

ENGINE LUBRICATION & COOLING SYSTEMS

SECTION **LC**

LC

CONTENTS

PREPARATION	2
PRECAUTION	3

KA24E

ENGINE LUBRICATION SYSTEM	4
Lubrication Circuit	4
Oil Pressure Check	5
Oil Pump	6
ENGINE COOLING SYSTEM	8
Cooling Circuit	8
System Check	8
Water Pump	9
Thermostat	10
Radiator	12
Cooling Fan	12

TD27T

ENGINE LUBRICATION SYSTEM	13
Lubrication Circuit	13
Oil Pressure Check	14
Oil Pump	15
Oil Filter Bracket	17

Oil Cooler	18
Oil Jet	19
ENGINE COOLING SYSTEM	20
Cooling Circuit	20
System Inspection	21
Water Pump	22
Thermostat	24
Radiator	25
Cooling Fan	25

KA24E

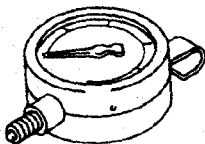
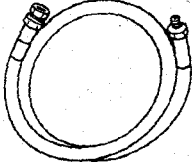
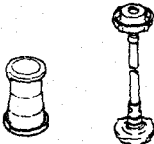
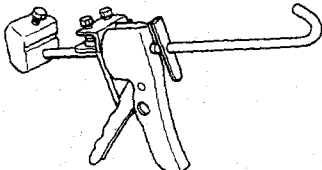
SERVICE DATA AND SPECIFICATIONS (S.D.S.)	26
Engine Lubrication System	26
Engine Cooling System	26

TD27T

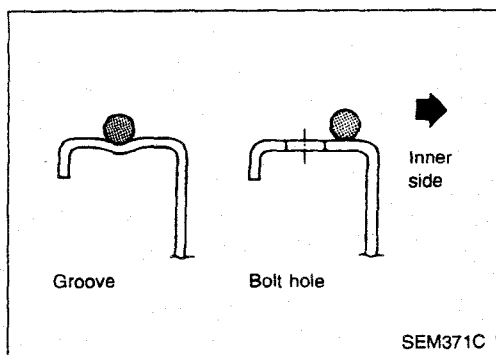
SERVICE DATA AND SPECIFICATIONS (S.D.S.)	27
Engine Lubrication System	27
Engine Cooling System	27

PREPARATION

SPECIAL SERVICE TOOLS

Tool number Tool name	Description	Engine application	
		KA24E	TD27T
ST25051001 Oil pressure gauge		X	X
ST25052000 Hose	Adapting oil pressure gauge to cylinder block 	X	X
EG17650301 Radiator cap tester adapter	Adapting radiator cap tester to radiator filler neck 	X	X
WS39930000 Tube presser	Pressing the tube of liquid gas-ket 	X	X

PRECAUTION



LIQUID GASKET APPLICATION PROCEDURE

- a. Before applying liquid gasket, use a scraper to remove all traces of old liquid gasket from mating surface.
- b. Apply a continuous bead of liquid gasket to mating surfaces.

(Use Genuine Liquid Gasket or equivalent.)

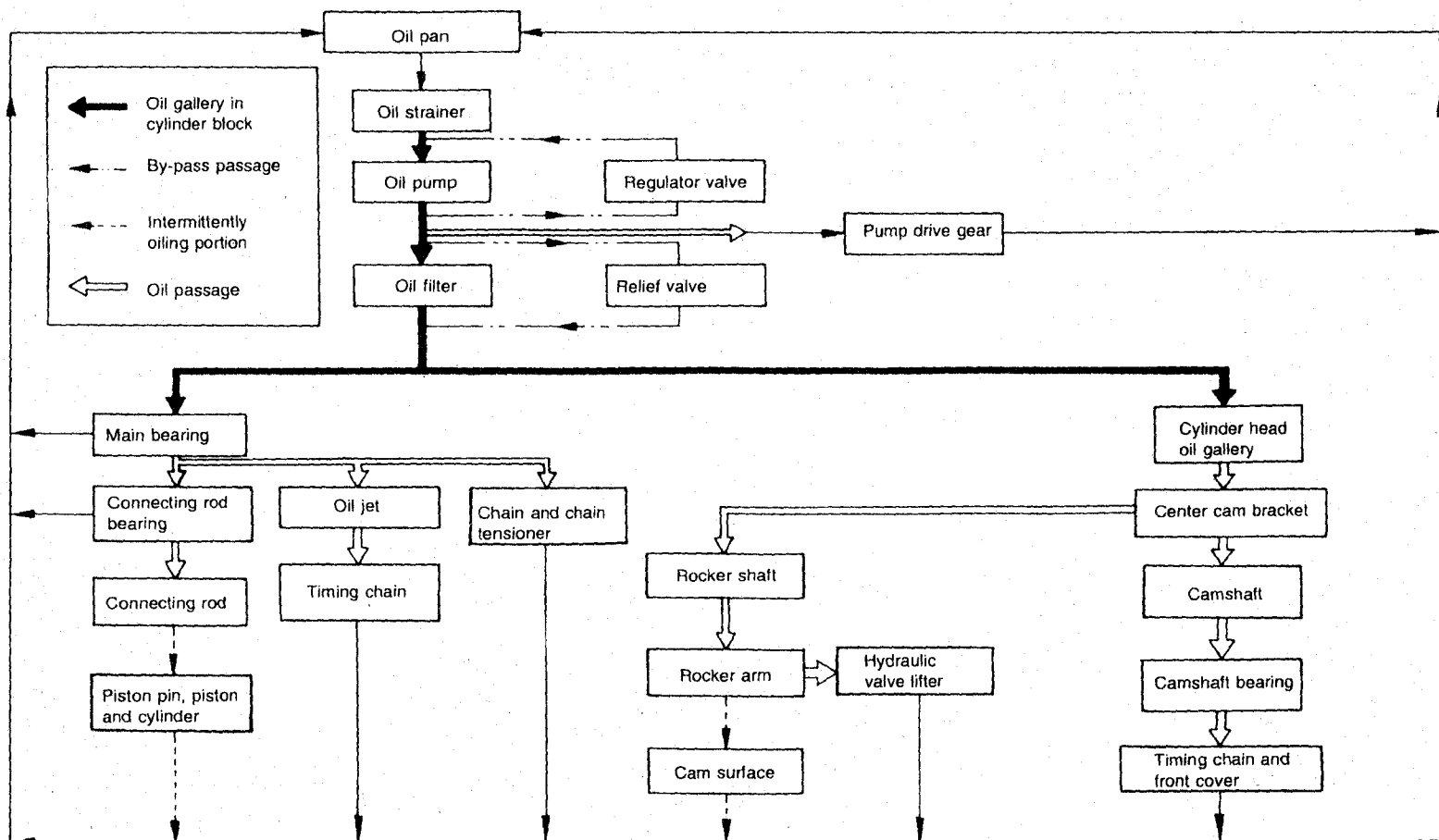
- Be sure liquid gasket is 3.5 to 4.5 mm (0.138 to 0.177 in) wide (for oil pan).
- Be sure liquid gasket is 2.0 to 3.0 mm (0.079 to 0.118 in) wide (in areas except oil pan).

- c. Apply liquid gasket to inner sealing surface around hole perimeter area.

(Assembly should be done within 5 minutes after coating.)

- d. Wait at least 30 minutes before refilling engine oil and engine coolant.

Lubrication Circuit



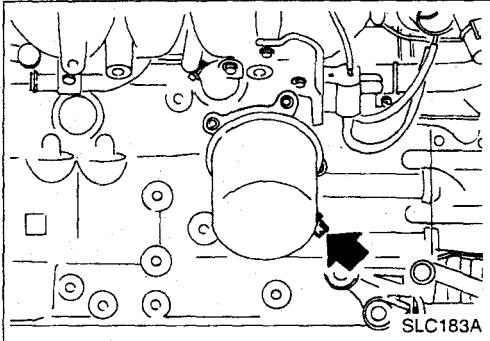
LC-4

SLC182A

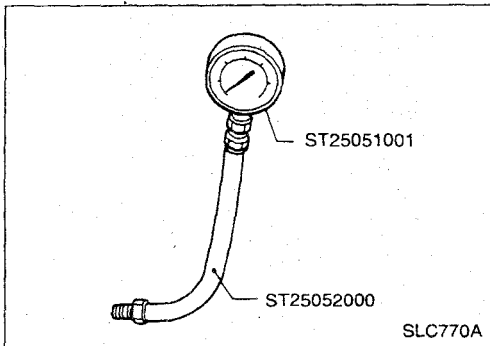
Oil Pressure Check

WARNING:

- Be careful not to burn yourself, as the engine and oil may be hot.
- Oil pressure check should be done in "Neutral" gear position.



1. Check oil level.
2. Remove oil pressure switch.



3. Install pressure gauge.
4. Start engine and warm it up to normal operating temperature.
5. Check oil pressure with engine running under no-load.

Engine rpm	Approximate discharge pressure kPa (bar, kg/cm ² , psi)
Idle speed	More than 78 (0.78, 0.8, 11)
3,000	412 - 481 (4.12 - 4.81, 4.2 - 4.9, 60 - 70)

If difference is extreme, check oil passage and oil pump for oil leaks.

