

# ENGINE LUBRICATION & COOLING SYSTEMS

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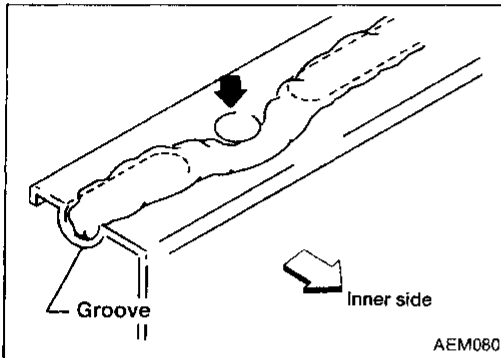
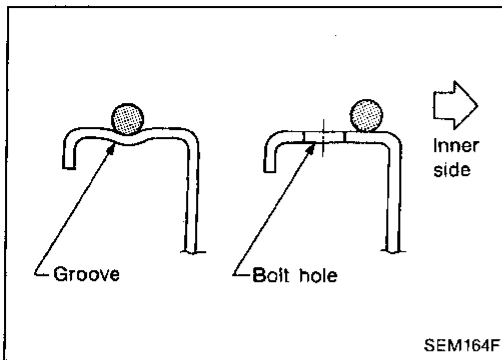
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# SECTION LC

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## PRECAUTION



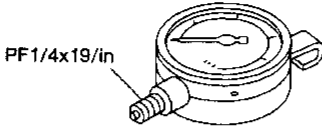
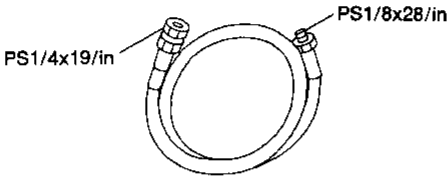
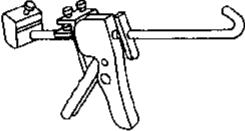
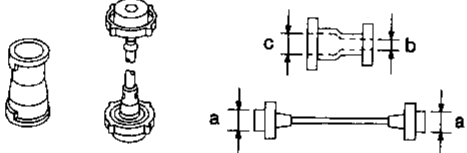
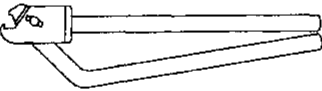
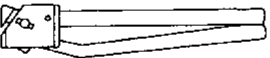
### Liquid Gasket Application Procedure

- Use a scraper to remove all traces of old liquid gasket from mating surfaces and grooves. Also, completely clean any oil from these areas.
- 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).
- Apply liquid gasket around the inner side of bolt holes (unless otherwise specified).
- Assembly should be done within 5 minutes after coating.
- Wait at least 30 minutes before refilling engine oil and engine coolant.

# PREPARATION

## Special Service Tools

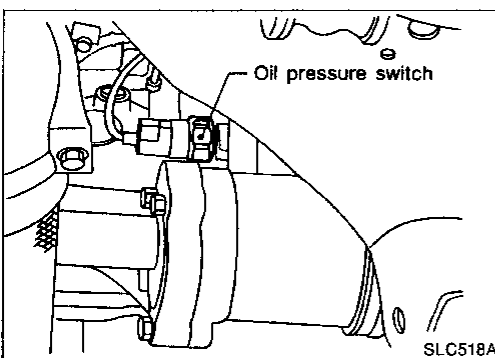
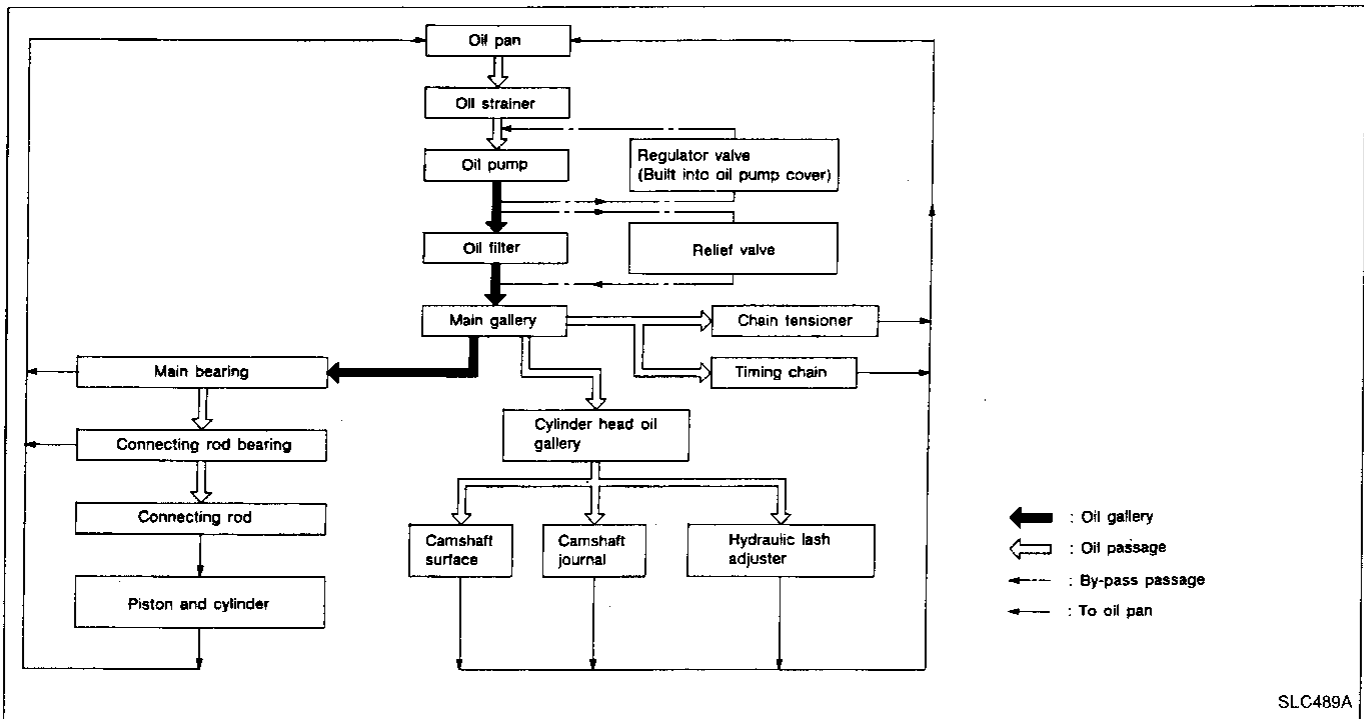
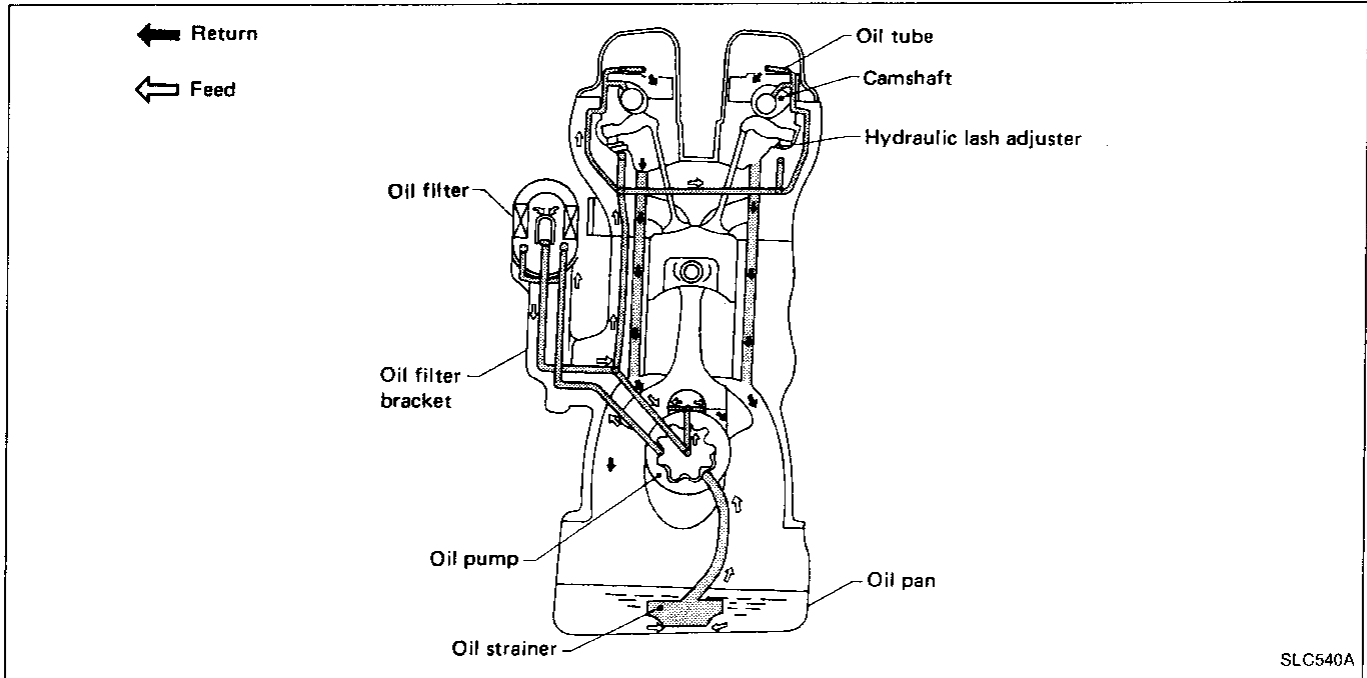
The actual shapes of Kent-Moore tools may differ from those of special service tools illustrated here.

