

ENGINE LUBRICATION & COOLING SYSTEMS

SECTION **LC**



LC

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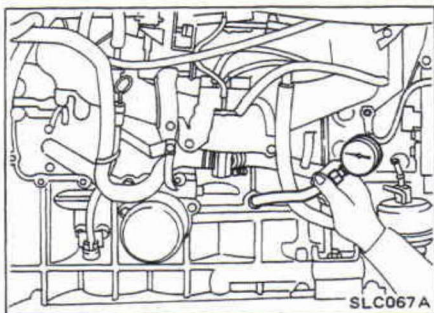
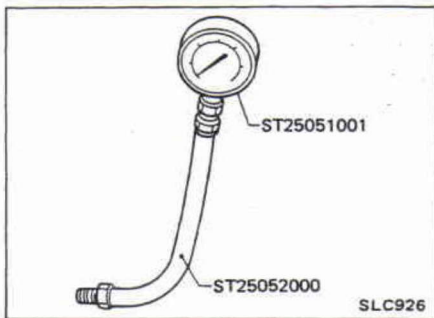
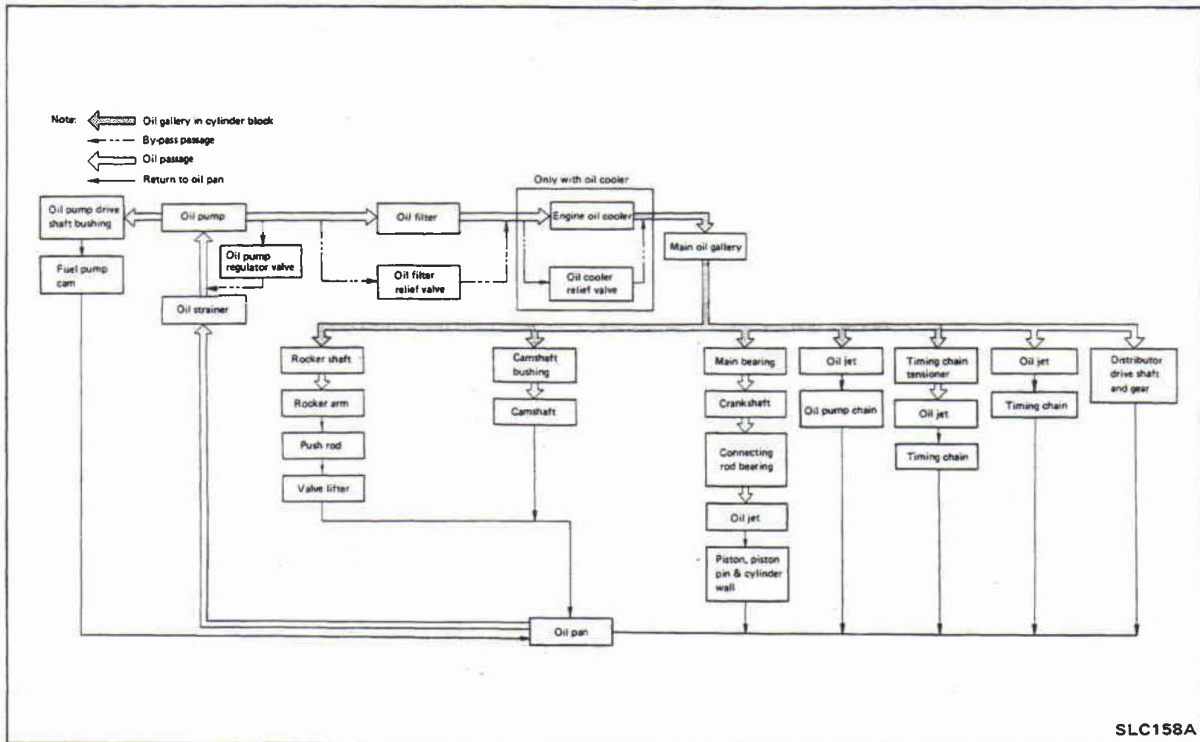
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PREPARATION

SPECIAL SERVICE TOOLS

Tool number Tool name	Description
ST25051001 Oil pressure gauge	
ST25052000 Hose	 <p data-bbox="1070 633 1337 685">Adapting oil pressure gauge to cylinder block</p>

Lubricating Circuit



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 speed rpm	Approximate discharge pressure kPa (bar, kg/cm ² , psi)
Idle speed	More than 49 (0.49, 0.5, 7)
2,800	392 - 451 (3.92 - 4.51, 4.0 - 4.6, 57 - 65)

Oil Pressure Check (Cont'd)

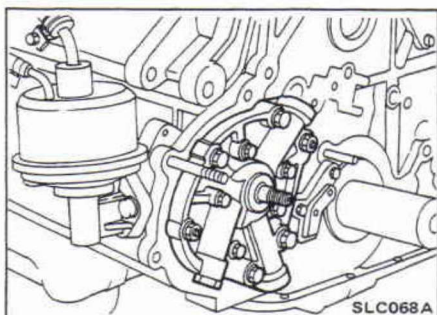
If difference is extreme, check oil passage and oil pump.

6. Install oil pressure switch with sealant.

Oil pressure switch:

 : 10 - 16 N·m

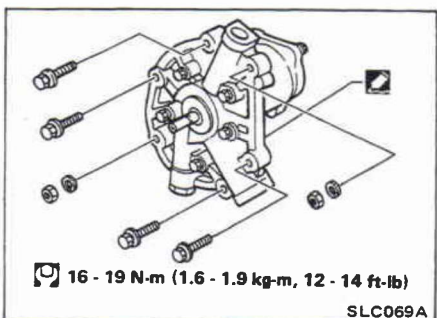
(1.0 - 1.6 kg-m, 7 - 12 ft-lb)



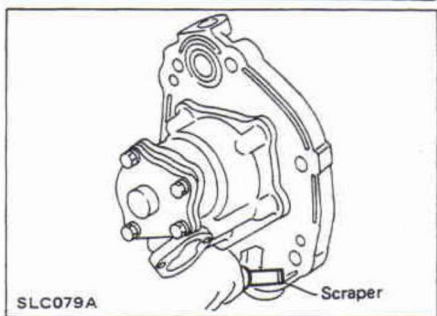
Oil Pump

REMOVAL AND INSTALLATION

1. Remove front cover.
2. Remove fuel pump.
3. Remove oil pump chain and sprocket.



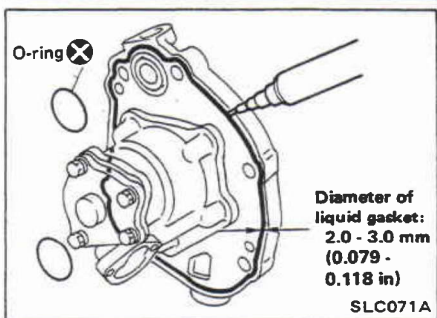
4. Remove oil pump assembly.
5. Installation is in reverse order of removal.



- Before installing oil pump, remove liquid gasket from mating surface of oil pump using a scraper.

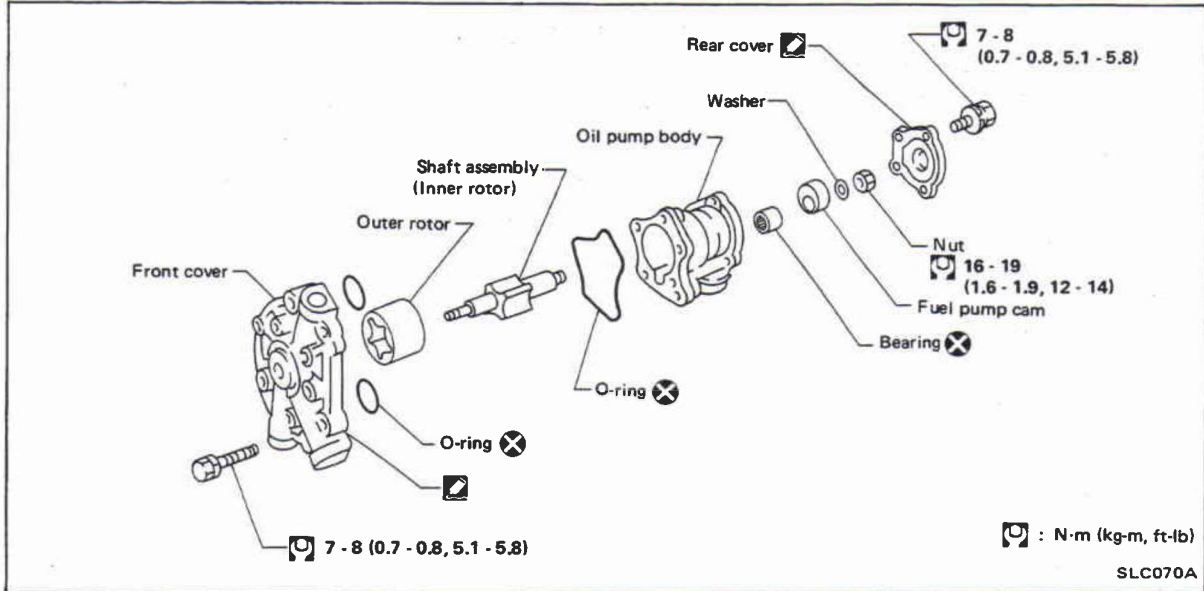
Be sure liquid gasket in grooves is also removed.