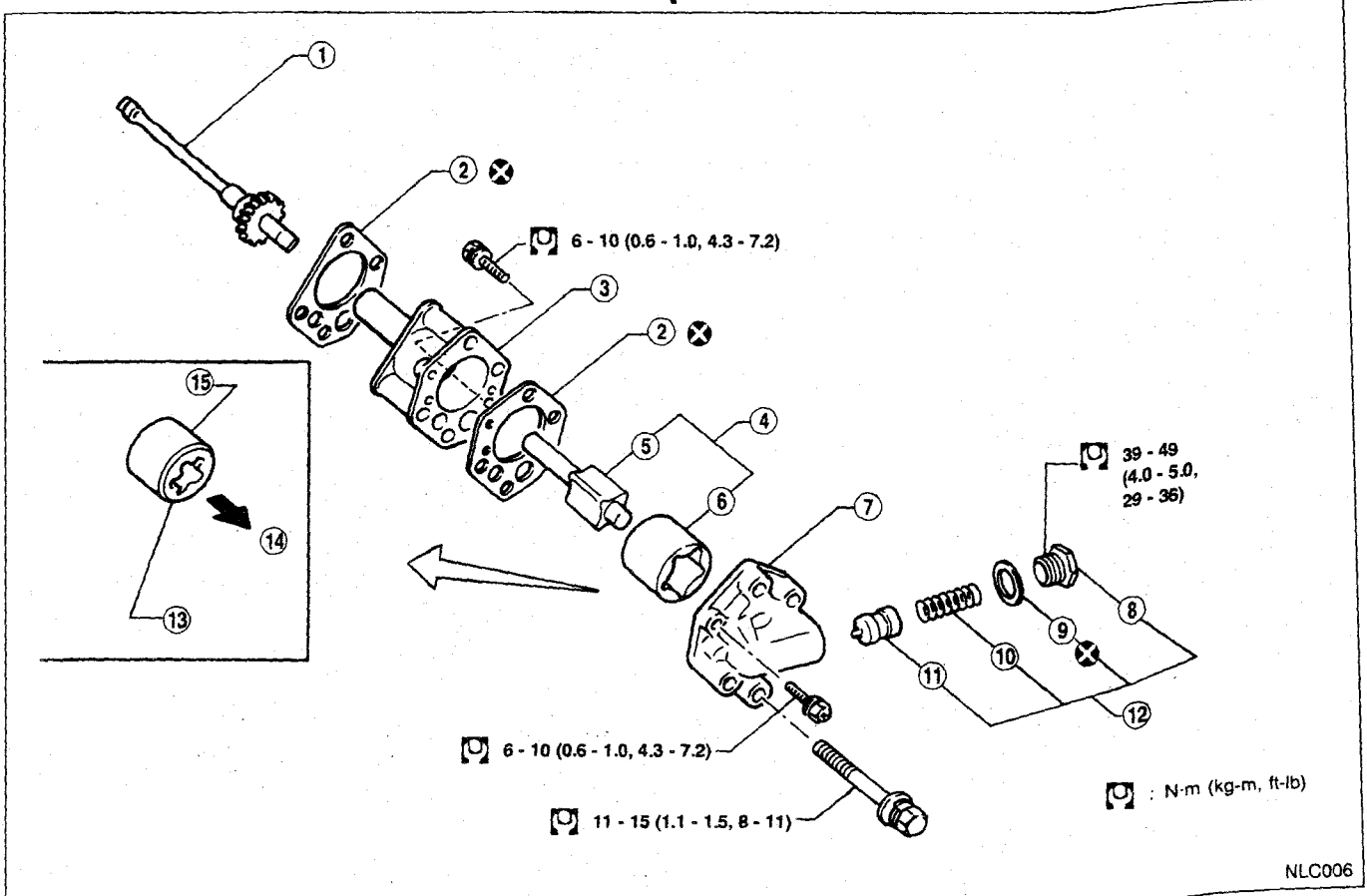
6. Install oil pressure switch with sealant.

Use proper liquid gasket.

Oil pressure switch:

⌚: 16 - 21 N·m (1.6 - 2.1 kg-m, 12 - 15 ft-lb)

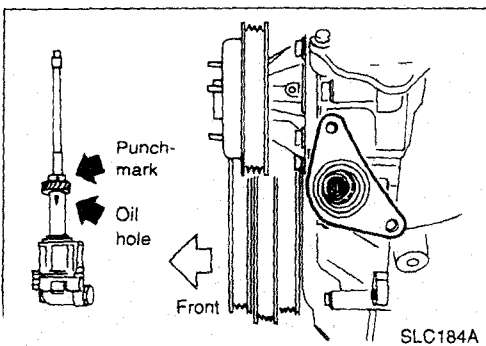
Oil Pump



- ① Drive spindle
- ② Gasket
- ③ Pump body
- ④ Rotor assembly
- ⑤ Inner rotor

- ⑥ Outer rotor
- ⑦ Pump cover
- ⑧ Cap
- ⑨ Washer
- ⑩ Spring

- ⑪ Regulator valve
- ⑫ Regulator valve set
- ⑬ Chamfer
- ⑭ Pump cover
- ⑮ Outer rotor



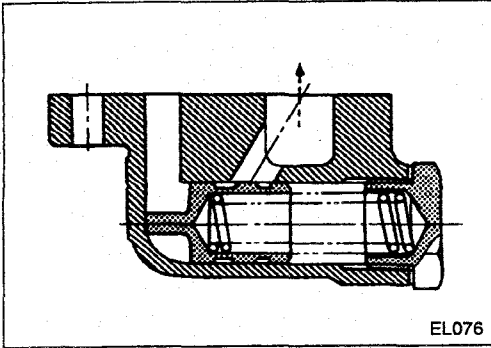
- Always replace with new oil seal and gasket.
- When removing oil pump, turn crankshaft so that No. 1 piston is at T.D.C. on its compression stroke.
- When installing oil pump, align punchmark on drive spindle and oil hole on oil pump.

Oil Pump (Cont'd)

REGULATOR VALVE INSPECTION

1. Visually inspect components for wear and damage.
2. Check oil pressure regulator valve sliding surface and valve spring.
3. Coat regulator valve with engine oil and check that it falls smoothly into the valve hole by its own weight.

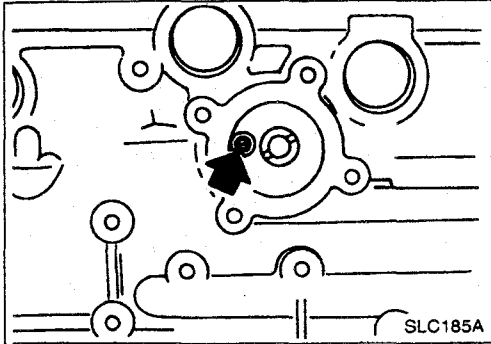
If damaged, replace regulator valve set or oil pump assembly.



EL076

OIL PRESSURE RELIEF VALVE INSPECTION

Inspect oil pressure relief valve for movement, cracks and breaks by pushing the ball. If replacement is necessary, remove valve by prying it out with suitable tool. Install a new valve in place by tapping it.



SLC185A

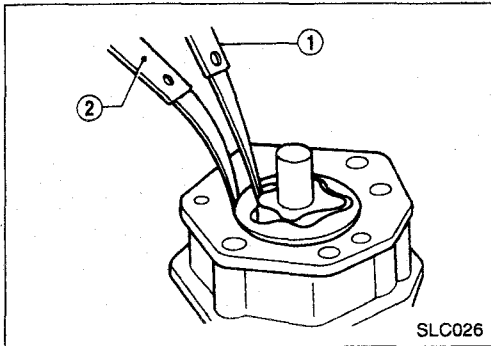
OIL PUMP INSPECTION

Using a feeler gauge, check the following clearances.

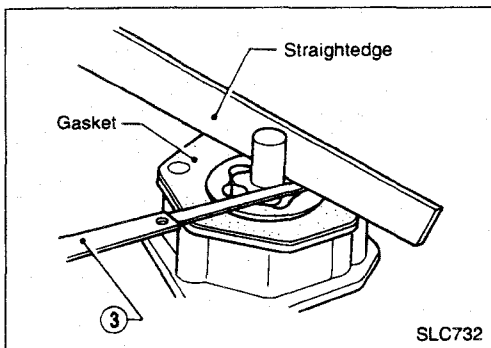
Unit: mm (in)

Rotor tip clearance ①	Less than 0.12 (0.0047)
Outer rotor to body clearance ②	0.15 - 0.21 (0.0059 - 0.0083)
Side clearance (with gasket) ③	0.04 - 0.08 (0.0016 - 0.0031)

If it exceeds the limit, replace gear set or entire oil pump assembly.

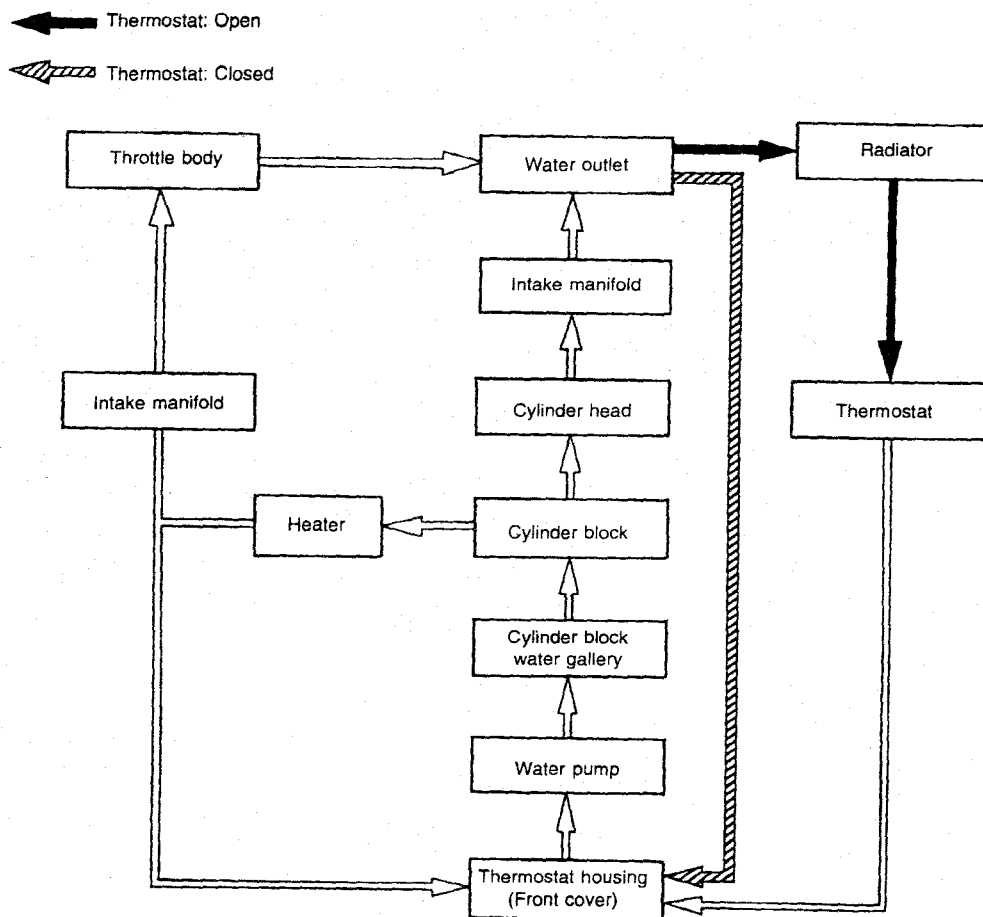


SLC026



SLC732

Cooling Circuit



SLC186A

System Check

WARNING:

Never remove the radiator cap when the engine is hot; serious burns could be caused by high pressure fluid escaping from the radiator.

Wrap a thick cloth around cap and carefully remove the cap by turning it a quarter turn to allow built-up pressure to escape and then turn the cap all the way off.

CHECKING COOLING SYSTEM HOSES

Check hoses for improper attachment, leaks, cracks, damage, loose connections, chafing and deterioration.

System Check (Cont'd)

CHECKING COOLING SYSTEM FOR LEAKS

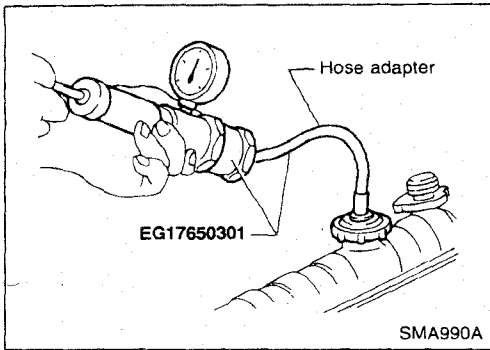
To check for leakage, apply pressure to the cooling system with a tester.

Testing pressure:

98 kPa (0.98 bar, 1.0 kg/cm², 14 psi)

CAUTION:

Higher than the specified pressure may cause radiator damage.