| Tool number<br>(Kent-Moore No.)<br>Tool name               | Description  |
|--|--|
| ST25051001<br>(J25695-1)<br>Oil pressure gauge             |  <p style="text-align: right;">Measuring oil pressure</p> <p style="text-align: right;"><b>Maximum measuring range:</b><br/><b>2,452 kPa (25 kg/cm<sup>2</sup>, 356 psi)</b></p> <p>NT558</p>   |
| ST25052000<br>(J25695-2)<br>Hose                           |  <p style="text-align: right;">Adapting oil pressure gauge<br/>to cylinder block</p> <p>NT559</p>  |
| WS39930000<br>( — )<br>Tube presser                        |  <p style="text-align: right;">Pressing the tube of liquid<br/>gasket</p> <p>NT052</p>  |
| EG17650301<br>(J33984-A)<br>Radiator cap tester<br>adapter |  <p style="text-align: right;">Adapting radiator cap tester<br/>to radiator filler neck</p> <p style="text-align: right;"><b>a: 28 (1.10) dia.</b><br/><b>b: 31.4 (1.236) dia.</b><br/><b>c: 41.3 (1.626) dia.</b></p> <p style="text-align: right;">Unit: mm (in)</p> <p>NT564</p> |
| KV99103510<br>( — )<br>Radiator plate pliers A             |  <p style="text-align: right;">Installing radiator upper and lower tanks</p> <p>NT224</p>   |
| KV99103520<br>( — )<br>Radiator plate pliers B             |  <p style="text-align: right;">Removing radiator upper and lower tanks</p> <p>NT225</p>   |

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# ENGINE LUBRICATION SYSTEM

## Lubrication Circuit



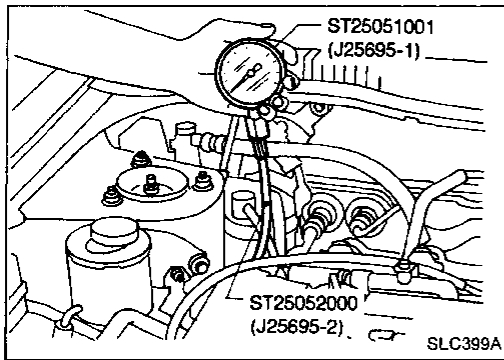
## Oil Pressure Check

### WARNING:

- Be careful not to burn yourself, as the engine and oil may be hot.
- Oil pressure check should be done in "Neutral position" (M/T) or "Parking position" (A/T).

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

# ENGINE LUBRICATION SYSTEM



## Oil Pressure Check (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 speed<br>rpm | Approximate discharge pressure<br>kPa (kg/cm <sup>2</sup> , psi) |
|---------------------|--|
| Idle speed          | More than 78 (0.8, 11)   |
| 3,200               | 314 - 392 (3.2 - 4.0, 46 - 57)                                   |