- Remove liquid gasket from mating surface of cylinder block.
- Clean all traces of liquid gasket using white gasoline.

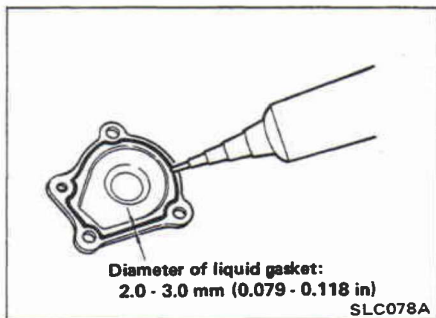


- Apply a continuous bead of liquid gasket to mating surface of oil pump as shown.
- Use **Genuine Liquid Gasket** or equivalent.
 - a. Be sure diameter of liquid gasket is within 2.0 to 3.0 mm (0.079 to 0.118 in) dia. range.
 - b. Attach pump housing to cylinder block within five minutes of applying liquid gasket.
 - c. After installing pump housing, wait at least 30 minutes before starting engine.
- Be sure that O-rings are properly fitted.

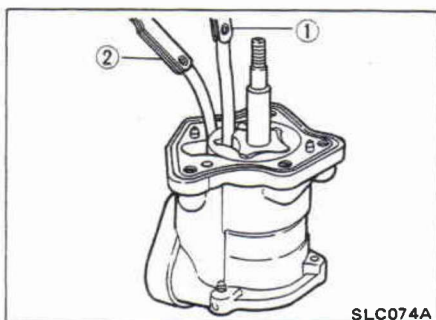
**Oil Pump (Cont'd)
DISASSEMBLY AND ASSEMBLY**



- When installing oil pump, apply engine oil to inner and outer rotor.
- Be sure that O-rings are properly fitted.



- When installing oil pump rear cover, apply liquid gasket as shown.
- Use Genuine Liquid Gasket or equivalent.
- Follow procedures described under "Oil Pump" on page LC-4 when applying liquid gasket.



Inspection

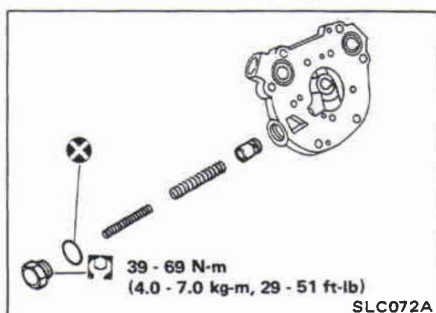
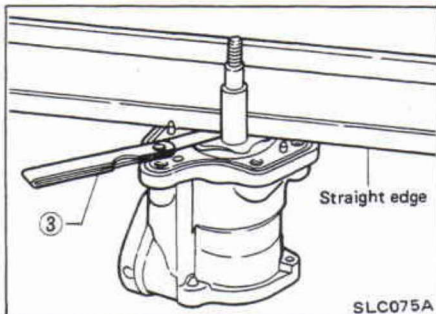
OIL PUMP INSPECTION

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	0.14 - 0.22 (0.0055 - 0.0087)
Side clearance ③	0.050 - 0.109 (0.0020 - 0.0043)

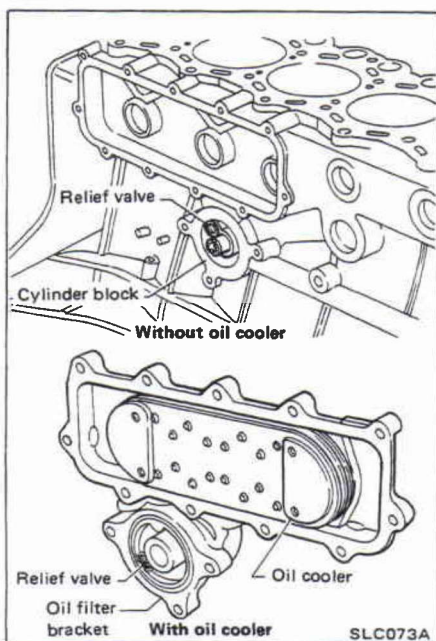
If it exceeds the limit, replace rotor or entire oil pump assembly.



OIL PUMP 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.



OIL FILTER RELIEF VALVE INSPECTION

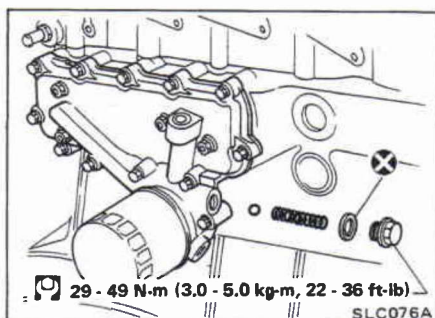
Inspect oil filter relief valve for movement, cracks and breaks by pushing the ball. If replacement is necessary, remove valve by prying it out with suitable tool.

Install a new valve in place by tapping it.

Inspection (Cont'd)**OIL COOLER RELIEF VALVE INSPECTION**

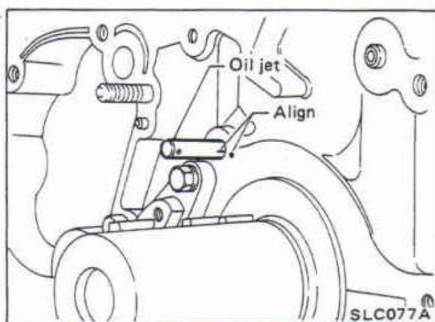
Inspect oil cooler relief valve for movement, cracks and breaks by pushing the ball.

If damaged, replace oil cooler relief valve set.

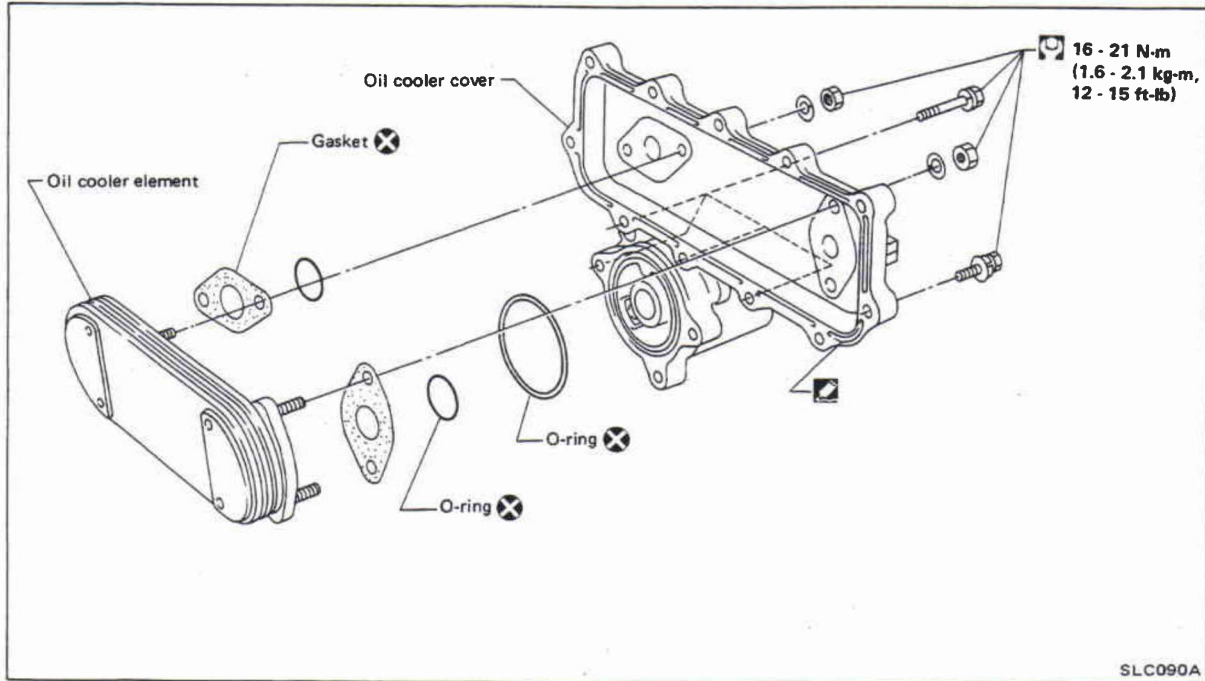
**Oil Jet****INSPECTION (For oil pump chain)**

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

Drive oil jet into place after positioning alignment mark on cylinder block with that on oil pump.