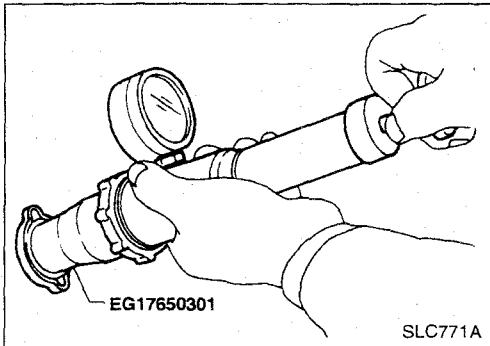


CHECKING RADIATOR CAP

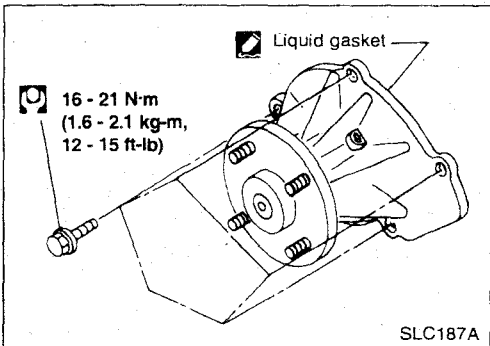
To check radiator cap, apply pressure to cap with a tester.

Radiator cap relief pressure:

78 - 98 kPa (0.78 - 0.98 bar, 0.8 - 1.0 kg/cm², 11 - 14 psi)

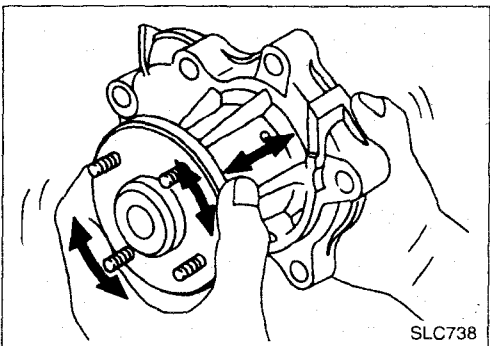


Water Pump



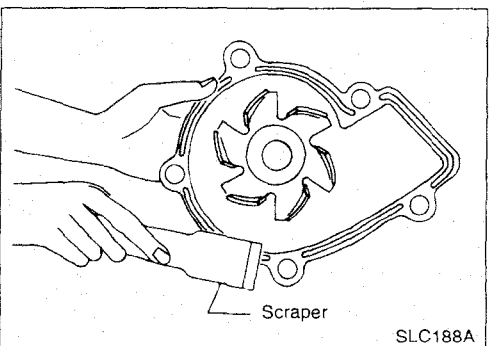
INSPECTION

Check for excessive end play and rough operation.

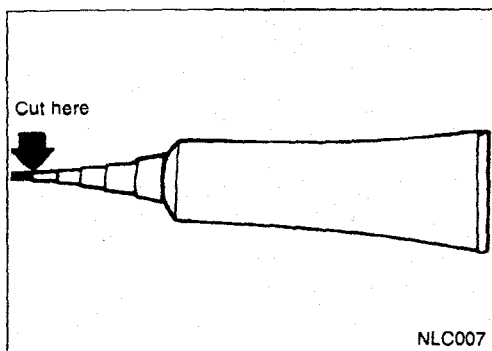


INSTALLATION

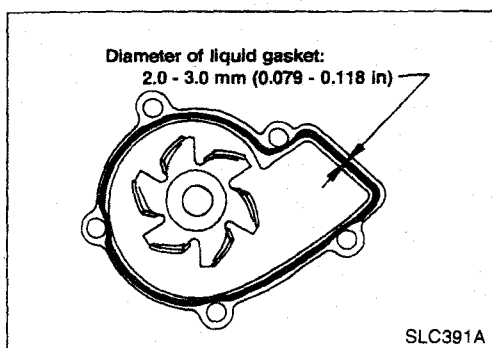
- Remove liquid gasket from mating surface of pump housing using a scraper.
- Be sure liquid gasket in grooves is also removed.**
- Remove liquid gasket from mating surface of cylinder block.
- Clean all traces of liquid gasket using white gasoline.



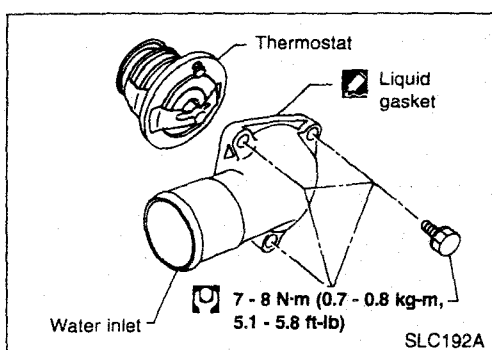
Water Pump (Cont'd)



- Cut off tip of nozzle of liquid gasket tube at point shown in figure.
- Use Genuine Liquid Gasket or equivalent.



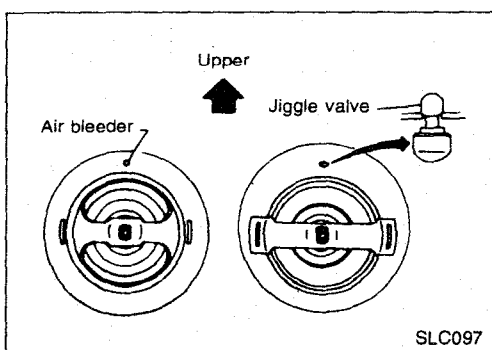
- Apply a continuous bead of liquid gasket to mating surface of pump housing as shown.



Thermostat

INSPECTION

1. Check for valve seating condition at normal temperatures. It should seat tightly.

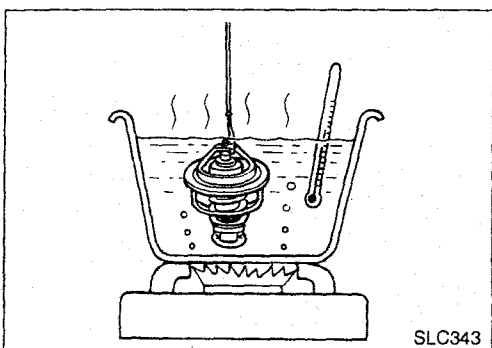


2. Check valve opening temperature and maximum valve lift.

	Standard type	Optional type
Valve opening temperature °C (°F)	76.5 (170)	82 (180)
Max. valve lift mm/°C (in/°F)	8/90 (0.31/194)	8/95 (0.31/203)

3. Then check if valve closes at 5°C (9°F) below valve opening temperature.

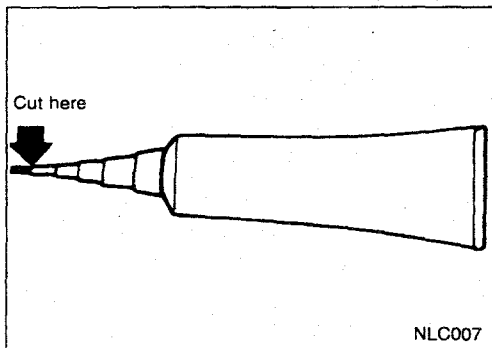
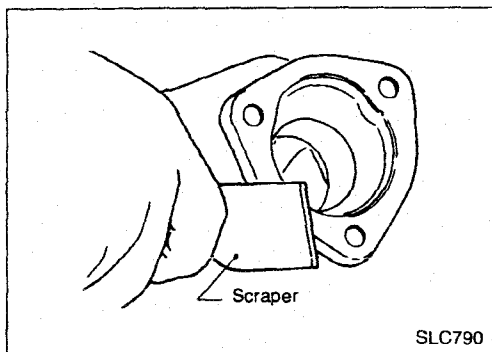
- After installation, run engine for a few minutes, and check for leaks.



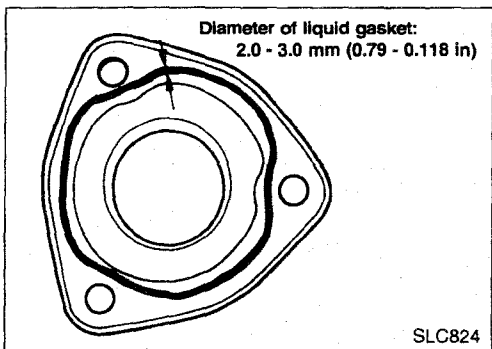
Thermostat (Cont'd)

INSTALLATION

- Remove liquid gasket from mating surface of thermostat using a scraper.
- Similarly, remove liquid gasket from mating surface of cylinder block.
- Clean all traces of liquid gasket using white gasoline.

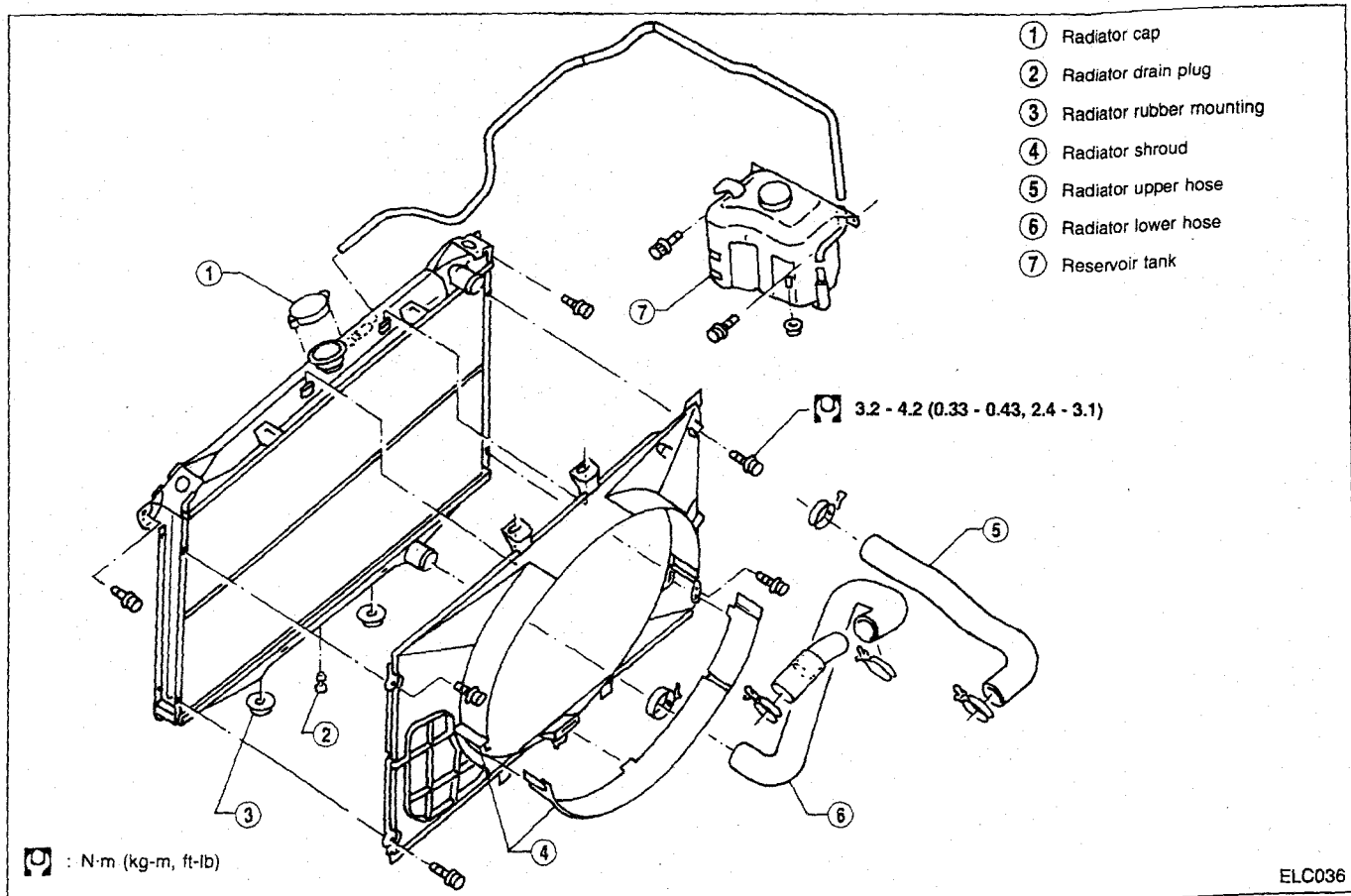


- Cut off tip of nozzle of liquid gasket tube at point shown in figure.
- Use Genuine Liquid Gasket or equivalent.