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

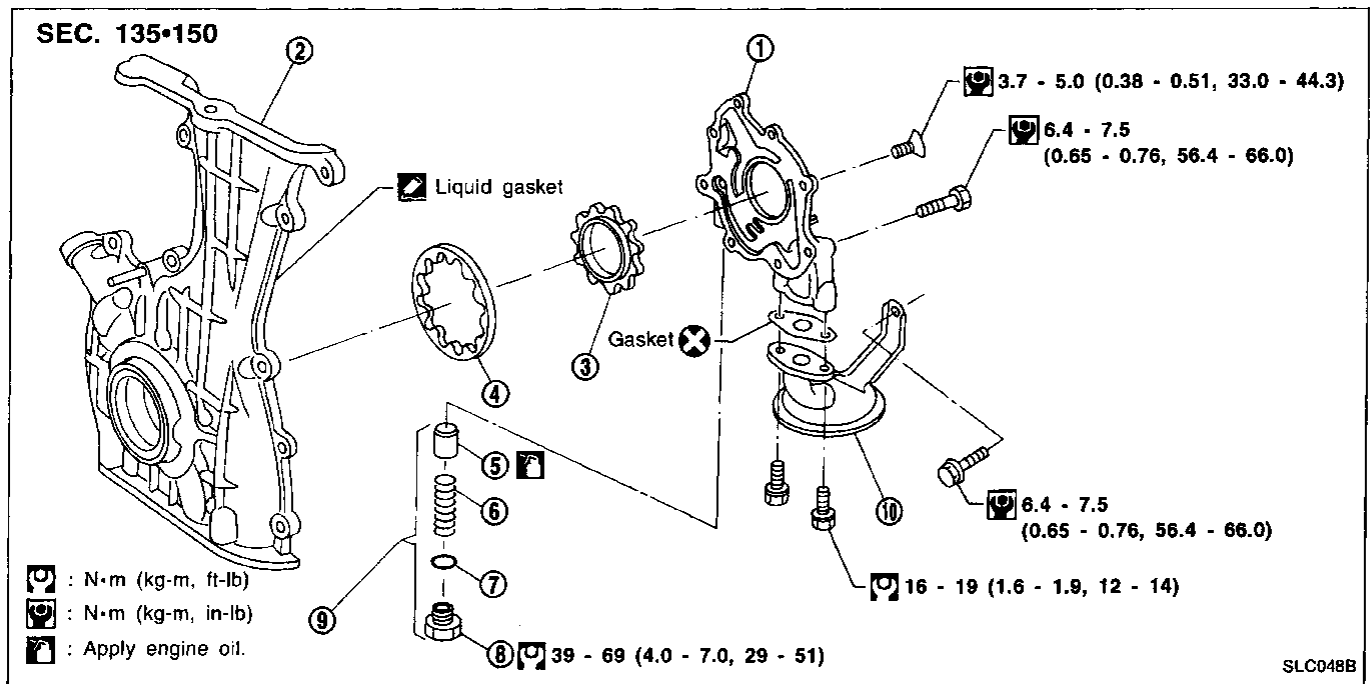
6. Install oil pressure switch with sealant.

## Oil Pump

### REMOVAL

1. Remove drive belts.
2. Remove cylinder head. (Refer to EM section.)
3. Remove oil pans. (Refer to EM section.)
4. Remove oil strainer and baffle plate.
5. Remove front cover assembly.

### DISASSEMBLY AND ASSEMBLY



- |                  |                   |                       |
|------------------|-------------------|-----------------------|
| ① Oil pump cover | ⑤ Regulator valve | ⑧ Plug                |
| ② Front cover    | ⑥ Spring          | ⑨ Regulator valve set |
| ③ Inner gear     | ⑦ Shims           | ⑩ Oil strainer        |
| ④ Outer gear     |                   |                       |

- Always replace oil seal and O-ring with new ones.
- When installing oil pump, apply engine oil to inner and outer gears.
- Be sure that O-rings are properly fitted.

# ENGINE LUBRICATION SYSTEM

## Oil Pump (Cont'd)

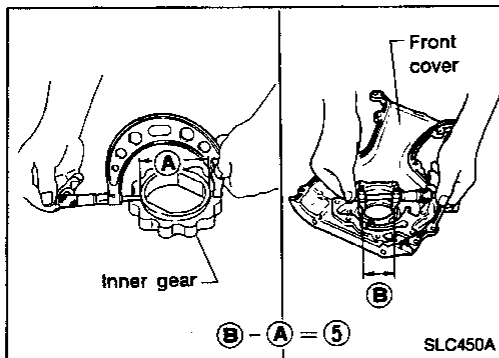
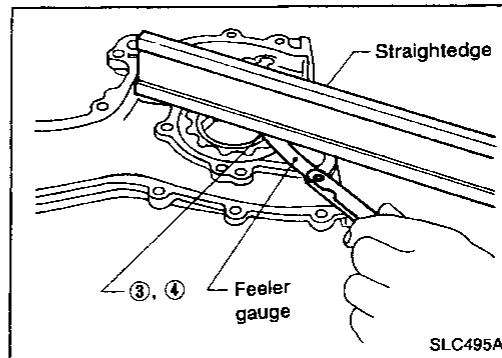
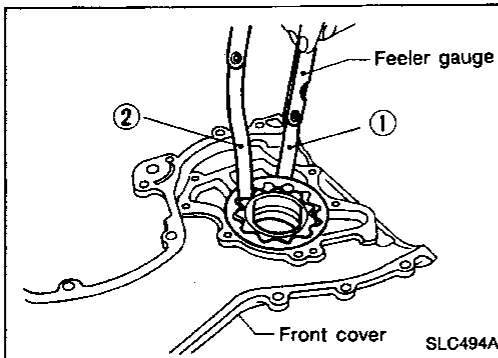
### INSPECTION

Using a feeler gauge, check the following clearances:

Unit: mm (in)

|   |                                 |
|---|---------------------------------|
| Body to outer gear clearance ①                      | 0.114 - 0.200 (0.0045 - 0.0079) |
| Inner gear to outer gear tip clearance ②            | Below 0.18 (0.0071)             |
| Body to inner gear clearance ③                      | 0.05 - 0.09 (0.0020 - 0.0035)   |
| Body to outer gear clearance ④                      | 0.05 - 0.11 (0.0020 - 0.0043)   |
| Inner gear to brazed portion of housing clearance ⑤ | 0.045 - 0.091 (0.0018 - 0.0036) |

- If the tip clearance (②) exceeds the limit, replace gear set.
- If body to gear clearances (①, ③, ④, ⑤) exceed the limit, replace front cover assembly.



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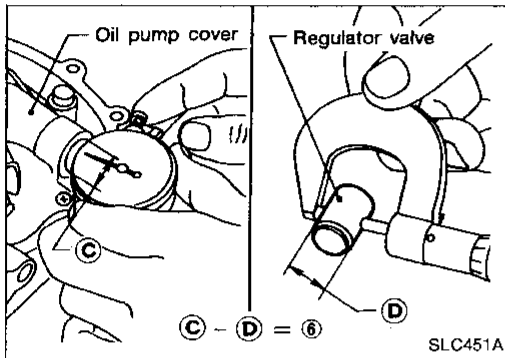
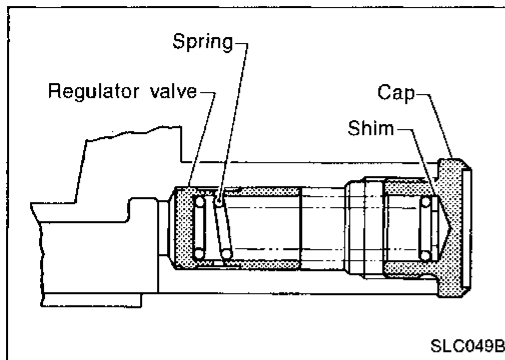
# ENGINE LUBRICATION SYSTEM

## 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. Check that it falls smoothly into the valve hole by its own weight.