Oil Cooler

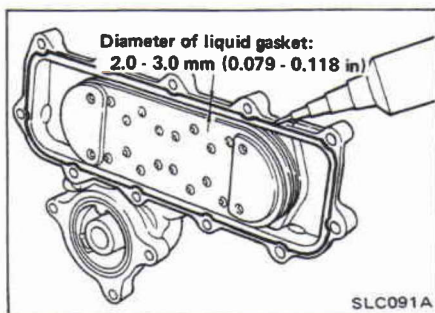


REMOVAL

1. Drain coolant from radiator.
 2. Remove oil cooler cover.
- Do not remove yellow nut.**
3. Remove oil cooler element.

INSPECTION

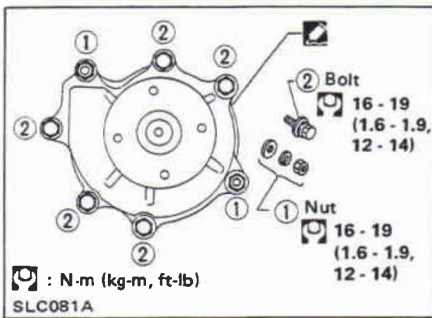
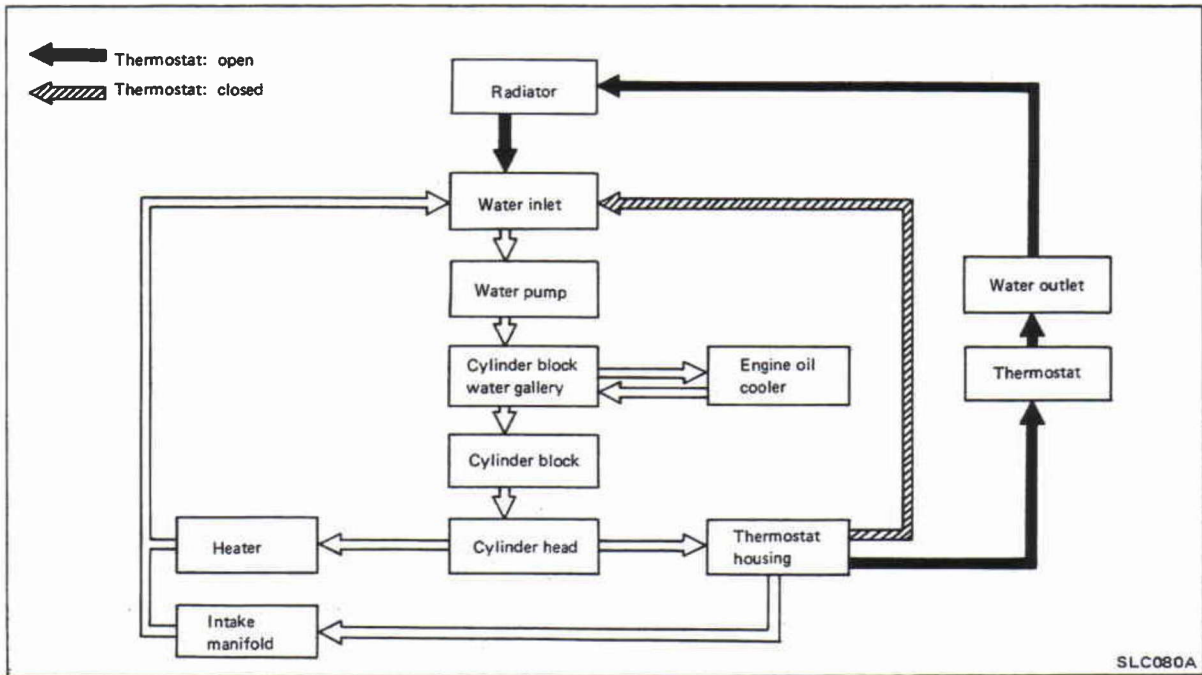
1. Check oil cooler element and housing for cracks.
 2. Check oil cooler for clogging by blowing through coolant inlet.
- Replace it if necessary.



INSTALLATION

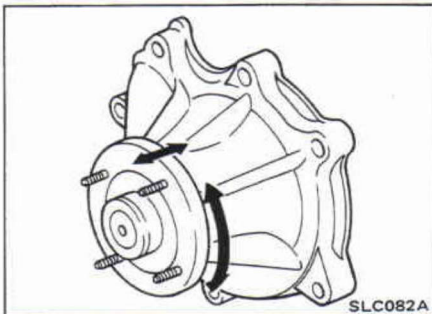
- When installing oil cooler, apply liquid gasket as shown.
 - Use Genuine Liquid Gasket or equivalent.
- Follow procedures described under "Oil Pump" on page LC-4 when applying liquid gasket.

Cooling Circuit



Water Pump REMOVAL

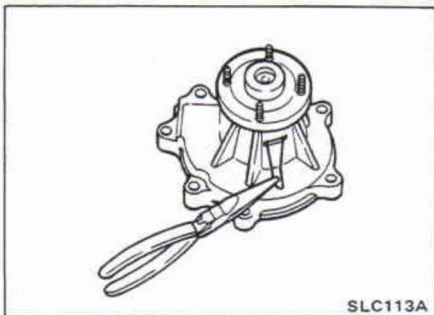
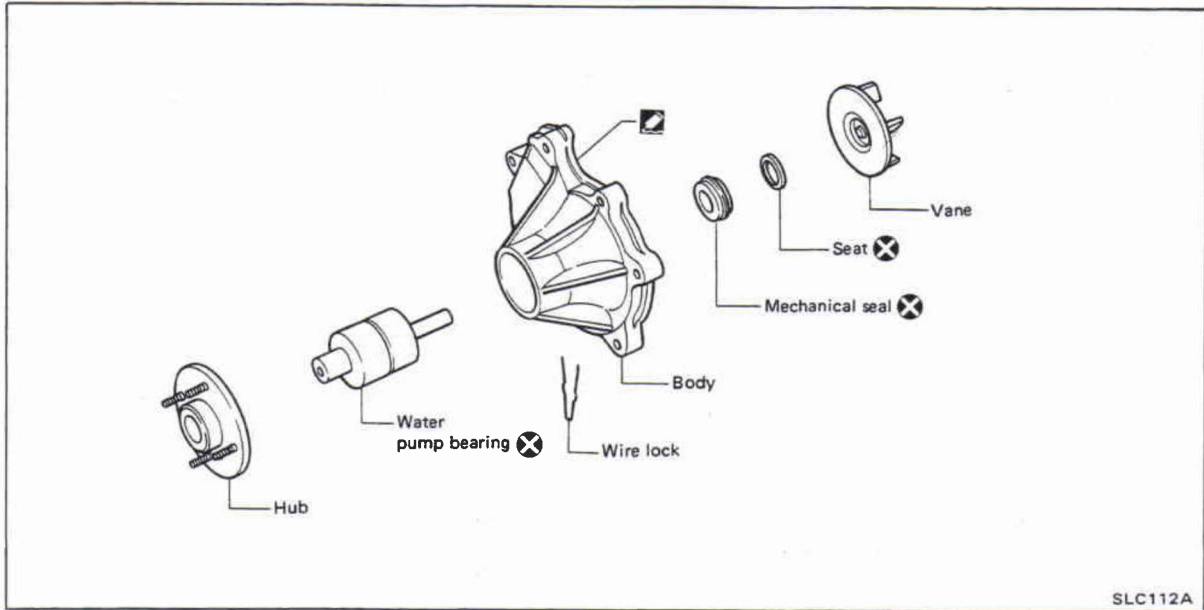
1. Drain coolant from radiator.
2. Remove fan belts, cooling fan and pulley.
3. Remove water pump.



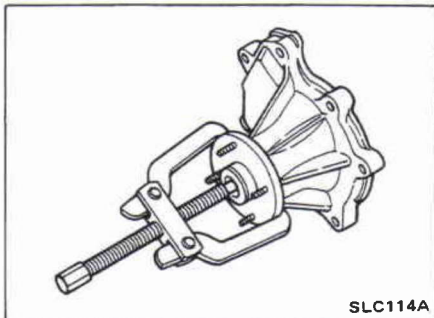
INSPECTION

1. Check for excessive end play and rough operation.
 2. Check for badly rusted or corroded body assembly and vane.
- If damaged, replace the parts or entire water pump assembly.

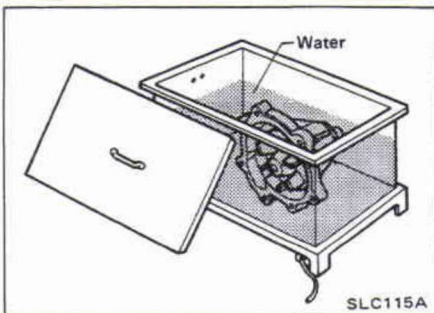
Water Pump (Cont'd)
DISASSEMBLY



1. Remove wire lock.

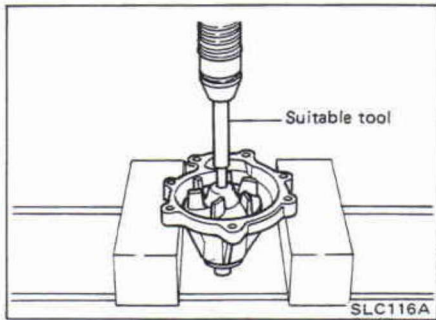


2. Remove hub.



3. Remove water pump bearing and vane.
a. Heat water pump to 80 to 100°C (176 to 212°F).

Water Pump (Cont'd)



- b. Push out water pump bearing and vane by using a press and suitable tool.
- 4. Remove mechanical seal and seat.

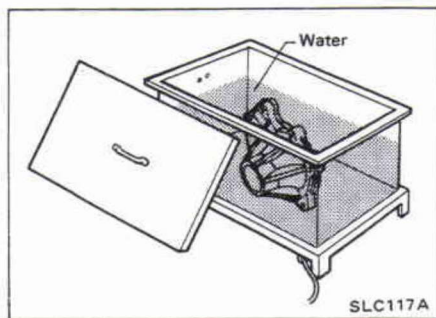
ASSEMBLY

- Always assemble the water pump with a new mechanical seal and water pump bearing.