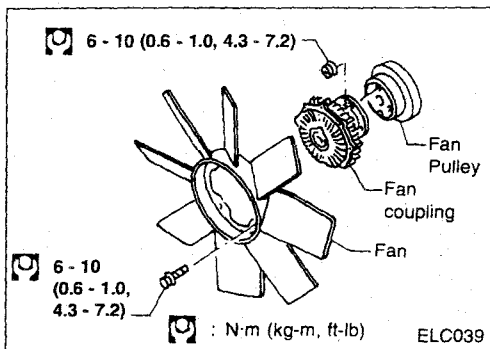


- Apply a continuous bead of liquid gasket to mating surface of water inlet.

Radiator

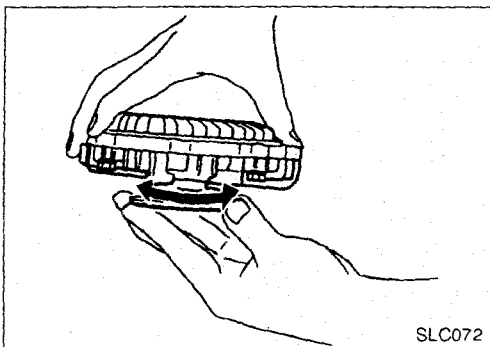


CAUTION:
When filling radiator with coolant, refer to MA section.



Cooling Fan

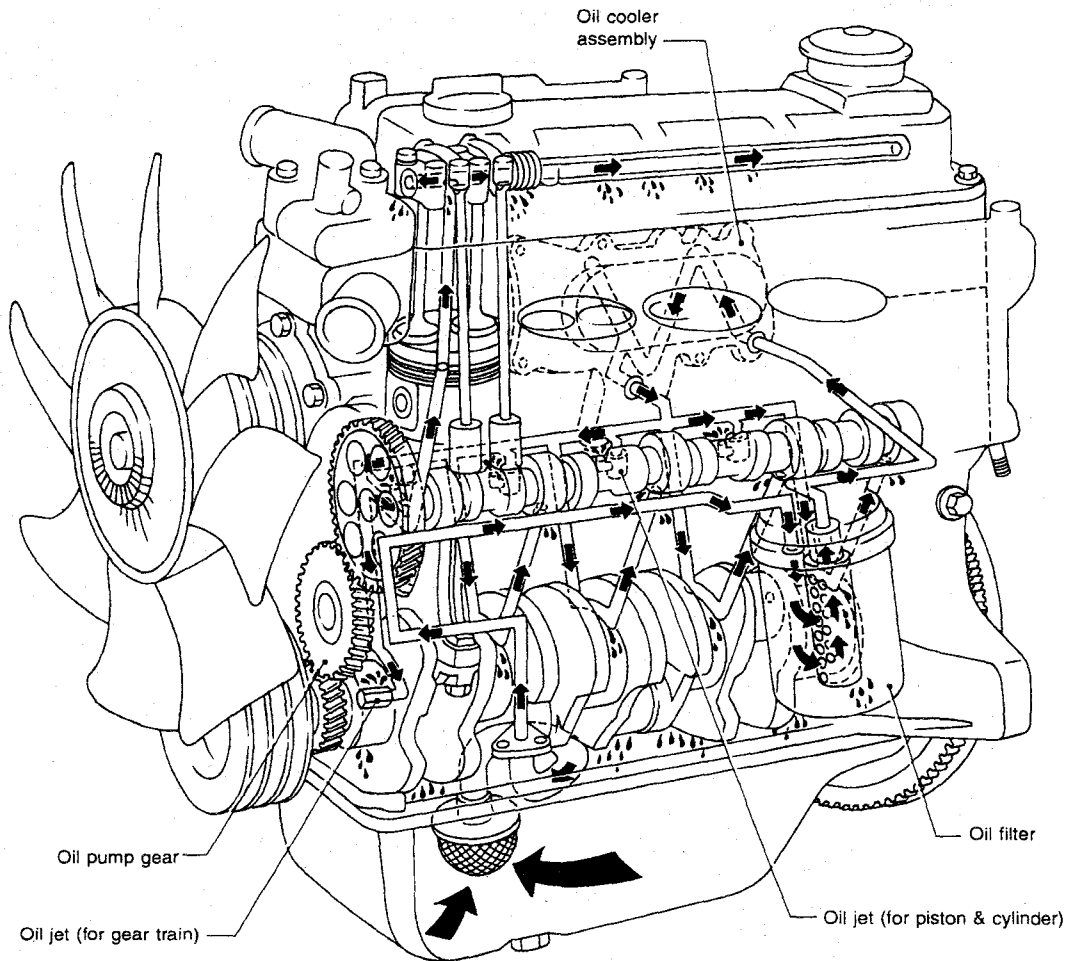
DISASSEMBLY AND ASSEMBLY



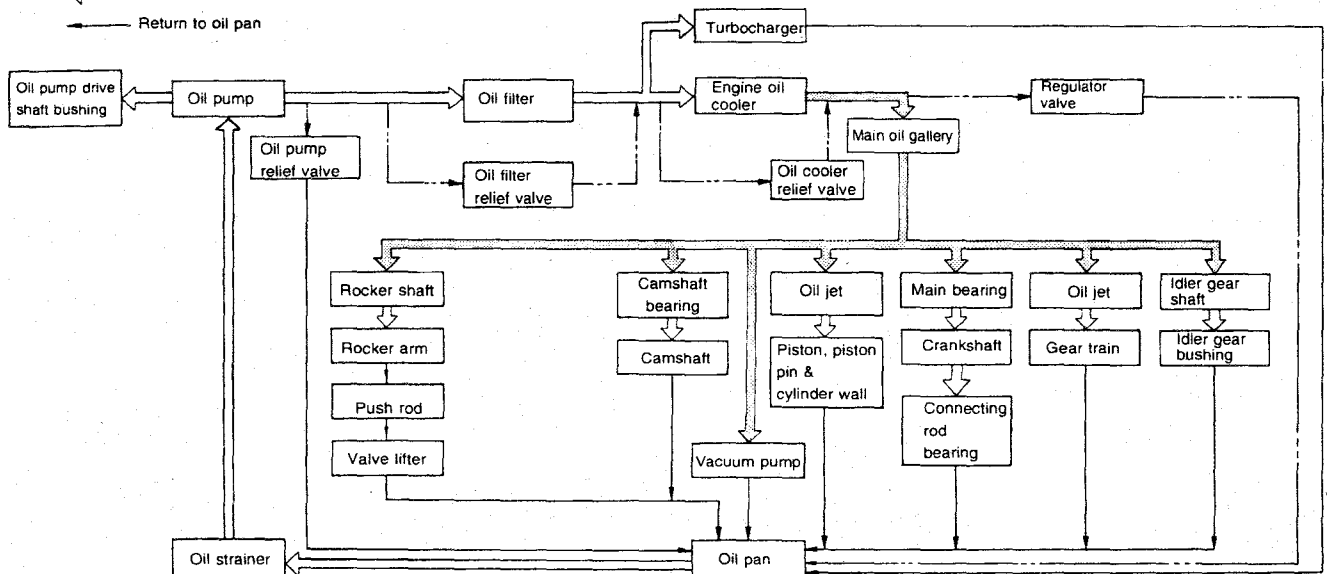
INSPECTION

Check that fan coupling operates smoothly, that there is no oil leakage and that bimetal is not bent.

Lubrication Circuit



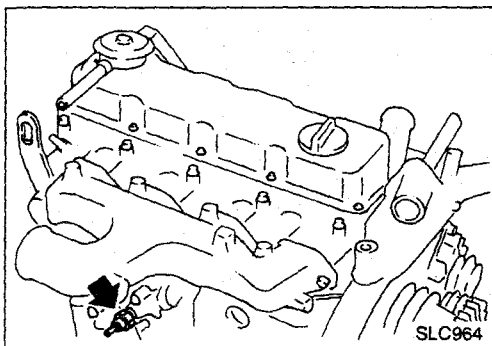
Note: Oil gallery in cylinder block
 By-pass passage
 Oil passage
 Return to oil pan



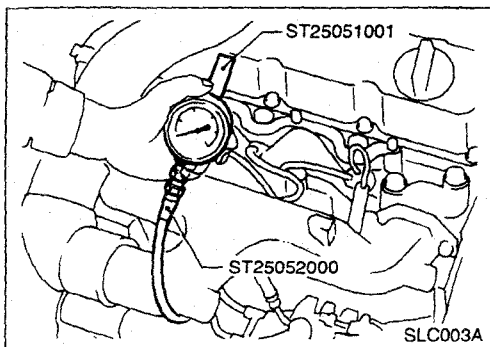
Oil Pressure Check

WARNING:

- Be careful not to burn yourself, as the engine and oil may be hot.
- Oil pressure check should be done in "Neutral" gear position.



1. Check oil level.
2. Remove oil pressure switch.



3. Install pressure gauge.
4. Start engine and warm it up to normal operating temperature.
5. Check oil pressure with engine running under no-load.

Engine rpm	Approximate discharge pressure kPa (bar, kg/cm ² , psi)
Idle speed	More than 78 (0.78, 0.8, 11)
3,000	294 - 392 (2.94 - 3.92, 3.0 - 4.0, 43 - 57)

If difference is extreme, check oil passage and oil pump for oil leaks.