**If damaged, replace regulator valve set or oil pump cover.**



4. Check regulator valve to oil pump cover clearance.

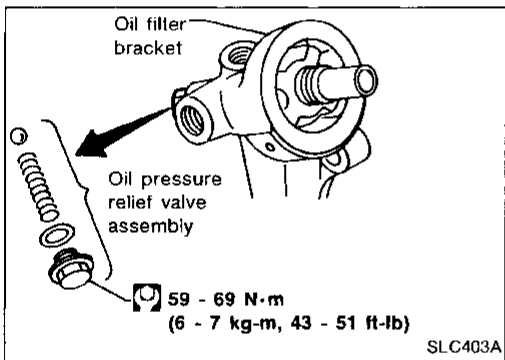
**Clearance:**

⑥ : 0.040 - 0.097 mm (0.0016 - 0.0038 in)

**If it exceeds the limit, replace oil pump cover.**

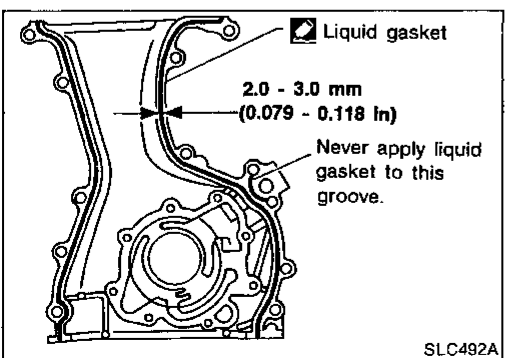
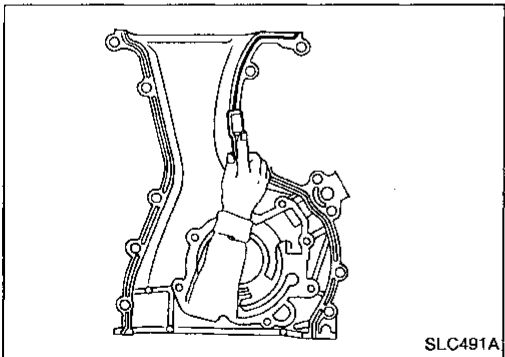
### OIL PRESSURE RELIEF VALVE INSPECTION

Inspect oil pressure relief valve for movement, cracks and breaks. If damaged, replace oil filter bracket assembly.



### INSTALLATION

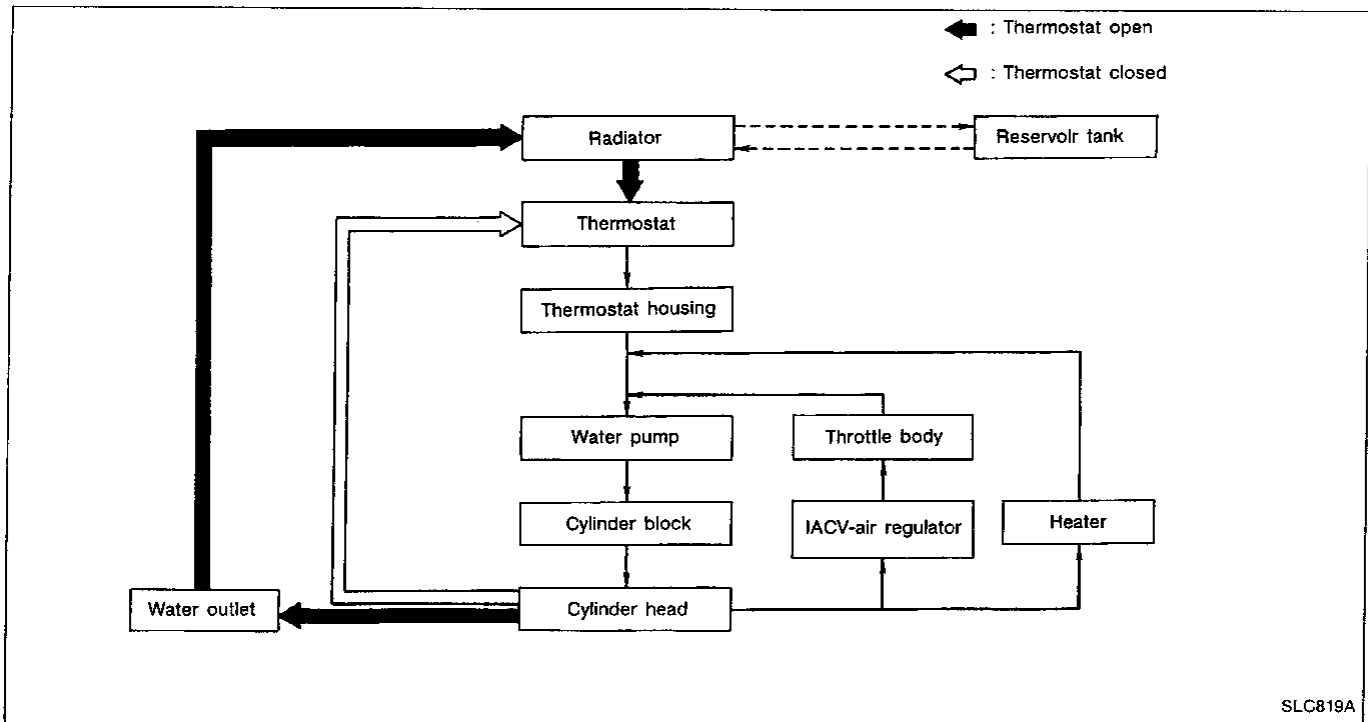
- Use a scraper to remove old liquid gasket from mating surface of front cover.
- Also remove traces of liquid gasket from mating surface of cylinder block.



1. Apply a continuous bead of liquid gasket to mating surface of front cover assembly.
- Use Genuine Liquid Gasket or equivalent.
2. Installation is the reverse order of removal.

# ENGINE COOLING SYSTEM

## Cooling Circuit

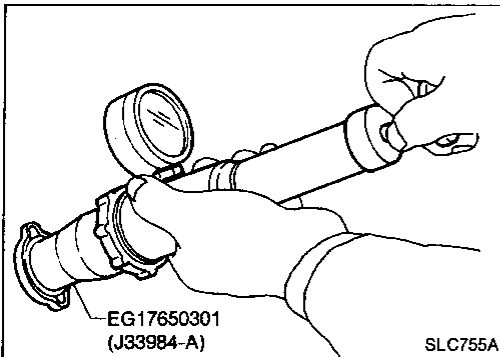


## System Check

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



## Cooling System Inspection

### CHECKING HOSES

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

### CHECKING RADIATOR CAP

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

#### Radiator cap relief pressure:

##### Standard

78 - 98 kPa  
(0.8 - 1.0 kg/cm<sup>2</sup>, 11 - 14 psi)

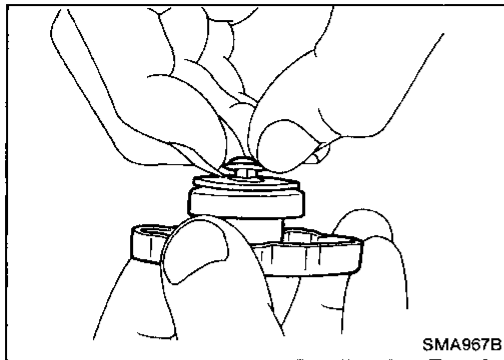
##### Limit

59 - 98 kPa  
(0.6 - 1.0 kg/cm<sup>2</sup>, 9 - 14 psi)



# ENGINE COOLING SYSTEM

## Cooling System Inspection (Cont'd)



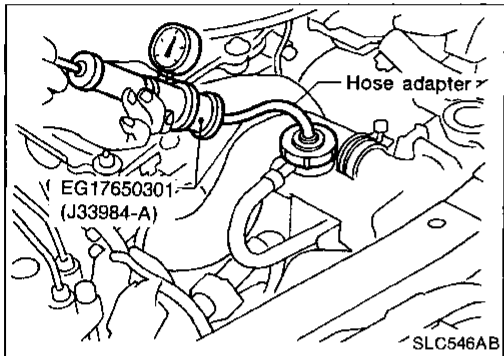
Pull the negative pressure valve to open it.  
Check that it closes completely when released.