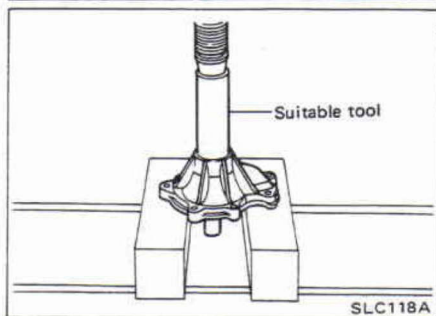
If body, hub and vane are to be reused, measure "interference fit" of each part to water pump bearing. Ensure that fit is within specified range as indicated below. If it is outside specified range, replace part with a new one.

Interference fit: mm (in)

- Body to bearing
0.027 - 0.055 (0.0011 - 0.0022)
- Hub to bearing
0.032 - 0.061 (0.0013 - 0.0024)
- Vane to bearing
0.032 - 0.061 (0.0013 - 0.0024)



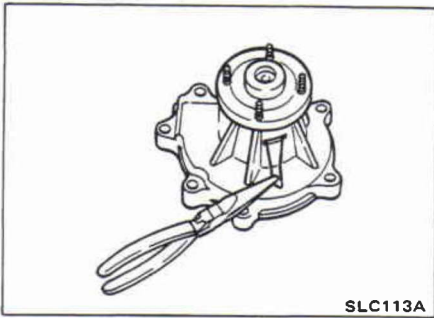
- 1. Install water pump bearing.
- a. Heat water pump body to 80 to 100°C (176 to 212°F).



- b. Using a suitable tool and press, press in outer race of bearing.

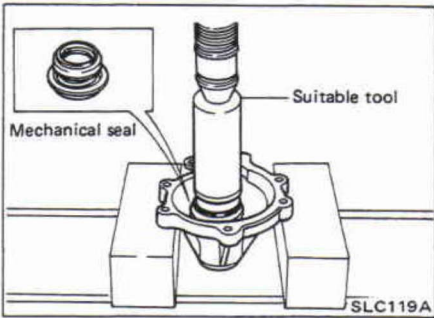
Water Pump (Cont'd)

c. Install wire lock.



SLC113A

2. Install mechanical seal.
 - a. Using a suitable tool and press, press in a new mechanical seal.



SLC119A

b. Place new seat into vane.

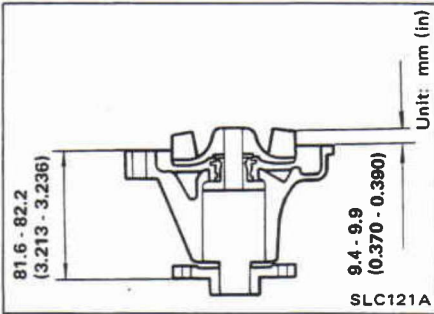
Seal face runout (Total indicator reading):
Limit 0.15 mm (0.0059 in)



SLC120A

3. Install hub and vane.

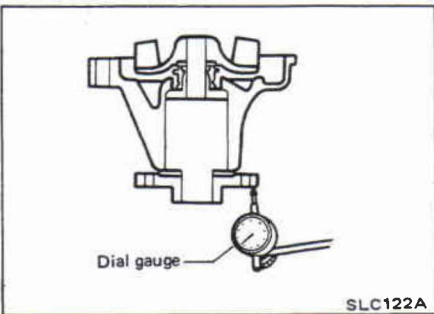
Using a suitable tool and press, press in hub and vane.
Ensure that hub and vane are properly pressed to dimensions shown in figure.



SLC121A

INSPECTION

1. Ensure that hub rotates smoothly by hand.
2. Measure face runout of hub.
Limit: 0.05 mm (0.0020 in)

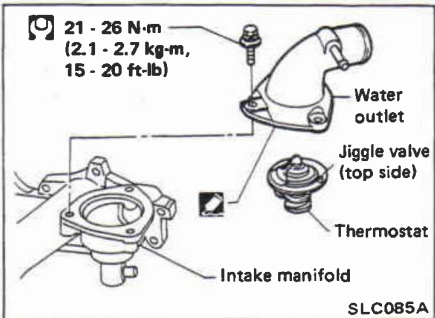
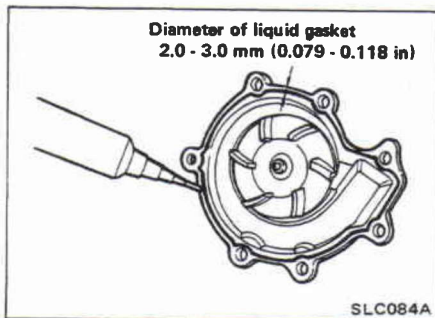


SLC122A

Water Pump (Cont'd)

INSTALLATION

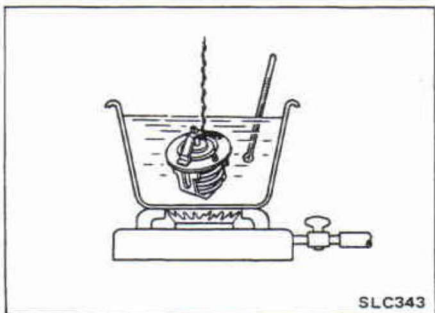
- When installing water pump, apply liquid gasket as shown.
 - Use **Genuine Liquid Gasket or equivalent.**
- Follow procedures described under "Oil Pump" on page LC-4 when applying liquid gasket.**
- After properly installing water pump, ensure that hub rotates smoothly by hand.



Thermostat

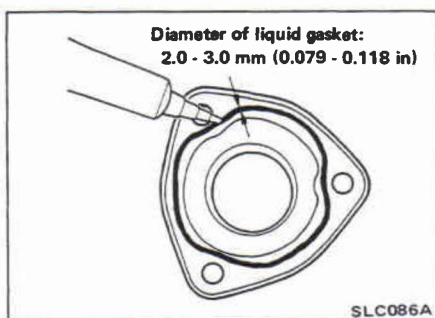
INSPECTION

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



	Tropical type and Gulf standard model	Standard type and Australia model	Frigid type
Valve opening temperature °C (°F)	76.5 (170)	82 (180)	88 (190)
Maximum valve lift mm/°C (in/°F)	10/90 (0.39/194)	10/95 (0.39/203)	10/100 (0.39/212)

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



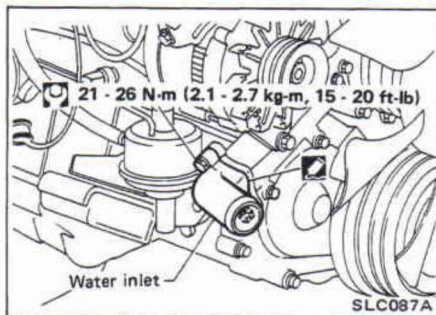
INSTALLATION

Liquid gasket type

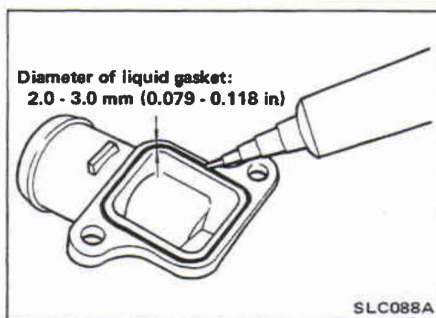
- When installing water outlet, apply liquid gasket as shown.
 - Use **Genuine Liquid Gasket or equivalent.**
- Follow procedures described under "Oil Pump" on page LC-4 when applying liquid gasket.**

Thermostat (Cont'd)**Conventional gasket type**

1. Before installing water outlet, remove all traces of liquid gasket from mating surface using a scraper.
 - Also remove traces of liquid gasket from mating surface of thermostat housing.
Perform the above operation only when liquid gasket is used between water outlet and thermostat housing.
2. Install gasket, thermostat and water outlet.