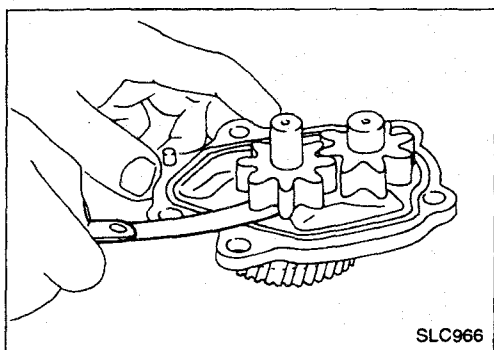
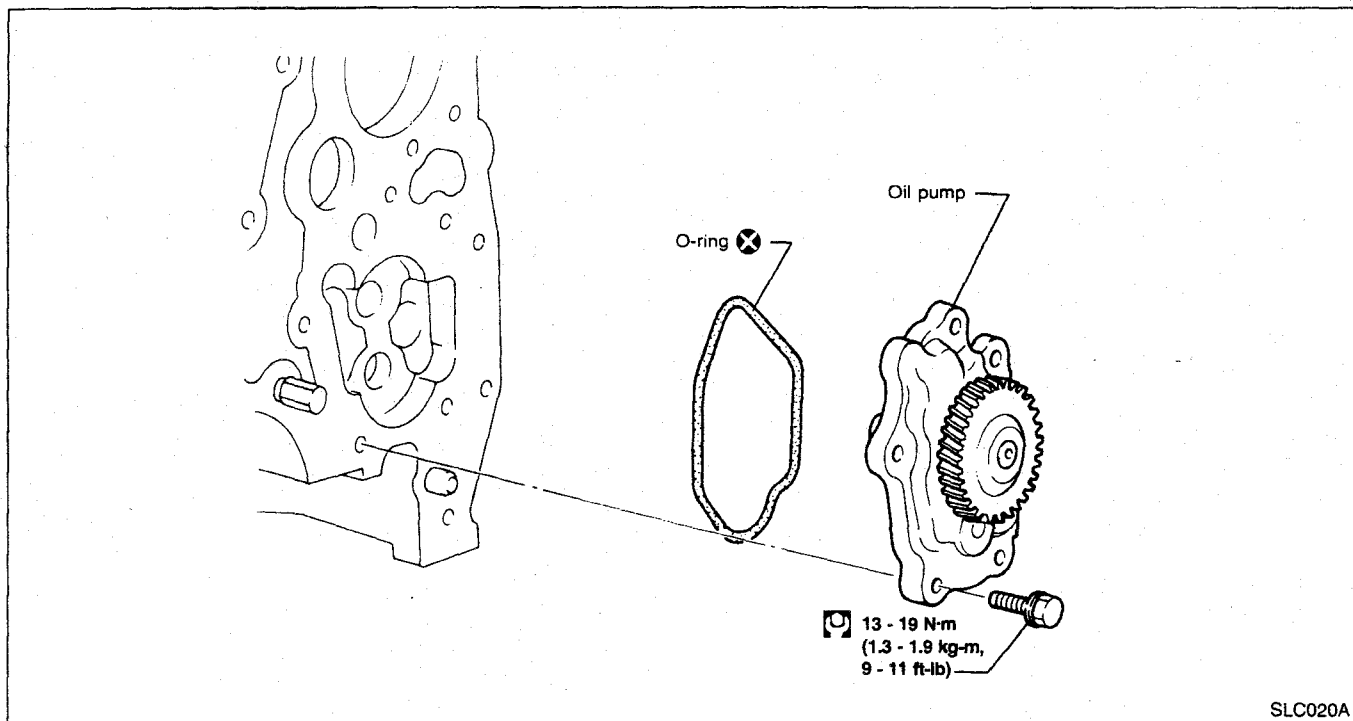
6. Install oil pressure switch.

Use proper liquid sealant.

Oil pressure switch:

⌚: 10 - 13 N·m (1.0 - 1.3 kg-m, 7 - 9 ft-lb)

Oil Pump

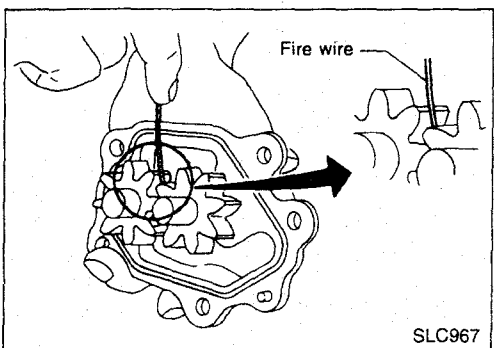


OIL PUMP INSPECTION

1. Inspect pump body, gears and drive shaft for wear and damage.
2. Using a feeler gauge and fuse wire, check the following clearances.

Gear side clearance:

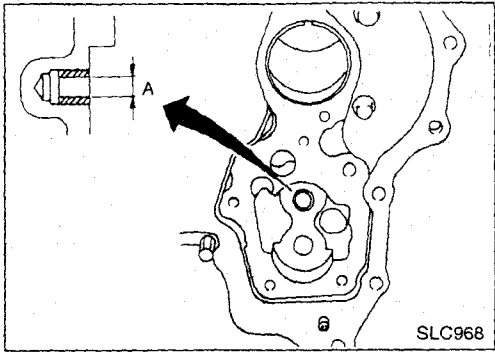
Less than 0.13 mm (0.0051 in)



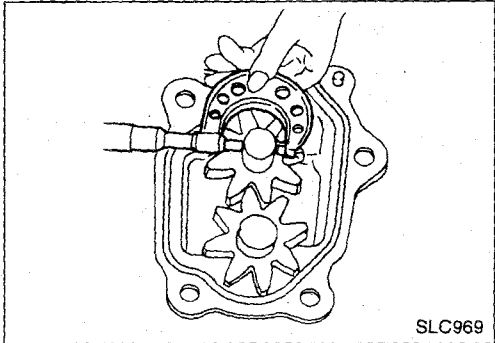
Gear backlash:

Less than 0.43 mm (0.0169 in)

Oil Pump (Cont'd)



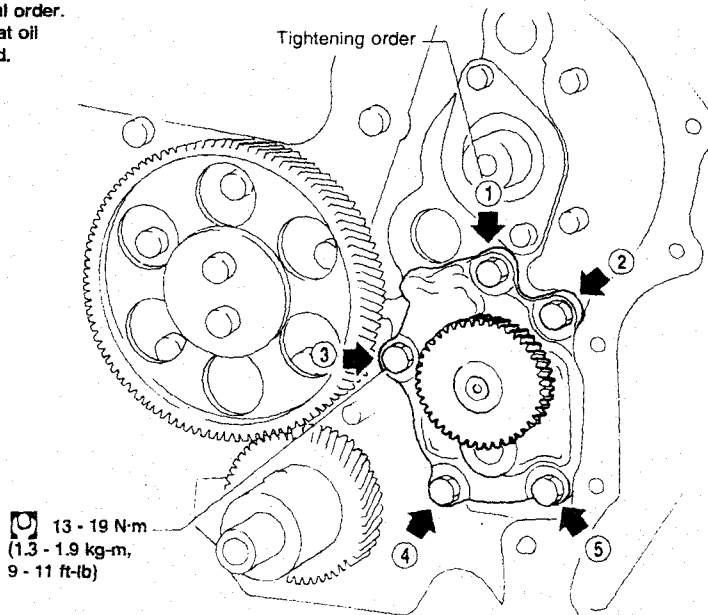
3. Measure inside diameter "A" of bushing.
A: 13.012 - 13.098 mm (0.5123 - 0.5157 in)



4. Measure outside diameter "B" of drive gear shaft.
B: 12.974 - 12.992 mm (0.5108 - 0.5115 in)
5. Calculate oil pump bushing clearance.
Oil pump bushing clearance (A - B):
Less than 0.15 mm (0.0059 in)

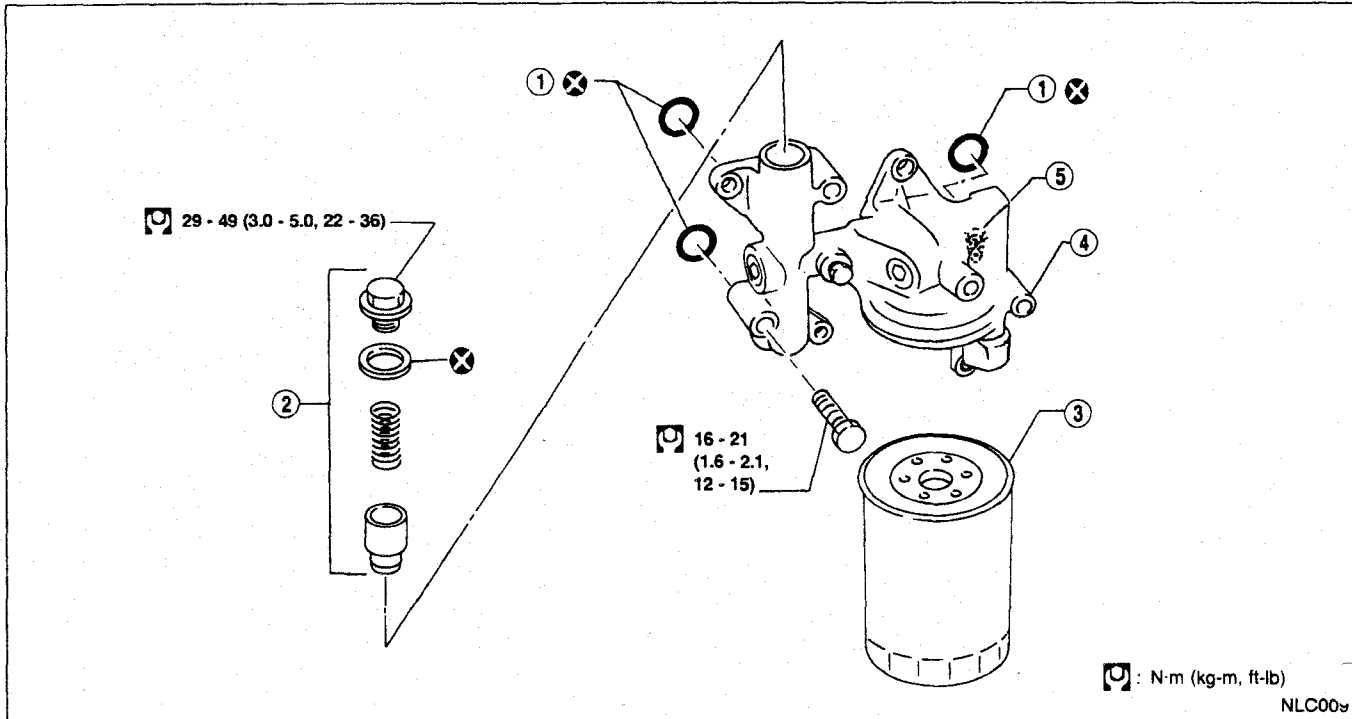
If it exceeds the limit, replace oil pump bushing or entire oil pump assembly.

- When installing oil pump, the bolt should be tightened in two or three stages according to numerical order.
- After installation, ascertain that oil pump turns smoothly by hand.