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## CHECKING COOLING SYSTEM FOR LEAKS

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

Testing pressure:  
157 kPa (1.6 kg/cm<sup>2</sup>, 23 psi)

### CAUTION:

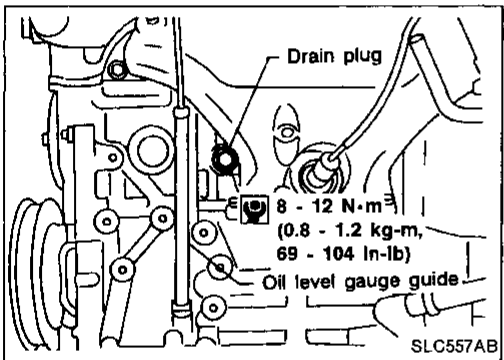
Higher than the specified pressure may cause radiator damage.

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## Water Pump

### REMOVAL

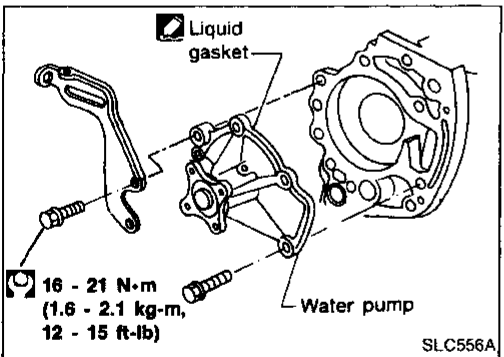
1. Drain coolant from radiator.
2. Remove cylinder block drain plug located at left front of cylinder block and drain coolant.
3. Remove front RH wheel and engine side cover.
4. Remove drive belts.
5. Remove front engine mounting.

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6. Remove water pump.

### CAUTION:

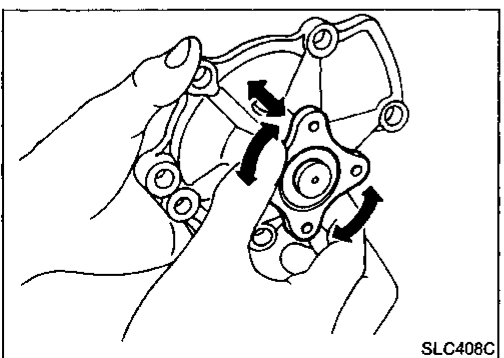
- When removing water pump assembly, be careful not to get coolant on drive belt.
- Water pump cannot be disassembled and should be replaced as a unit.
- After installing water pump, connect hose and clamp securely, then check for leaks using radiator cap tester.

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### INSPECTION

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

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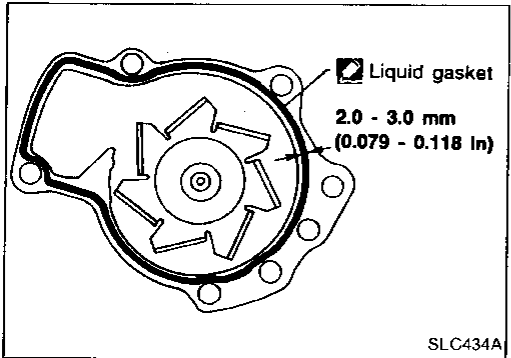
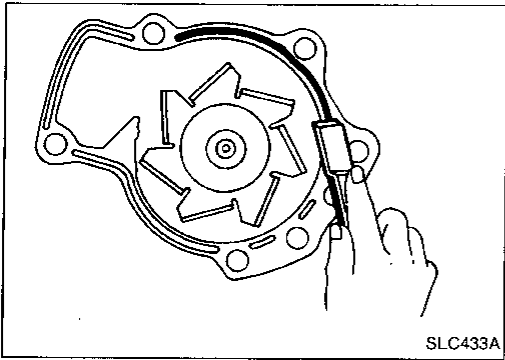
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# ENGINE COOLING SYSTEM

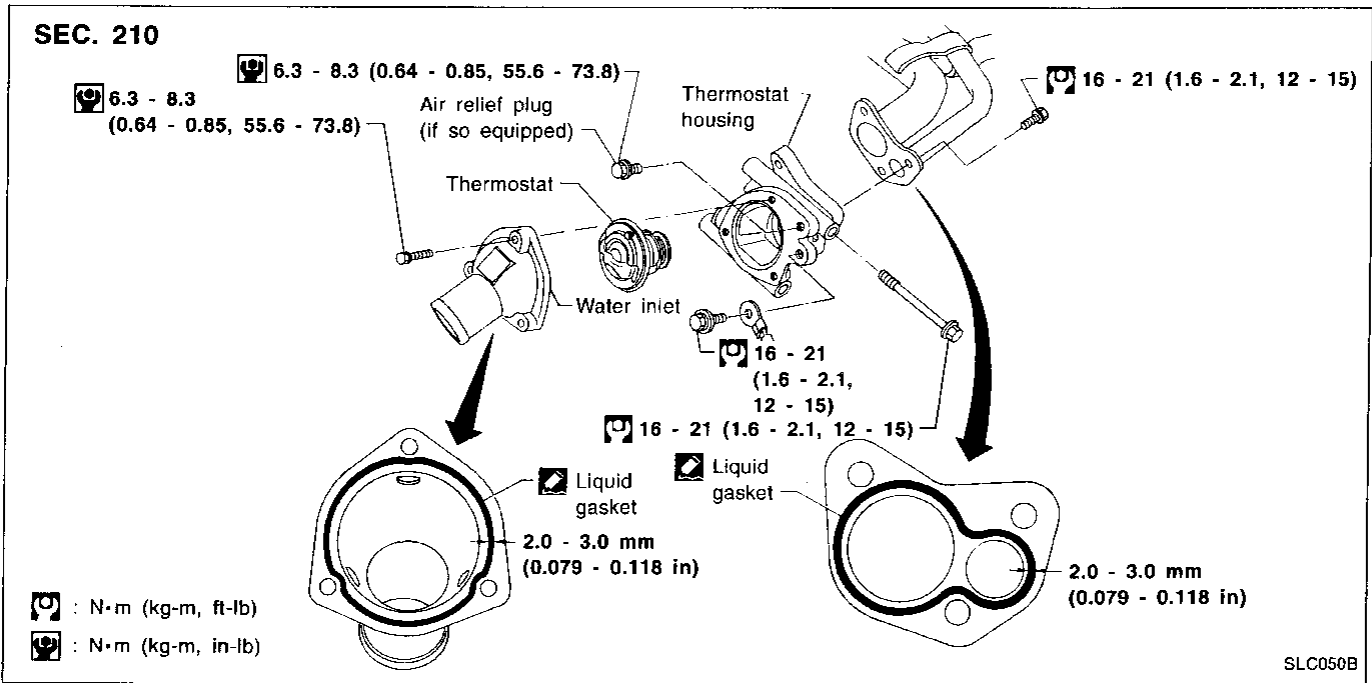
## Water Pump (Cont'd)