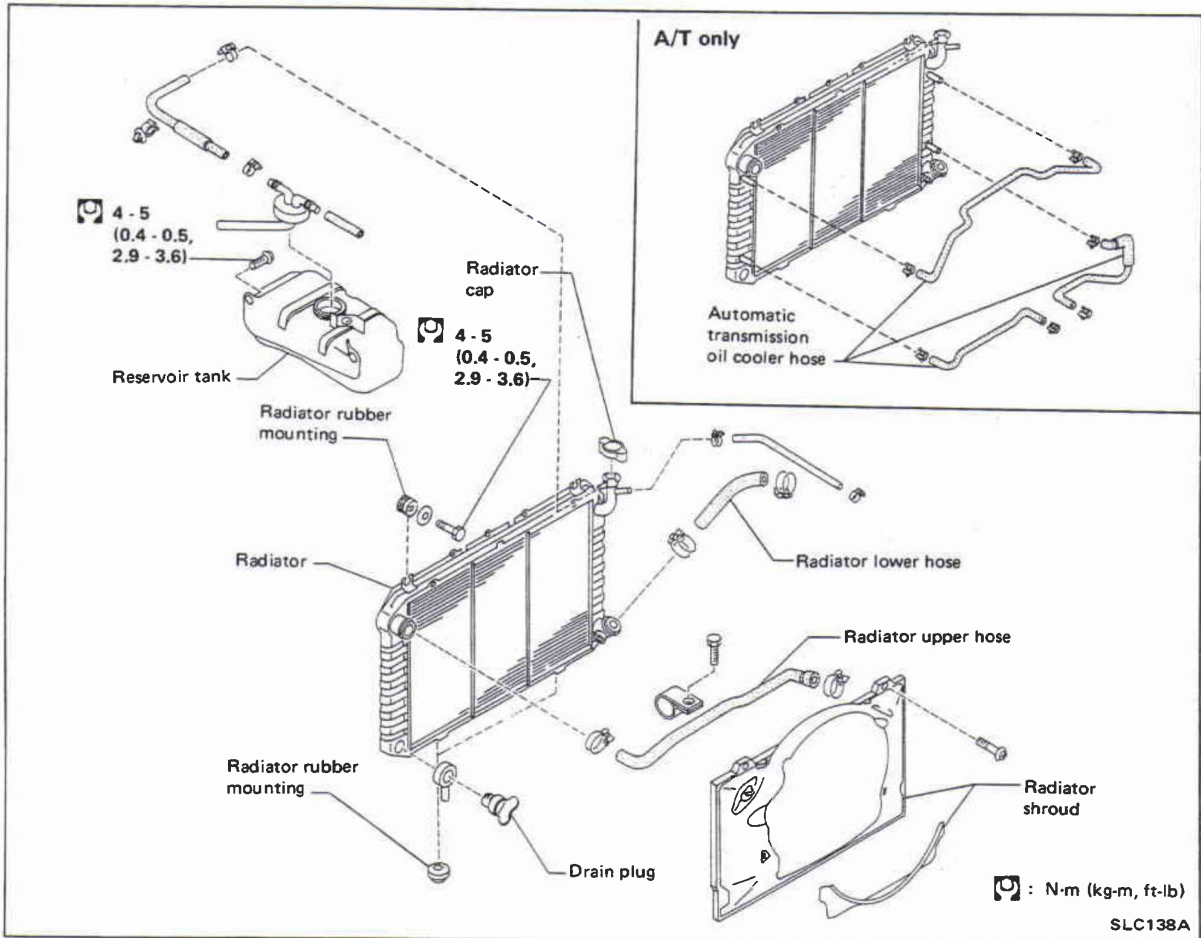
**Water Inlet
INSPECTION**

Visual inspection for water leaks. If there is leakage, replace liquid gasket.

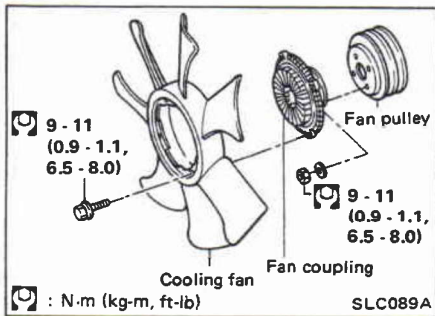
**INSTALLATION**

- When installing water inlet apply liquid gasket as shown.
 - Use **Genuine Liquid Gasket** or equivalent.
- Follow procedures described under "Oil Pump" on page LC-4 when applying liquid gasket.

Radiator

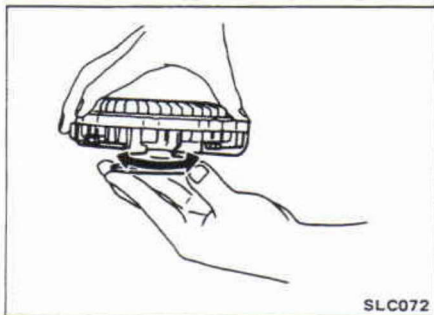


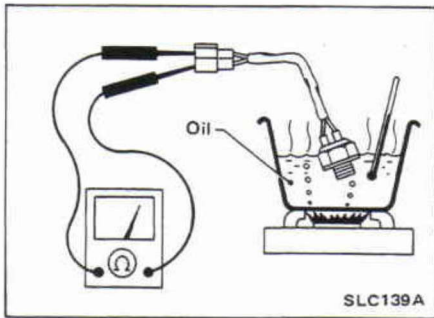
Cooling Fan
DISASSEMBLY AND ASSEMBLY



INSPECTION

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



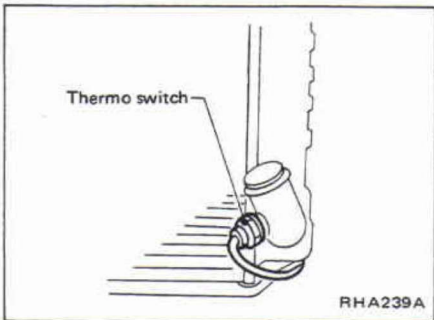


Thermo Switch (For A/C cut system)

INSPECTION

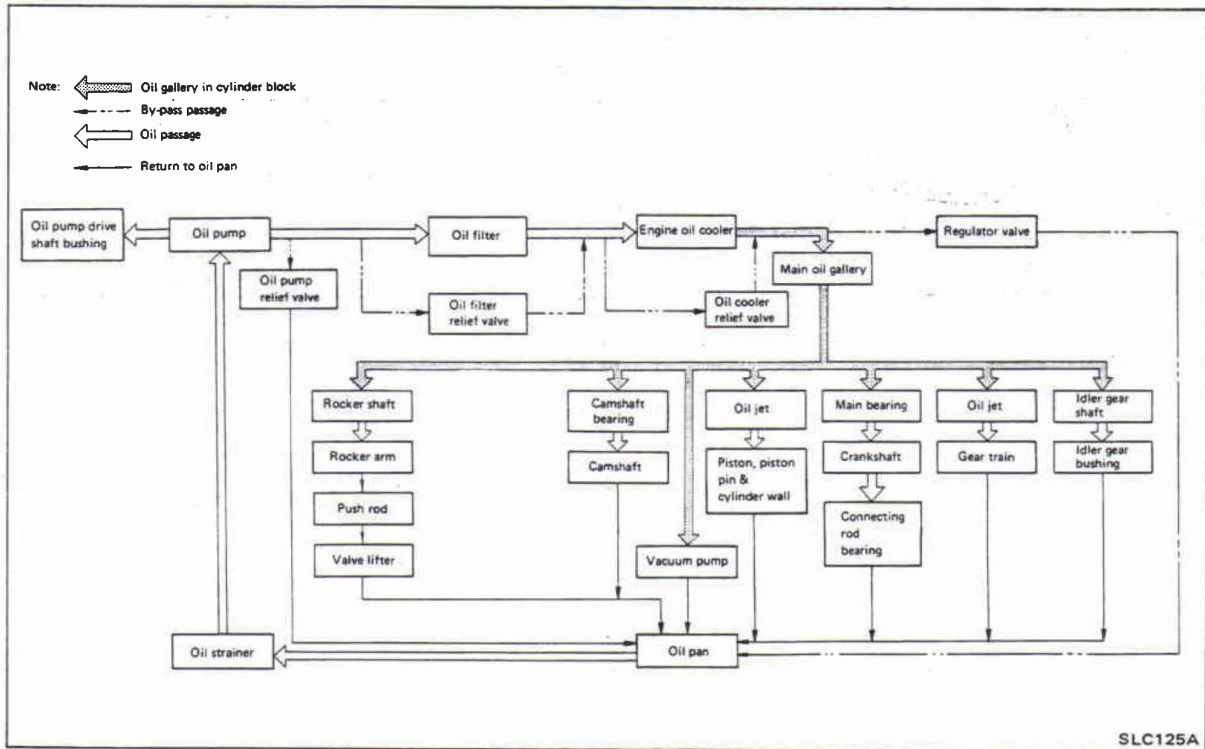
Check thermo switch for proper operation.

Operating temperature	°C (°F)	Operation
Increasing to 107	(225)	OFF → ON
Decreasing to 103	(217)	ON → OFF



For Australia A/T models and Gulf standard models

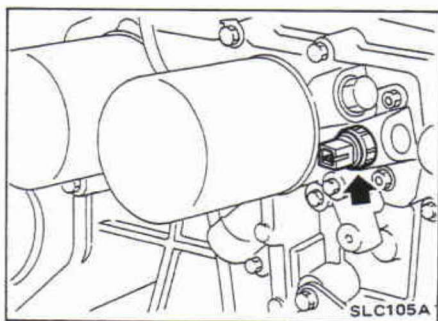
Lubrication Circuit



Oil Pressure Check (On-vehicle service)

WARNING:

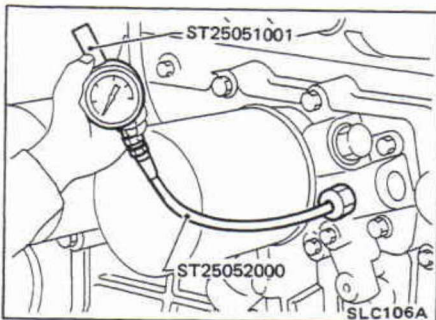
- Be careful not to burn yourself, as the engine and oil may be hot.
- Oil pressure check should be done in "Neutral" gear position.