NLC008

Oil Filter Bracket



NLC000

- ① O-ring
- ② Oil pump relief valve

- ③ Oil filter
- ④ Oil filter bracket

- ⑤ Oil filter relief valve

OIL PUMP RELIEF VALVE INSPECTION

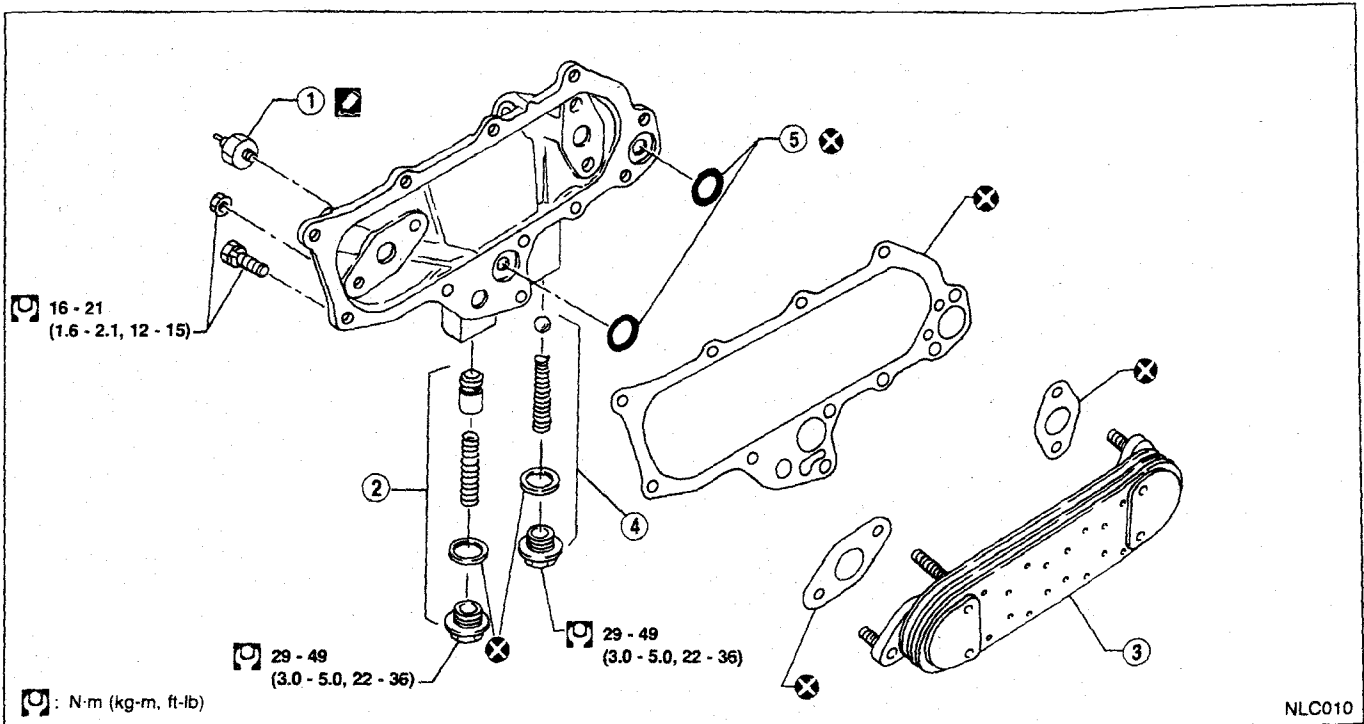
1. Visually inspect components for wear and damage.
 2. Coat relief valve with engine oil and check that it falls smoothly into the valve hole by its own weight.
- If damaged, replace oil pump relief valve set.

OIL FILTER RELIEF VALVE INSPECTION

Inspect oil filter short valve for movement, cracks and breaks by pushing the ball.

If damaged, replace oil filter bracket assembly.

Oil Cooler



NLC010

- ① Oil pressure switch
- ② Regulator valve

- ③ Oil cooler element
- ④ Oil cooler relief valve

- ⑤ O-ring

OIL COOLER RELIEF VALVE INSPECTION

Inspect oil cooler relief valve for movement, cracks and breaks by pushing the ball.

If damaged, replace oil cooler relief valve set.

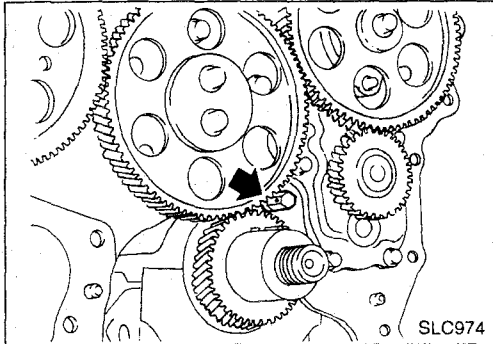
REGULATOR VALVE INSPECTION

1. Visually inspect components for wear and damage.
 2. Coat regulator valve with engine oil and check that it falls smoothly into the valve hole by its own weight.
- If damaged, replace regulator valve set.

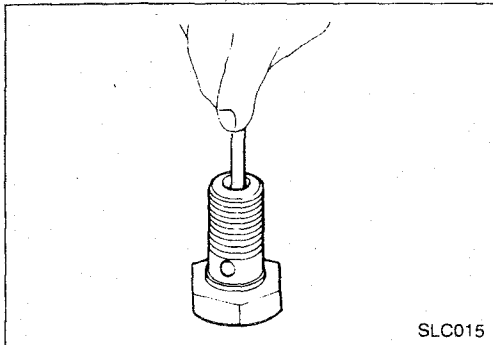
Oil Jet

INSPECTION (For gear train)

Make sure that the holes are not clogged. Clean them with a wire if necessary.

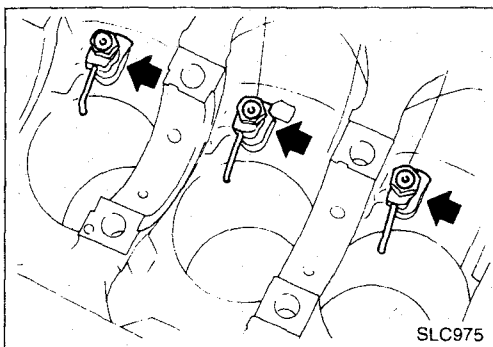


Oil jet has to be installed with oil hole facing crank gear and idler gear.



INSPECTION (For piston)

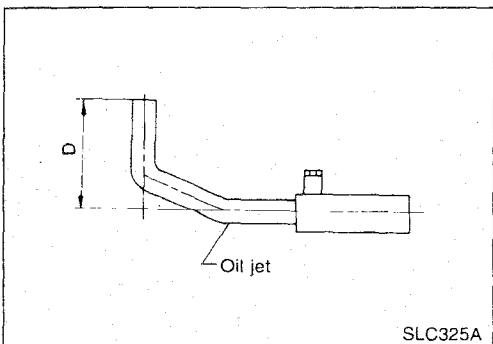
1. Blow through outlet of oil jet and make sure that air comes out of inlet.
2. Push cut-off valve of oil jet bolt with a clean resin or brass rod and make sure that cut-off valve moves smoothly with proper repulsion.



When installing oil jet, align oil jet's boss with hole on cylinder block.

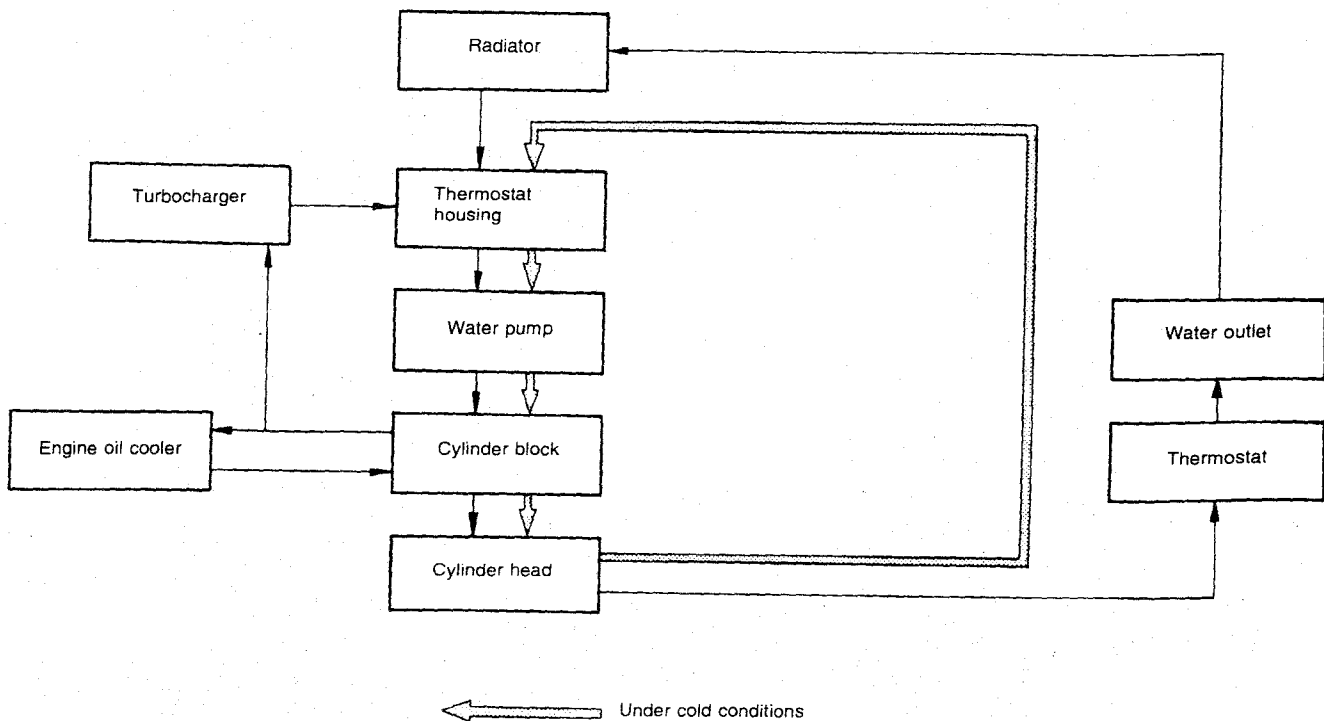
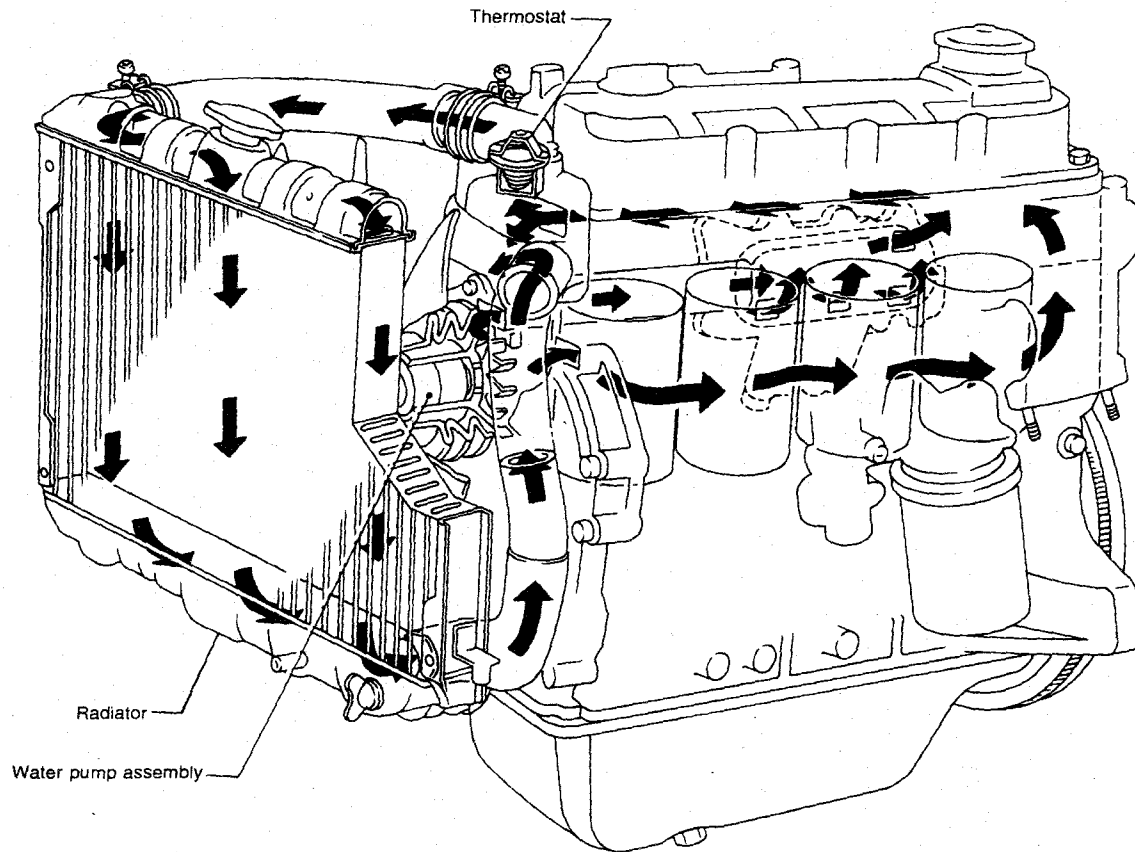
Oil jet bolt:

⌘ : 29 - 39 N·m
(3.0 - 4.0 kg-m, 22 - 29 ft-lb)



Dimension "D":
22 mm (0.87 in)

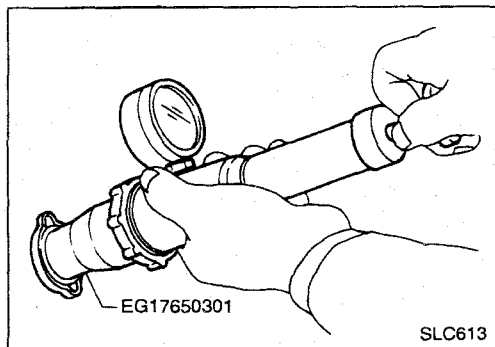
Cooling Circuit



System Inspection

CHECKING HOSES

Check hoses for proper attachment, leaks, cracks, damage, loose connections, chafing and deterioration.



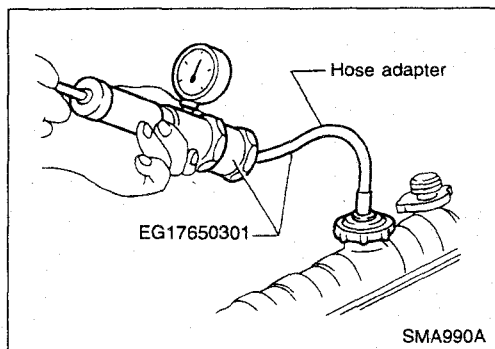
CHECKING RADIATOR CAP

To check the radiator cap, apply pressure to the cap with a cap tester.

Radiator cap relief pressure:

78 - 98 kPa

(0.78 - 0.98 bar, 0.8 - 1.0 kg/cm², 11 - 14 psi)



CHECKING COOLING SYSTEM FOR LEAKS

Apply pressure to the cooling system by means of a tester to check for leakage.

Testing pressure:

98 kPa (0.98 bar, 1.0 kg/cm², 14 psi)

CAUTION:

Higher than the specified pressure may cause radiator damage.

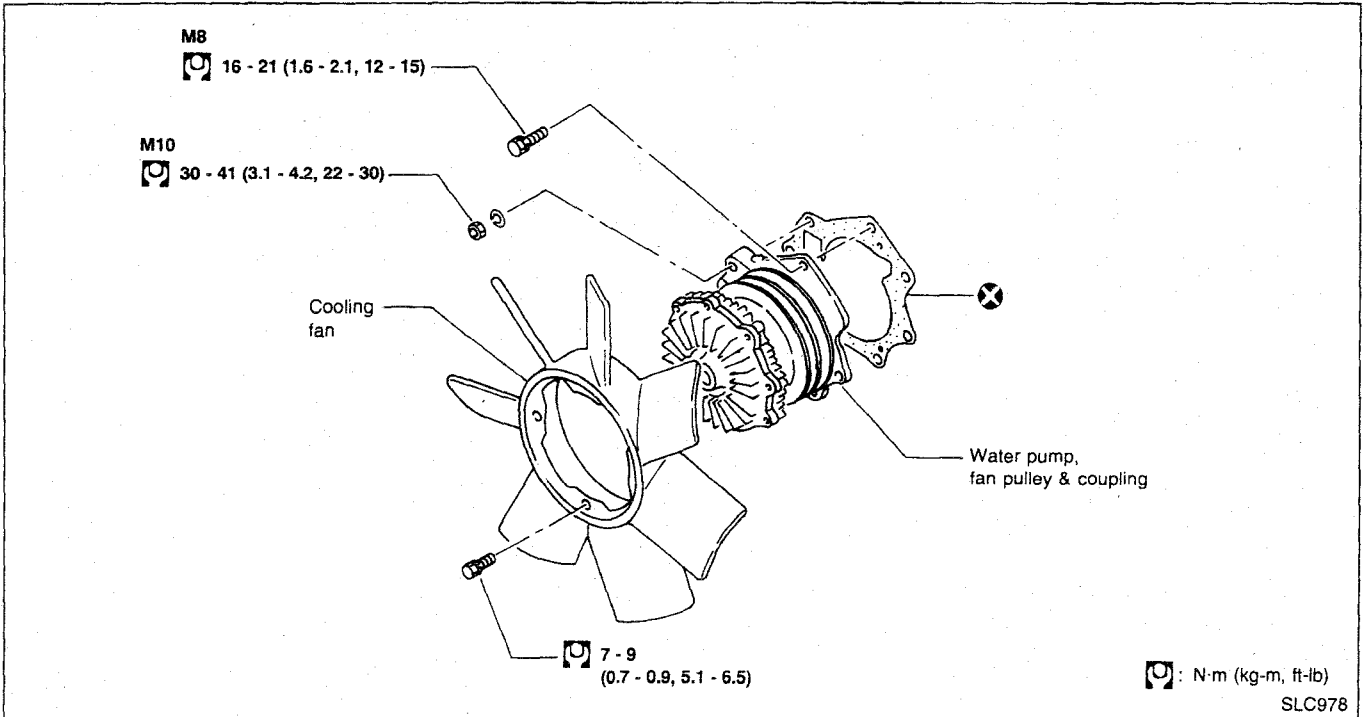
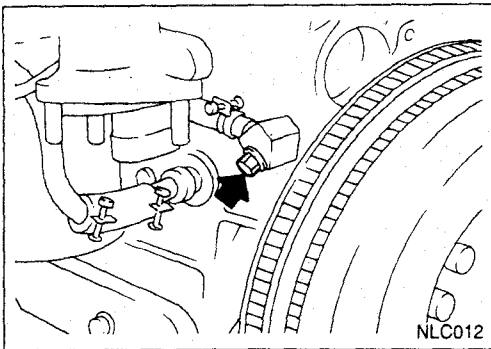
Water Pump

REMOVAL AND INSTALLATION

Drain coolant from drain plugs on cylinder block and radiator.

Cylinder block drain plug:
(Use proper sealant)

 : 20 - 29 N·m
(2.0 - 3.0 kg-m, 14 - 22 ft-lb)

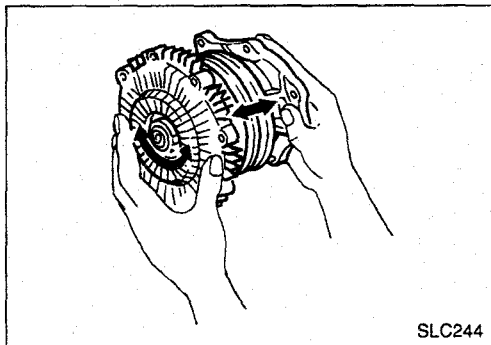
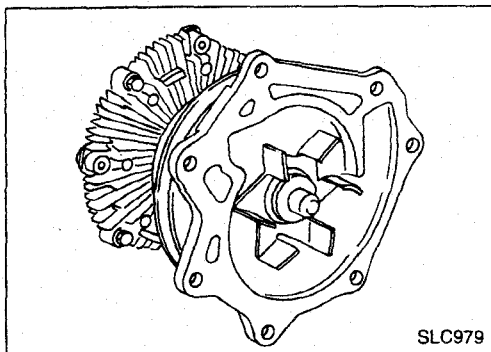


CAUTION:

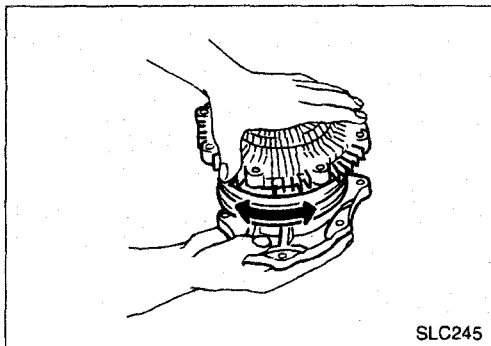
- When removing water pump assembly, be careful not to spill coolant on drive belt.
- Water pump cannot be disassembled and should be replaced as a unit.
- Always replace with new gasket.
- After installing water pump, connect hose and clamp securely, then check for leaks using radiator cap tester.