### INSTALLATION

1. Use a scraper to remove old liquid gasket from mating surface of water pump.
  - Also remove traces of liquid gasket from mating surface of cylinder block .
2. Apply a continuous bead of liquid gasket to mating surface of water pump.
  - Use Genuine Liquid Gasket or equivalent.



## Thermostat



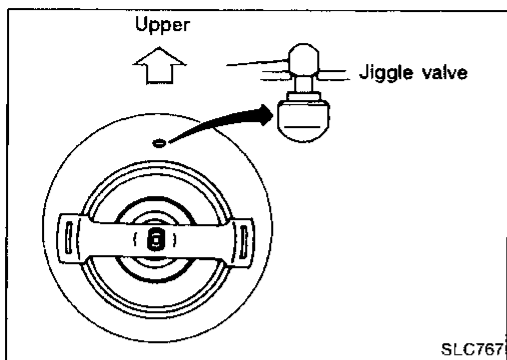
# ENGINE COOLING SYSTEM

## Thermostat (Cont'd)

### REMOVAL AND INSTALLATION

1. Drain engine coolant.
2. Remove lower radiator hose.
3. Remove water inlet, then take out thermostat.
4. Install thermostat with jiggle valve or air bleeder facing upward.

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

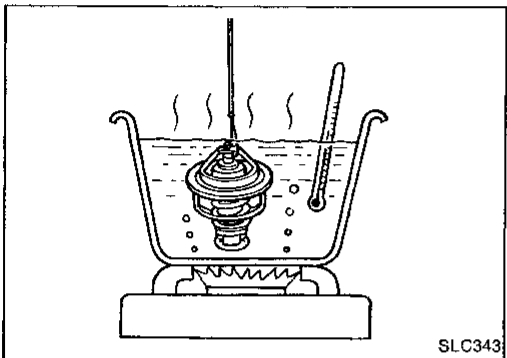


### INSPECTION

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

|                           |               |                           |
|---------------------------|---------------|---------------------------|
| Valve opening temperature | °C (°F)       | 76.5 (170)                |
| Valve lift                | mm/°C (in/°F) | More than 8/90 (0.31/194) |

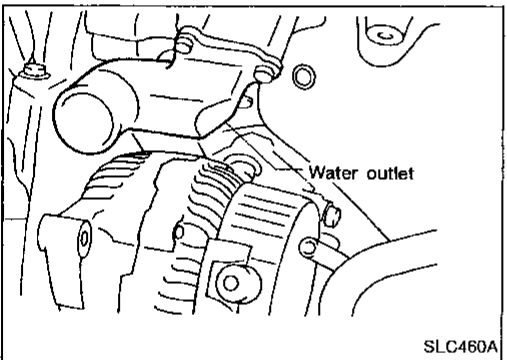
3. Then check if valve closes at 5°C (9°F) below valve opening temperature.



### Water Outlet

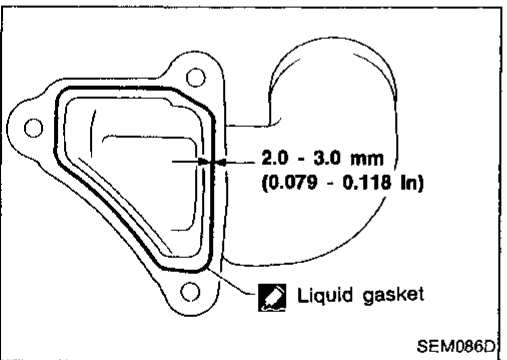
#### INSPECTION

Visually inspect for water leaks. If there is leakage, apply liquid gasket.



#### INSTALLATION

1. Use a scraper to remove old liquid gasket from water inlet.
  - Also remove traces of liquid gasket from mating surface of cylinder head.
2. Apply a continuous bead of liquid gasket to mating surface of water outlet.
  - Use Genuine Liquid Gasket or equivalent.