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

ENGINE LUBRICATION SYSTEM

TD42



Oil Pressure Check (On-vehicle service)(Cont'd)

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)

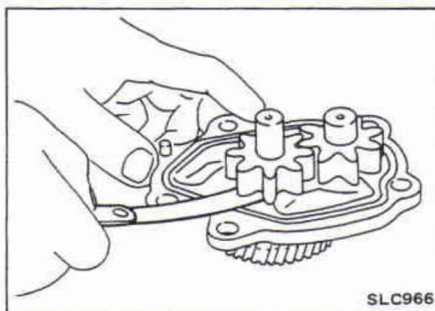
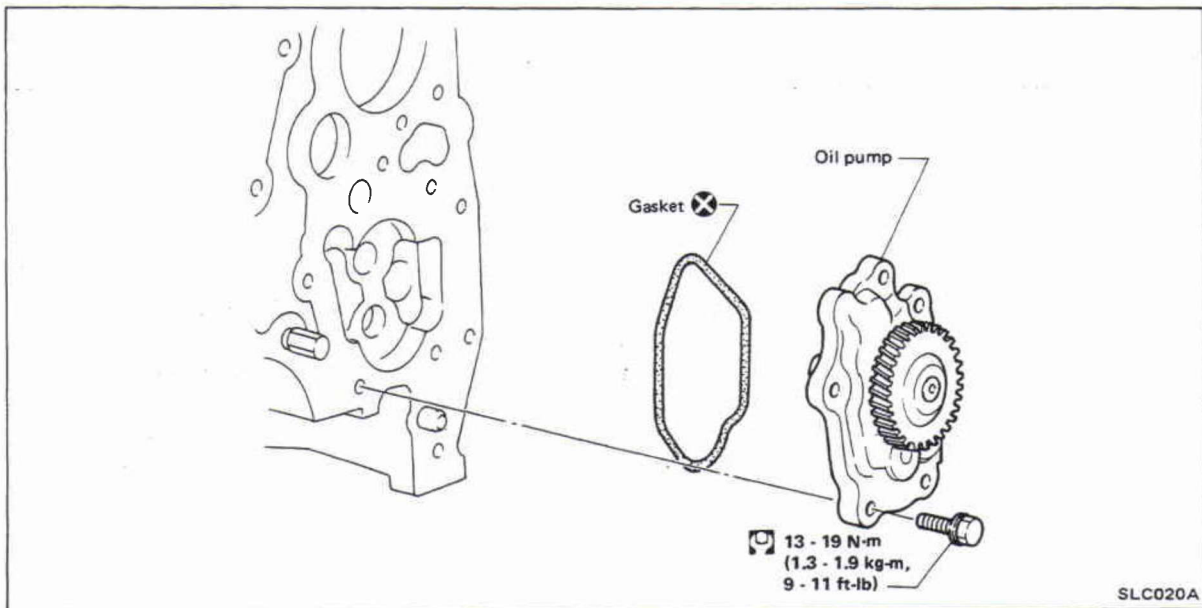
If difference is extreme, check oil passage and oil pump for oil leaks.

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

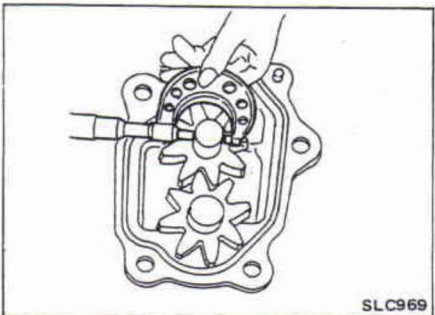
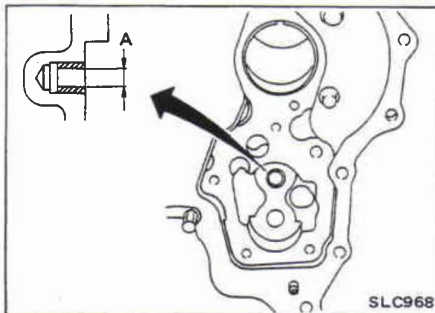
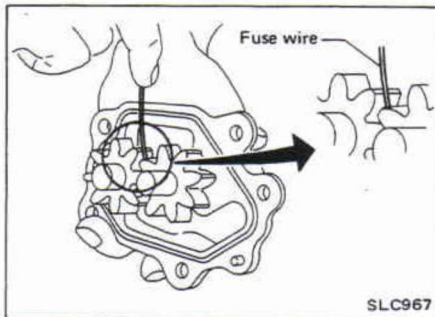


OIL PUMP INSPECTION

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)

Oil Pump (Cont'd)**Gear backlash:****Less than 0.30 mm (0.0118 in)**

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.

Oil Pump (Cont'd)

- 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.

Tightening order

13 - 19
(1.3 - 1.9,
9 - 11)

: N-m (kg-m, ft-lb)
SLC965

29 - 49 (3.0 - 5.0, 22 - 36)

O-ring

Oil pump relief valve

16 - 21
(1.6 - 2.1, 12 - 15)

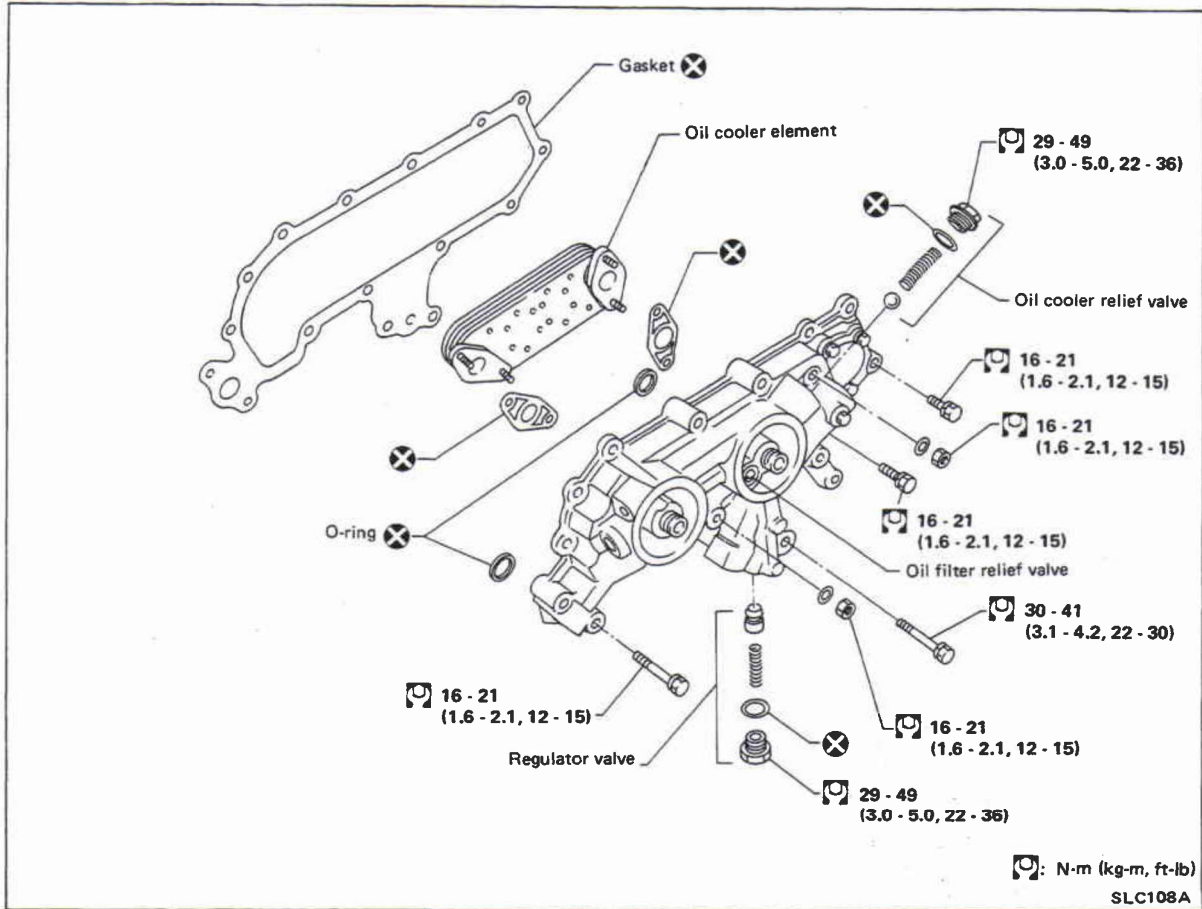
: N-m (kg-m, ft-lb)
SLC107A

Oil Pump 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 Cooler



OIL FILTER RELIEF VALVE INSPECTION

Inspect oil filter relief valve for movement, cracks and breaks by pushing the ball.
If damaged, replace oil filter bracket assembly.

OIL COOLER RELIEF VALVE INSPECTION

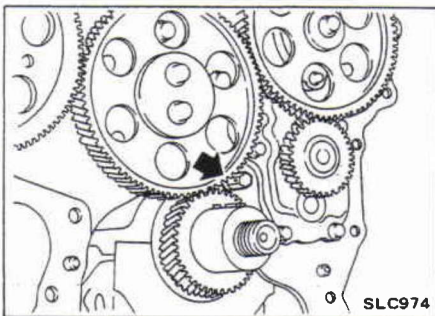
Inspect oil cooler relief valve for movement, cracks and breaks by pushing the ball.
If damaged, replace oil cooler relief valve set.

**Oil Cooler (Cont'd)
REGULATOR VALVE INSPECTION**

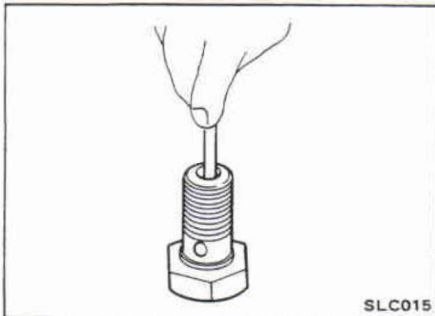
1. Visually inspect components for wear and damage.
 2. Coat regulator valve with engine oil and check that it falls smoothly into the valve hole by its own weight.
- If damaged, replace regulator valve set.

