.0079 - 0.0272)	0.95 (0.0374)

# SERVICE DATA AND SPECIFICATIONS (SDS)

**VG33E**

Piston, Piston Ring and Piston Pin (Cont'd)

## PISTON PIN

Unit: mm (in)  
=NGEM0032S03

Piston pin outer diameter	20.971 - 20.983 (0.8256 - 0.8261)
Interference fit of piston pin to piston	0 - 0.004 (0 - 0.0002)
Piston pin to connecting rod bushing clearance	0.005 - 0.017 (0.0002 - 0.0007)

Values measured at ambient temperature of 20°C (68°F)

## Connecting Rod

Unit: mm (in)  
NGEM0033

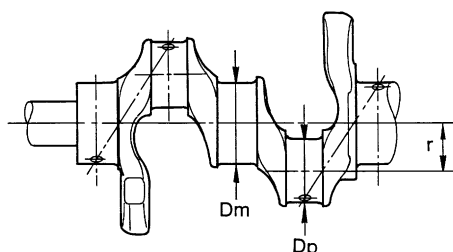
Center distance	154.1 - 154.2 (6.067 - 6.071)	
Bend, torsion [per 100 (3.94)]	Limit Bend: 0.15 (0.0059) Torsion: 0.30 (0.0118)	
Piston pin bushing inner diameter*	20.982 - 20.994 (0.8261 - 0.8265)	
Connecting rod big end inner diameter	53.000 - 53.013 (2.0866 - 2.0871)	
Side clearance	Standard	0.20 - 0.35 (0.0079 - 0.0138)
	Limit	0.40 (0.0157)

\*After installing in connecting rod

## Crankshaft

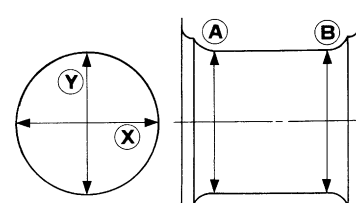
Unit: mm (in)  
NGEM0034

Main journal dia. "Dm"	No. 1 main journal	Grade No. 3	62.696 - 62.975 (2.4683 - 2.4793)
		Grade No. 4	62.963 - 62.969 (2.4789 - 2.4791)
		Grade No. 5	62.957 - 62.963 (2.4786 - 2.4789)
		Grade No. 6	62.951 - 62.957 (2.4784 - 2.4786)
	Except No. 1 main journal	Grade No. 0	62.967 - 62.975 (2.4790 - 2.4793)
		Grade No. 1	62.959 - 62.967 (2.4787 - 2.4790)
		Grade No. 2	62.951 - 62.959 (2.4784 - 2.4787)
Pin journal dia. "Dp"		49.955 - 49.974 (1.9667 - 1.9675)	
Center distance "r"		41.5 (1.634)	
Out-of-round (X - Y)	Standard	Less than 0.005 (0.0002)	
Taper (A - B)	Standard	Less than 0.005 (0.0002)	
Runout [TIR]	Standard	Less than 0.025 (0.0010)	
	Limit	Less than 0.10 (0.0039)	
Free end play	Standard	0.050 - 0.170 (0.0020 - 0.0067)	
	Limit	0.30 (0.0118)	



SEM645

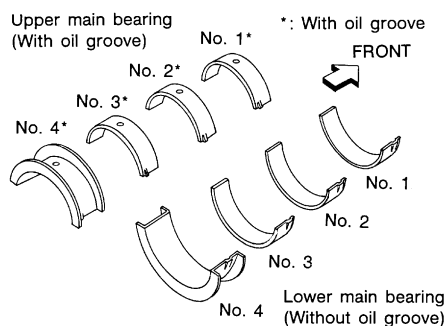
Out-of-round (X - Y)  
Taper (A - B)



EM715

**Available Main Bearing**

NGEM0084



SEM327A

**NO. 1 MAIN BEARING**

NGEM0084S01

Grade number	Thickness "T" mm (in)	Width "W" mm (in)	Identification color(mark)
0	1.822 - 1.825 (0.0717 - 0.0719)	22.4 - 22.6 (0.882 - 0.890)	Black (A)
1	1.825 - 1.828 (0.0719 - 0.0720)		Brown (B)
2	1.828 - 1.831 (0.0720 - 0.0721)		Green (C)
3	1.831 - 1.834 (0.0721 - 0.0722)		Yellow (D)
4	1.834 - 1.837 (0.0722 - 0.0723)		Blue (E)
5	1.837 - 1.840 (0.0723 - 0.0724)		Pink (F)
6	1.840 - 1.843 (0.0724 - 0.0726)		Purple (G)

**NO. 2 AND 3 MAIN BEARING**

NGEM0084S02

Grade number	Thickness "T" mm (in)	Width "W" mm (in)	Identification color
0	1.817 - 1.821 (0.0715 - 0.0717)	18.9 - 19.1 (0.744 - 0.752)	Black
1	1.821 - 1.825 (0.0717 - 0.0719)		Brown
2	1.825 - 1.829 (0.0719 - 0.0720)		Green
3	1.829 - 1.833 (0.0720 - 0.0722)		Yellow
4	1.833 - 1.837 (0.0722 - 0.0723)		Blue

**NO. 4 MAIN BEARING**

NGEM0084S03

Grade number	Thickness "T" mm (in)	Identification color
0	1.817 - 1.821 (0.0715 - 0.0717)	Black
1	1.821 - 1.825 (0.0717 - 0.0719)	Brown
2	1.825 - 1.829 (0.0719 - 0.0720)	Green
3	1.829 - 1.833 (0.0720 - 0.0722)	Yellow
4	1.833 - 1.837 (0.0722 - 0.0723)	Blue

GI  
 MA  
 EM  
 LC  
 EC  
 FE  
 CL  
 MT  
 AT  
 TF  
 PD  
 AX  
 SU  
 BR  
 ST  
 RS  
 BT  
 HA  
 SC  
 EL  
 IDX

# SERVICE DATA AND SPECIFICATIONS (SDS)

**VG33E**

Available Main Bearing (Cont'd)

## UNDER SIZE

~NGEM0084S04  
Unit: mm (in)

		Thickness "T" mm (in)	Main journal diameter "Dm"
0.25 (0.0098)	No.1 main bearing	1.956 - 1.962 (0.0770 - 0.0772)	Grind so that bearing clearance is the specified value.
	No.2,3 and No.4 main bearing	1.948 - 1956 (0.0767 - 0.0770)	

## Available Connecting Rod Bearing

### CONNECTING ROD BEARING UNDERSIZE

NGEM0036

NGEM0036S01  
Unit: mm (in)

		Thickness	Crank pin journal diameter "Dp"
Standard		1.502 - 1.506 (0.0591 - 0.0593)	49.955 - 49.974 (1.9667 - 1.9675)
Undersize	0.08 (0.0031)	1.542 - 1.546 (0.0607 - 0.0609)	Grind so that bearing clearance is the specified value.
	0.12 (0.0047)	1.562 - 1.566 (0.0615 - 0.0617)	
	0.25 (0.0098)	1.627 - 1.631 (0.0641 - 0.0642)	

## Miscellaneous Components

NGEM0037

Unit: mm (in)

Drive plate runout [TIR]	Less than 0.15 (0.0059)
--------------------------	-------------------------

## BEARING CLEARANCE

NGEM0037S01  
Unit: mm (in)

Main bearing clearance	Standard	0.028 - 0.055 (0.0011 - 0.0022)
	Limit	0.090 (0.0035)
Connecting rod bearing clearance	Standard	0.014 - 0.054 (0.0006 - 0.0021)
	Limit	0.090 (0.0035)