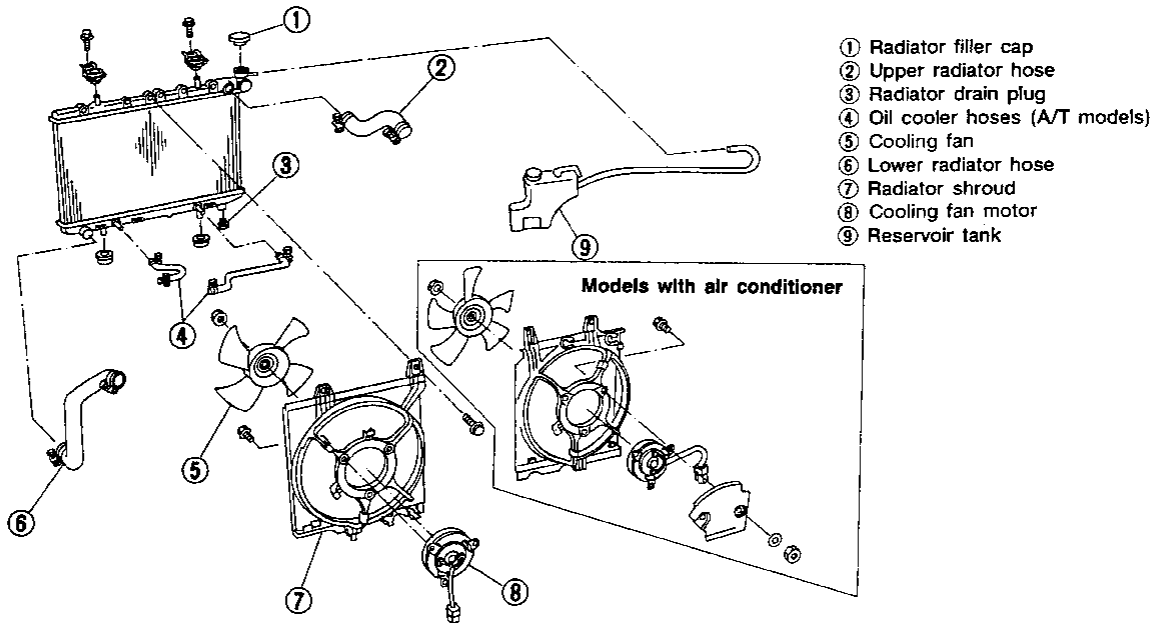


# ENGINE COOLING SYSTEM

## Radiator

### REMOVAL AND INSTALLATION

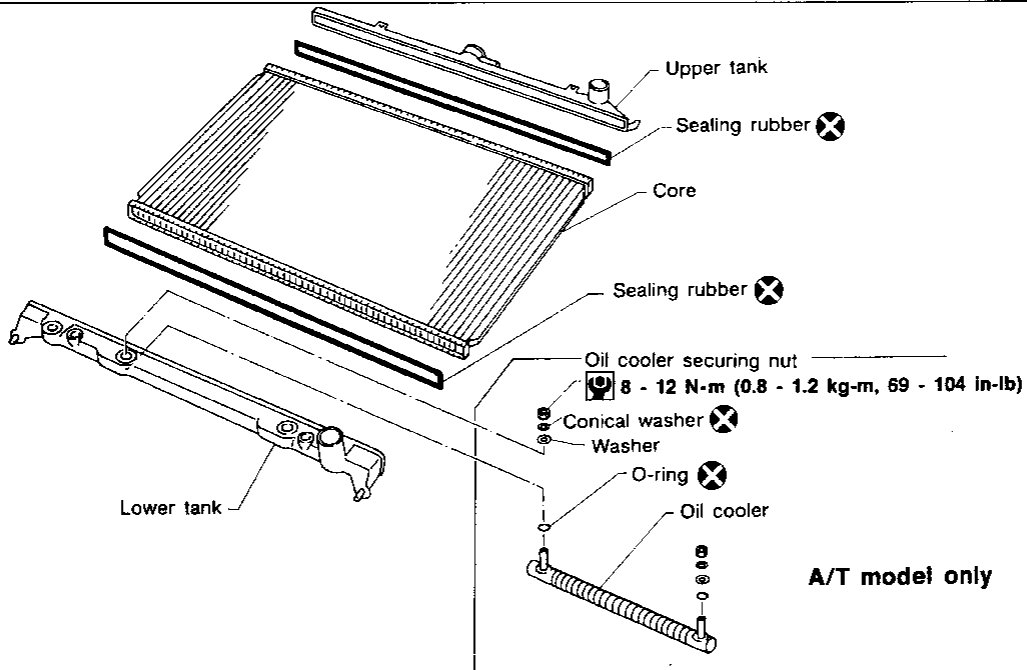
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### DISASSEMBLY AND ASSEMBLY

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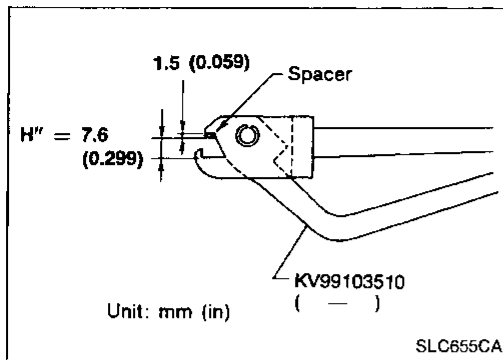
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# ENGINE COOLING SYSTEM

## Radiator (Cont'd)

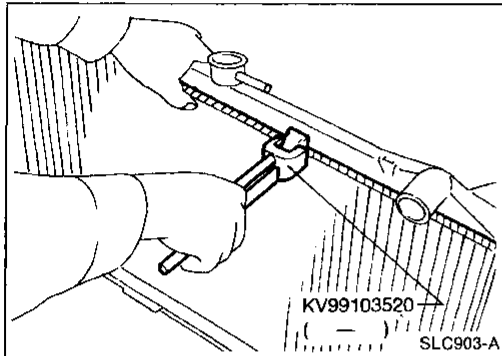
### PREPARATION

1. Attach a spacer to the tip of the radiator plate pliers A. Spacer specification: 1.5 mm (0.059 in) thick x 18 mm (0.71 in) wide x 8.5 mm (0.335 in) long.
2. Make sure that when radiator plate pliers A are closed dimension H'' is approx. 7.6 mm (0.299 in).
3. Adjust dimension H'' with the spacer, if necessary.



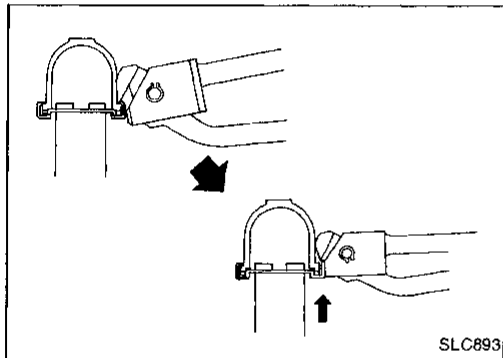
### DISASSEMBLY

1. Remove tank with Tool.



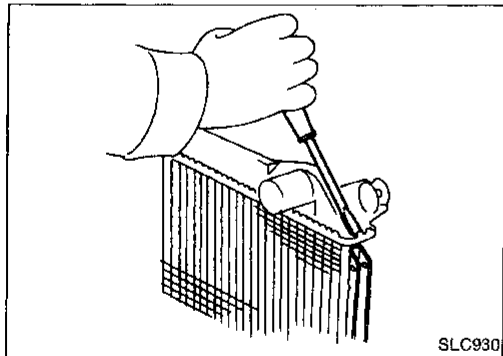
- Grip the crimped edge and bend it upwards so that Tool slips off.

**Do not bend excessively.**

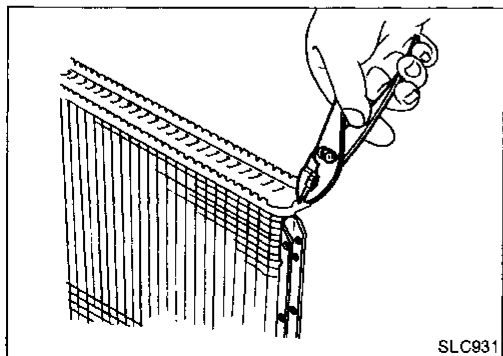


- In areas where Tool cannot be used, use a screwdriver to bend the edge up.