Water Pump (Cont'd)**INSPECTION**

1. Check for badly rusted or corroded body assembly and vane.



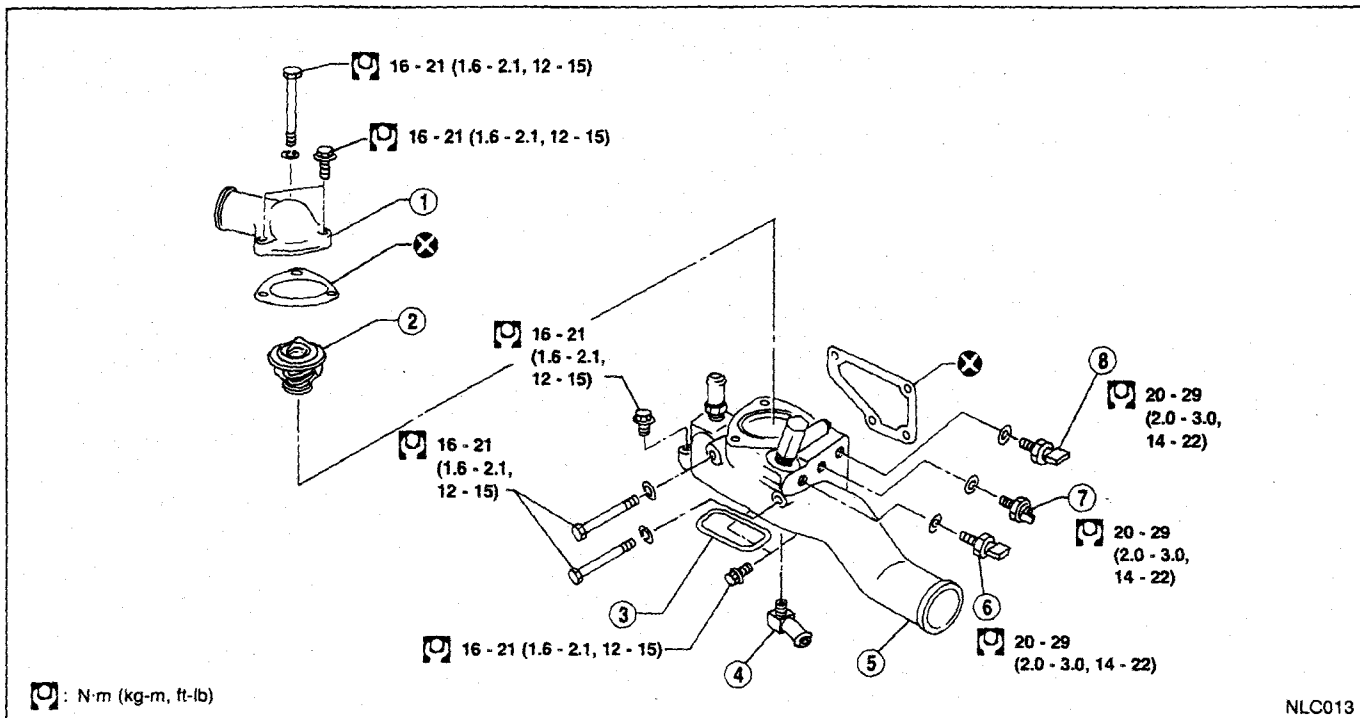
2. Check the water pump bushing for excessive end play and irregular movement.



3. Check fan coupling for rough operation, oil leakage or bent bimetal.

The water pump and fan coupling cannot be disassembled and should be replaced as a unit.

Thermostat



- ① Water outlet
- ② Thermostat with jiggle valve
- ③ Rubber seal
- ④ Water connector
- ⑤ Thermostat housing

- ⑥ Water temperature sensor (E.G.R.)
Cable colours:
Green/Red
Light green/White

- ⑦ Water temperature sensor
- ⑧ Water temperature sensor (Glow)
Cable colours:
Black
Yellow/Black

CAUTION:

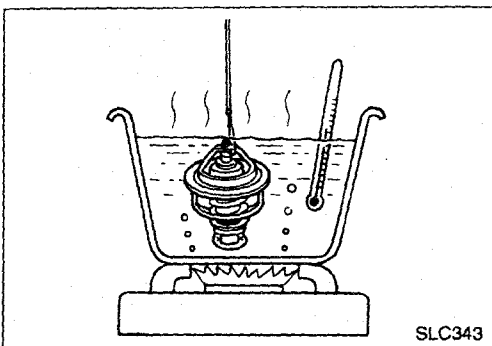
- After installation, run engine for a few minutes, and check for leaks.
- Be careful not to spill coolant over engine compartment. Place a rag to absorb coolant.

INSPECTION

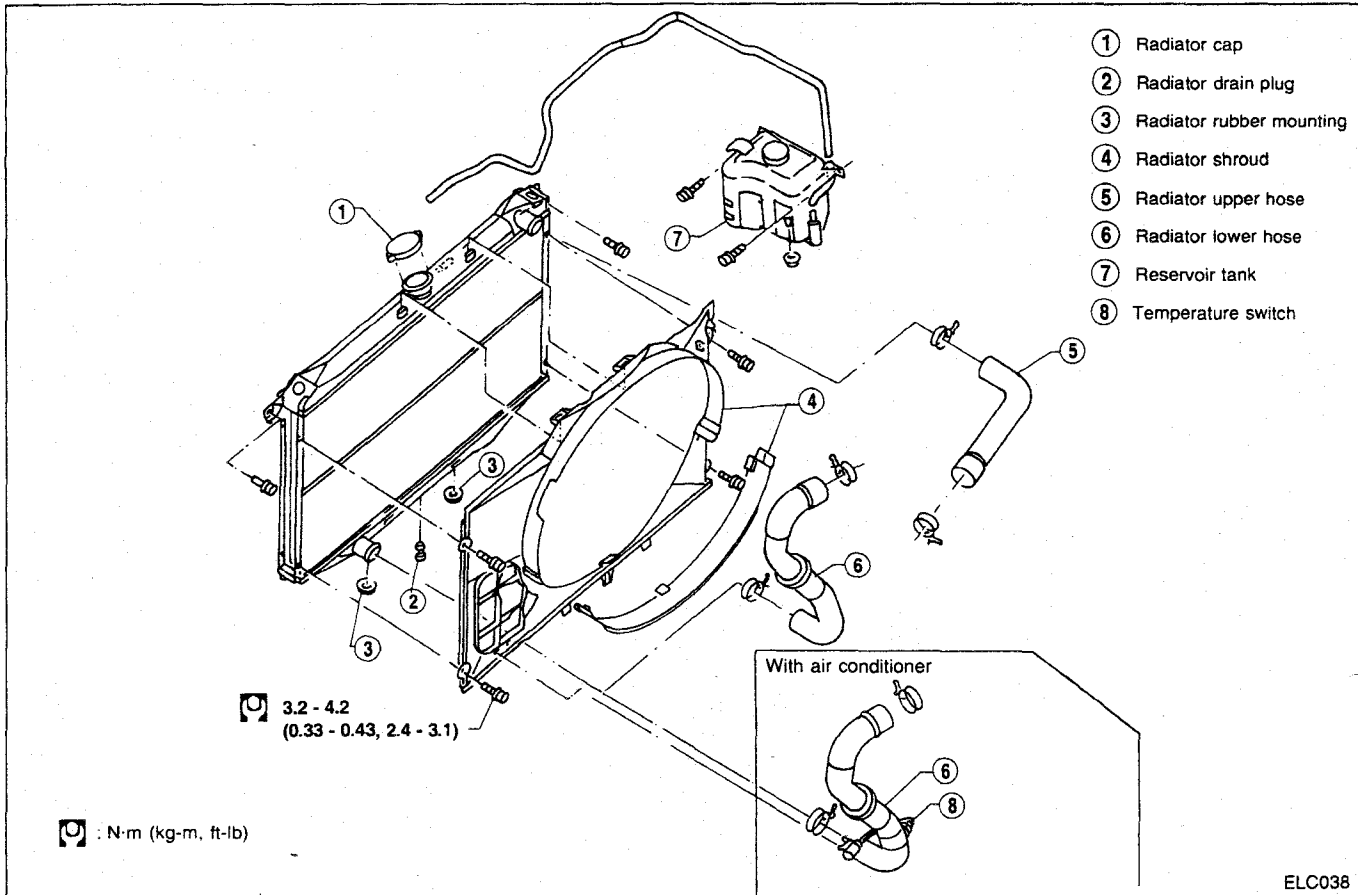
1. Check for valve seating condition at ordinary temperatures. It should seat tightly.
2. Check valve opening temperature and maximum valve lift.

	Standard type	Optional type
Valve opening temperature °C (°F)	82 (180)	88 (190)
Max. valve lift mm/°C (in/°F)	8/95 (0.315/203)	8/100 (0.315/212)

3. Then check if valve closes at 5°C (9°F) below valve opening temperature.



Radiator

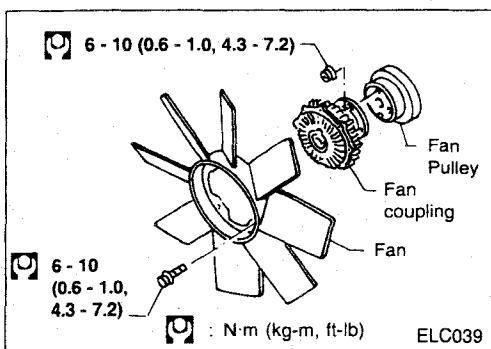


CAUTION:

When filling radiator with coolant, refer to MA section.

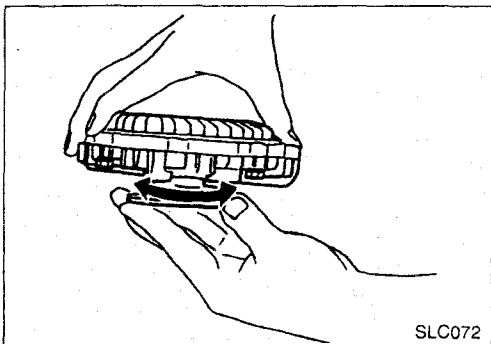
Cooling Fan

DISASSEMBLY AND ASSEMBLY



INSPECTION

Check fan coupling for irregular operation, oil leakage or bent bimetal.



Engine Lubrication System

Oil pressure check

Engine rpm	Approximate discharge pressure kPa (bar, kg/cm ² , psi)
Idle speed	More than 78 (0.78, 0.8, 11)
3,000	412 - 481 (4.12 - 4.81, 4.2 - 4.9, 60 - 70)

Oil pump

Unit: mm (in)

Rotor tip clearance	Less than 0.12 (0.0047)
Outer rotor to body clearance	0.15 - 0.21 (0.0059 - 0.0083)
Side clearance (with gasket)	0.04 - 0.08 (0.0016 - 0.0031)

Engine Cooling System

Thermostat

	Standard type	Optional type
Valve opening temperature °C (°F)	76.5 (170)	82 (180)
Maximum valve lift mm/°C (in/°F)	8/90 (0.31/194)	8/95 (0.31/203)

Radiator

Unit: kPa (bar, kg/cm², psi)

Cap relief pressure	78 - 98 (0.78 - 0.98, 0.8 - 1.0, 11 - 14)
Leakage test pressure	98 (0.98, 1.0, 14)

Engine Lubrication System

Oil pressure check

Engine rpm	Approximate discharge pressure kPa (bar, kg/cm ² , psi)
Idle speed	More than 78 (0.78, 0.8, 11)
3,000	294 - 392 (2.94 - 3.92, 3.0 - 4.0, 43 - 57)

Oil pump

Unit: mm (in)

Gear side clearance	Less than 0.13 (0.0051)
Gear backlash	Less than 0.43 (0.0169)
Oil pump bushing clearance	Less than 0.15 (0.0059)
Oil pump bushing inside diameter	13.012 - 13.098 (0.5123 - 0.5157)
Drive gear shaft outside diameter	12.974 - 12.992 (0.5108 - 0.5115)

Engine Cooling System

Thermostat

	Standard type	Optional type
Valve opening temperature °C (°F)	82 (180)	88 (190)
Max. valve lift mm/°C (in/°F)	8/95 (0.315/203)	8/100 (0.315/212)

Radiator

Unit: kPa (bar, kg/cm², psi)

Cap relief pressure	78 - 98 (0.78 - 0.98, 0.8 - 1.0, 11 - 14)
Leakage test pressure	98 (0.98, 1.0, 14)