**Oil Jet
INSPECTION (For gear train)**

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

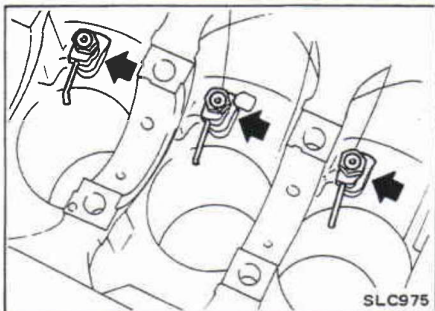


Oil jet has to be installed with oil hole facing crank gear and idler gear.



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 plastic or brass rod and make sure that cut-off valve moves smoothly with proper repulsion.

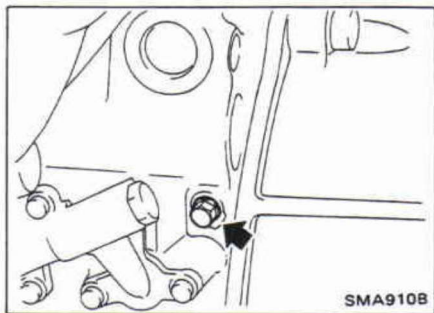
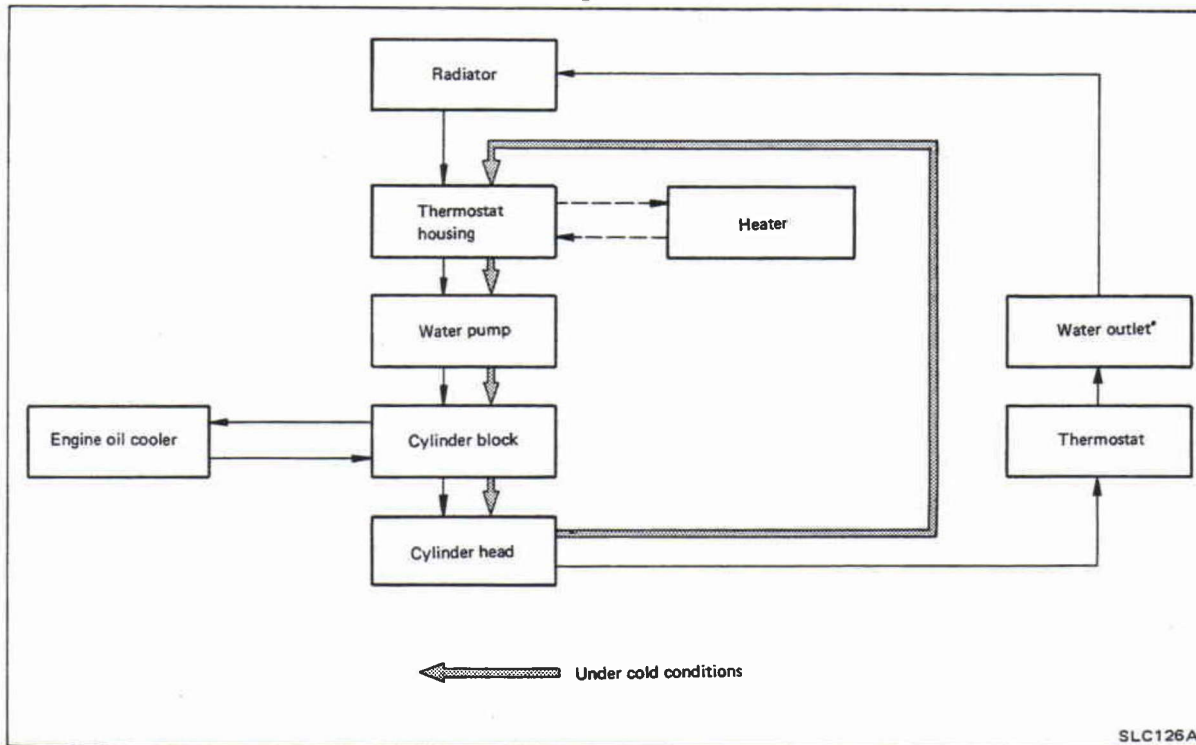


When installing oil jet, align oil jet's boss with hole on cylinder block.

: Oil jet bolt

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

Cooling Circuit



Water Pump

REMOVAL AND INSTALLATION

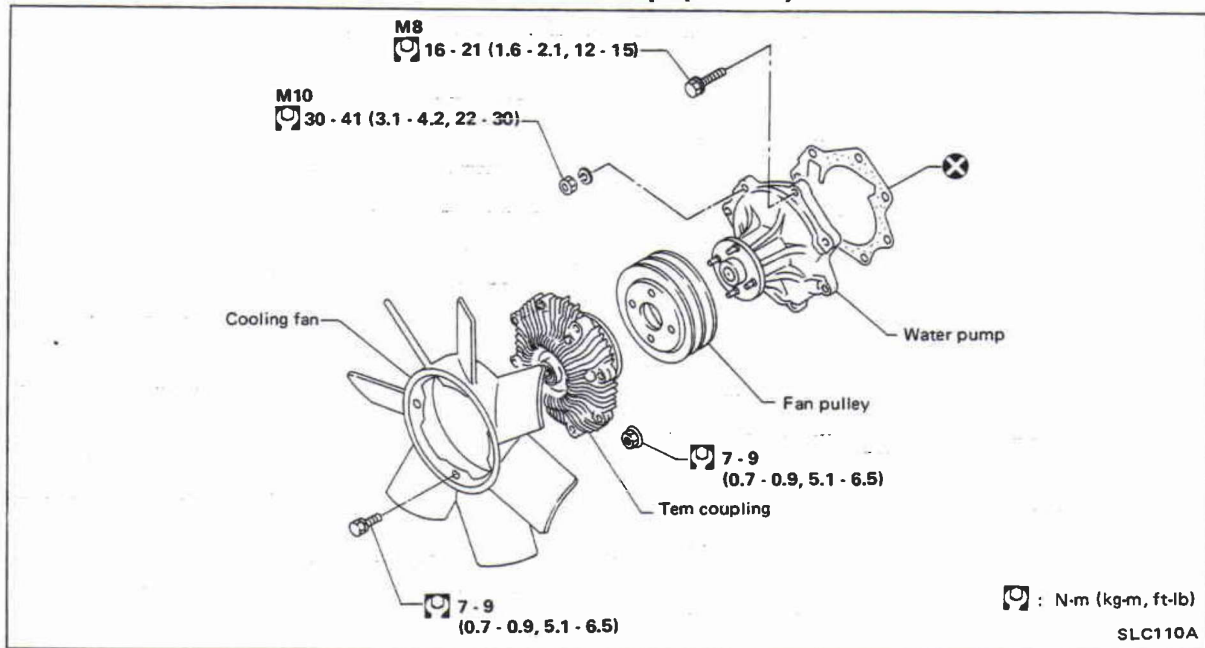
Drain coolant from drain plugs on cylinder block and radiator.

☐: Cylinder block drain plug

(Use proper sealant)

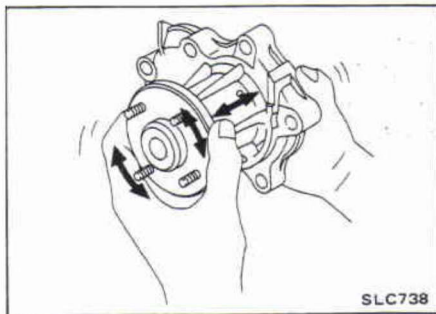
20 - 29 N·m (2.0 - 3.0 kg·m, 14 - 22 ft·lb)

Water Pump (Cont'd)



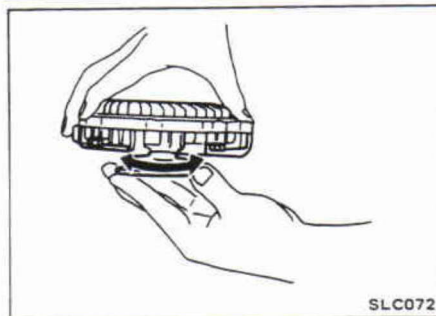
CAUTION:

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



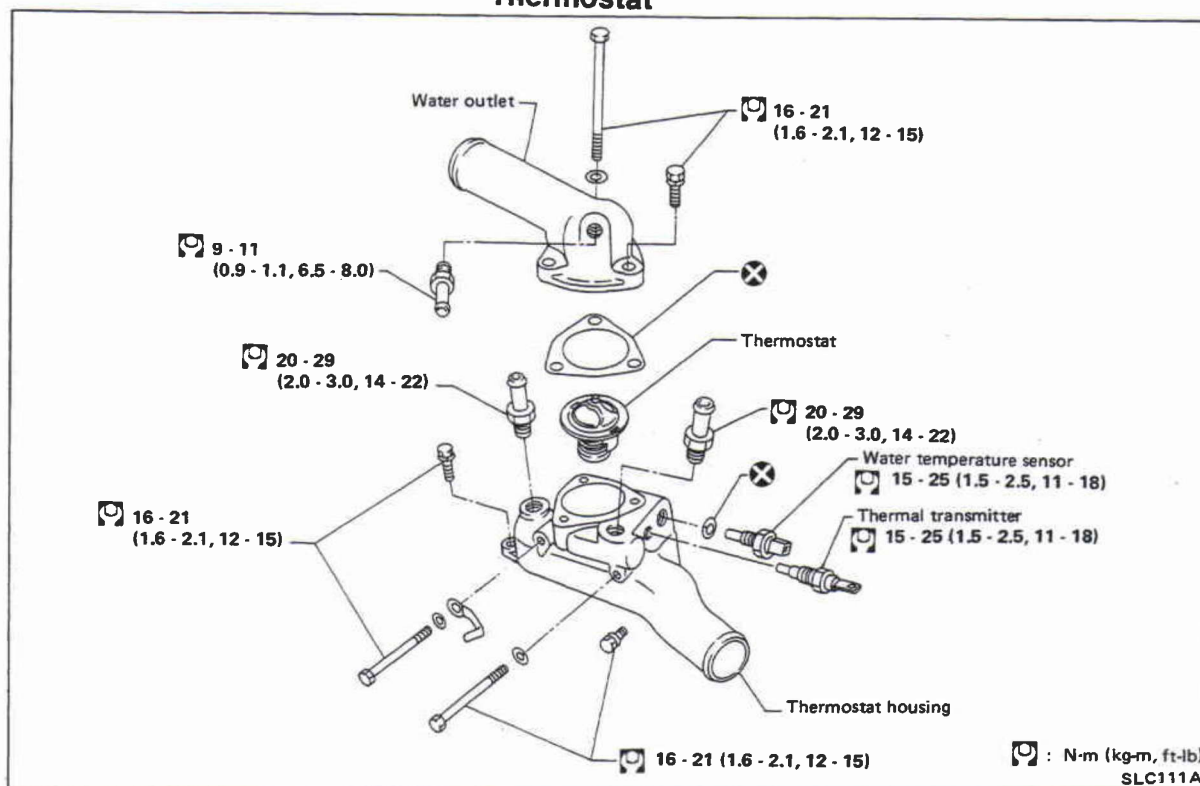
INSPECTION

1. Check for badly rusted or corroded body assembly and vane.
2. Check for rough operation due to excessive end play.



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

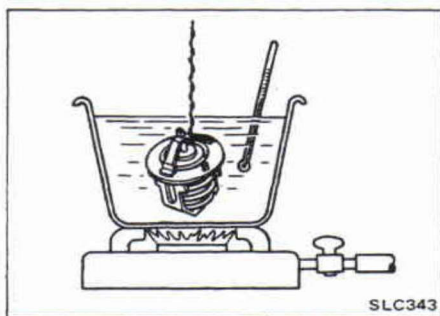
Thermostat



- 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

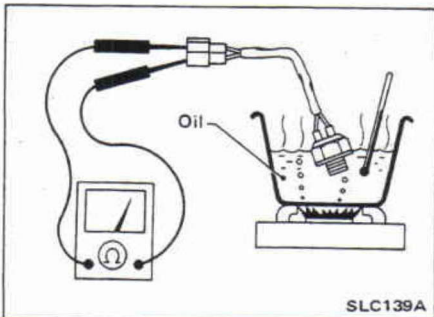
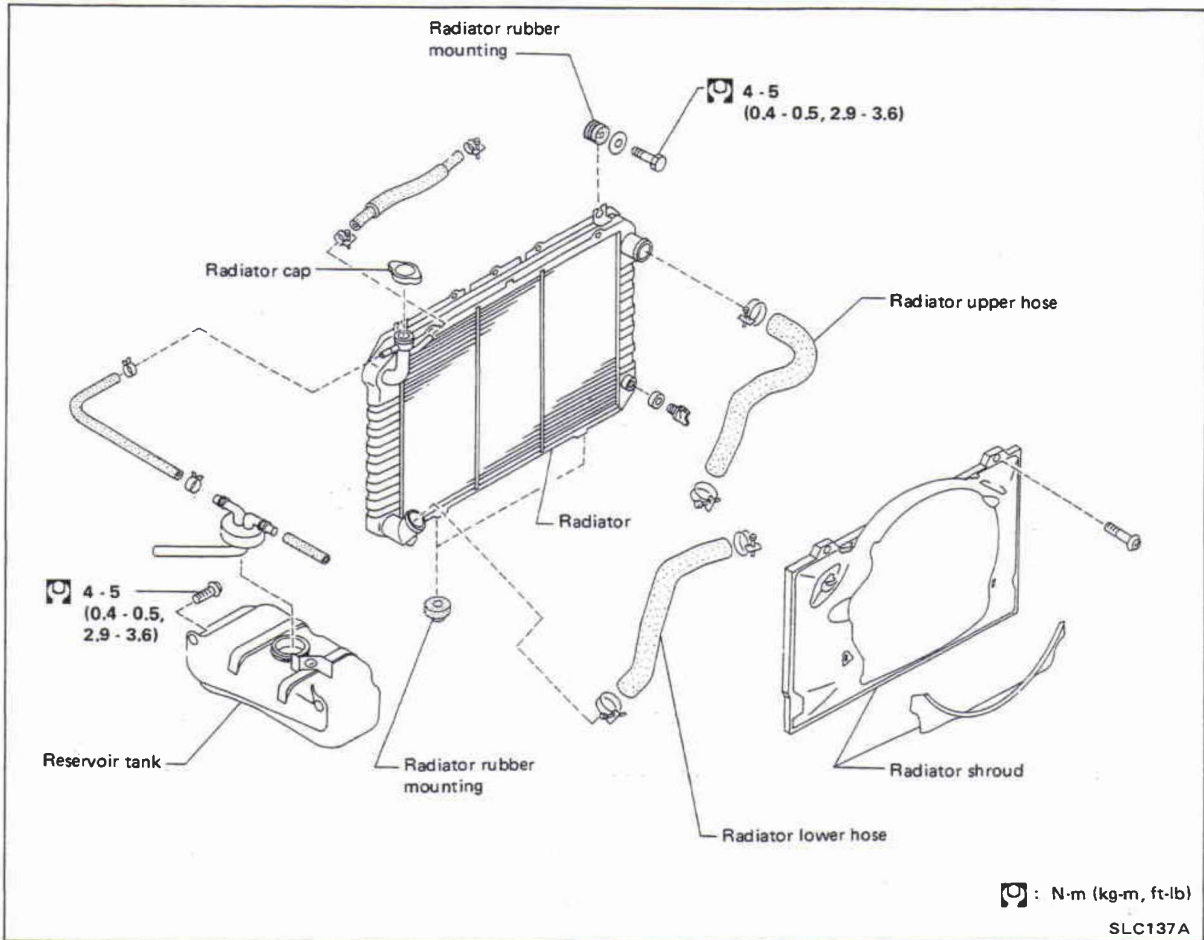
1. Check for valve seating condition at ordinary temperatures. It should seat tightly.
2. Check valve opening temperature and maximum valve lift.



	Tropical type	Standard 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.

Radiator

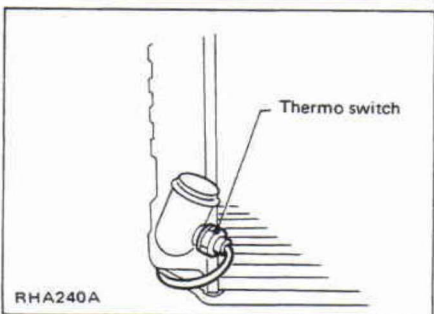


Thermo Switch (For A/C cut system)

INSPECTION

Check thermo switch for proper operation.

Operating temperature	°C (°F)	Operation
Increasing to	107 (225)	OFF → ON
Decreasing to	103 (217)	ON → OFF



For Hardtop and Wagon models except for Australia

Engine Lubrication System

OIL PRESSURE CHECK

Engine rpm	Approximate discharge pressure kPa (bar, kg/cm ² , psi)
Idle speed	More than 49 (0.49, 0.5, 7)
2,800	392 - 451 (3.92 - 4.51, 4.0 - 4.6, 57 - 65)

OIL PUMP

	Unit: mm (in)
Rotor tip clearance ①	Less than 0.12 (0.0047)
Outer rotor to body clearance ②	0.14 - 0.22 (0.0055 - 0.0087)
Side clearance ③	0.050 - 0.109 (0.0020 - 0.0043)

Engine Cooling System

THERMOSTAT

Model except Australia and Gulf standard

	Standard	Frigid type	Tropical type
Valve opening temperature °C (°F)	82 (180)	88 (190)	76.5 (170)
Max. valve lift mm/°C (in/°F)	10/95 (0.39/203)	10/100 (0.39/212)	10/90 (0.39/194)

Australia model

	Standard	Frigid type	Tropical type
Valve opening temperature °C (°F)	82 (180)	-	-
Max. valve lift mm/°C (in/°F)	10/95 (0.39/203)	-	-

Gulf standard model

	Standard	Frigid type	Tropical type
Valve opening temperature °C (°F)	76.5 (170)	-	-
Max. valve lift mm/°C (in/°F)	10/90 (0.39/194)	-	-

THERMO SWITCH

Operating temperature	°C (°F)
OFF → ON	107 (225)
ON → OFF	103 (217)

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 INSPECTION

Unit: mm (in)

Gear side clearance	Less than 0.13 (0.0051)
Gear backlash	Less than 0.30 (0.0118)
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

	Tropical type	Standard 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)

THERMO SWITCH

Operating temperature	°C (°F)
OFF → ON	107 (225)
ON → OFF	103 (217)