**Be careful not to damage tank.**



2. Make sure the edge stands straight up.
3. Remove oil cooler from tank. (A/T models only)

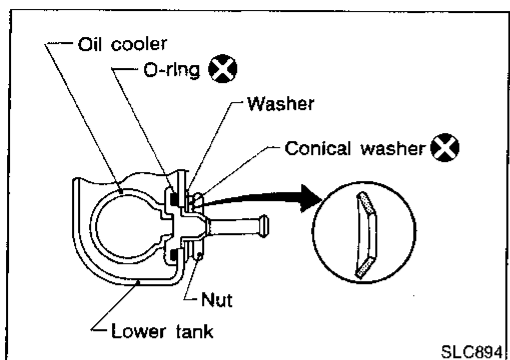


# ENGINE COOLING SYSTEM

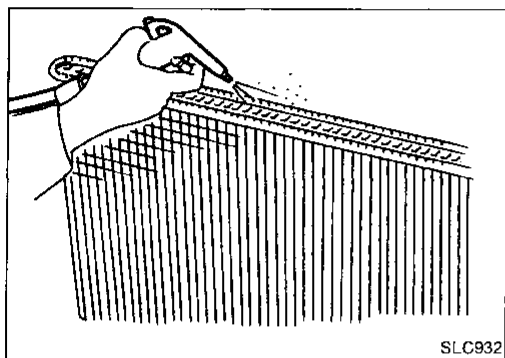
## Radiator (Cont'd)

### ASSEMBLY

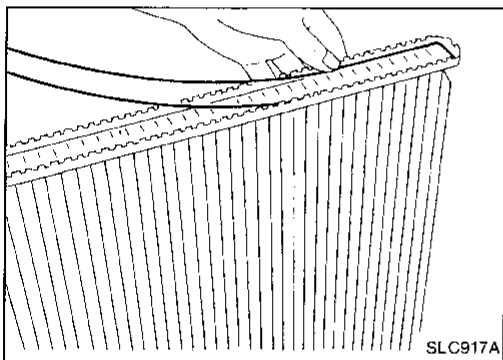
1. Install oil cooler. (A/T models only)  
**Pay attention to direction of conical washer.**



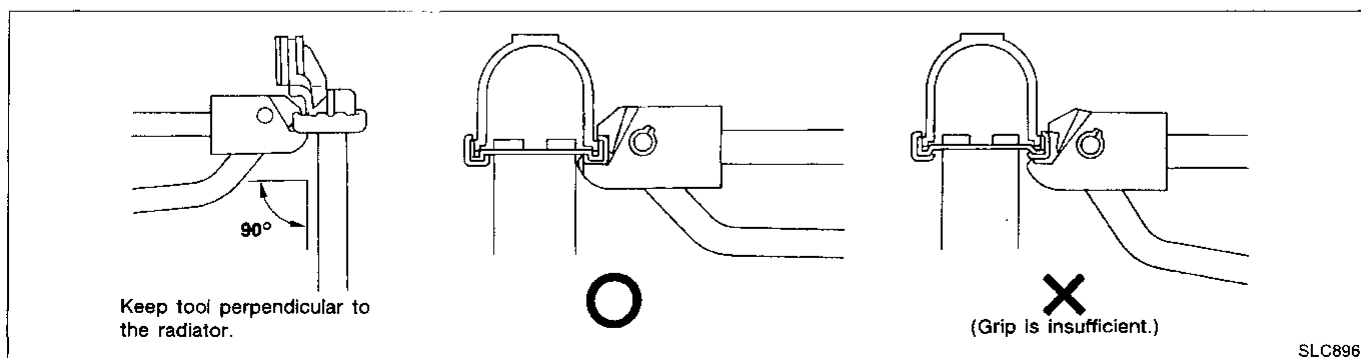
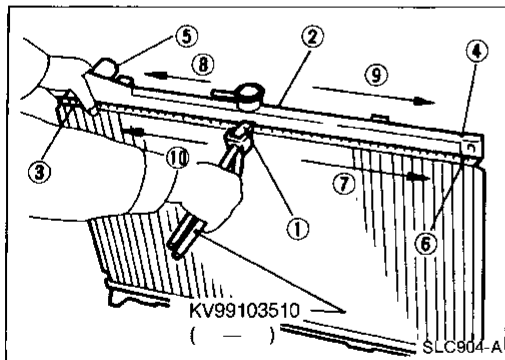
2. Clean contact portion of tank.



3. Install sealing rubber.  
**Push it in with fingers.**  
**Be careful not to twist sealing rubber.**

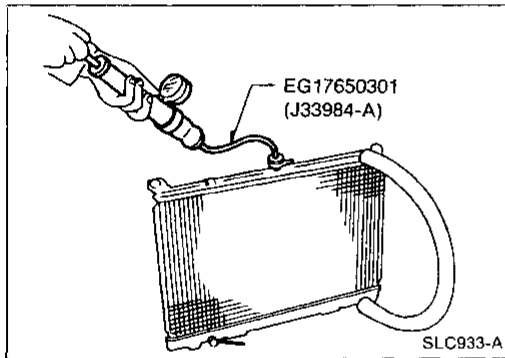
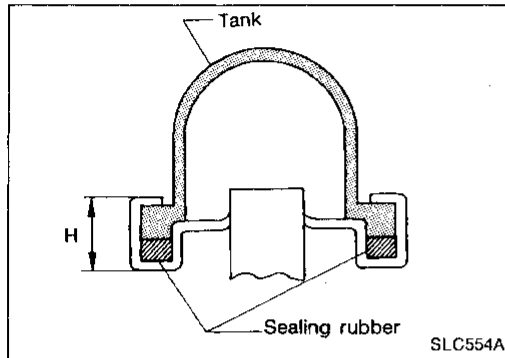
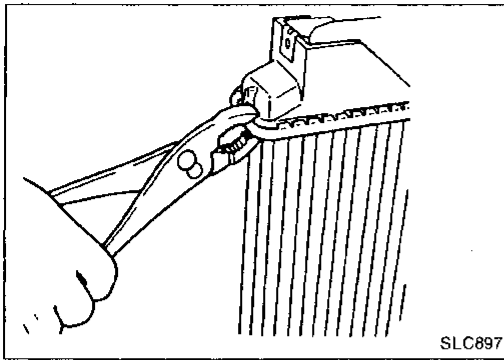


4. Caulk tank in specified sequence with Tool.



# ENGINE COOLING SYSTEM

## Radiator (Cont'd)



- Use pliers in the locations where Tool cannot be used.

5. Make sure that the rim is completely crimped down.

**Standard height "H":**

**8.0 - 8.4 mm (0.315 - 0.331 in)**

6. Confirm that there is no leakage.

**Refer to Inspection.**

### INSPECTION

Apply pressure with Tool.

**Specified pressure value:**

**157 kPa (1.6 kg/cm<sup>2</sup>, 23 psi)**

#### WARNING:

**To prevent the risk of the hose coming undone while under pressure, securely fasten it down with a hose clamp.**

**Attach a hose to the oil cooler as well. (A/T models only)**

### Cooling Fan Control System

Cooling fans are controlled by the ECM. For details, refer to EC section ("Cooling Fan", "TROUBLE DIAGNOSIS FOR DTC P1900").

### Refilling Engine Coolant

For details on refilling engine coolant, refer to MA section ("REFILLING ENGINE COOLANT", "Changing Engine Coolant").

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# ENGINE COOLING SYSTEM

## Overheating Cause Analysis

|   |                                       | Symptom                            | Check items  |                                       |   |
|---|---------------------------------------|------------------------------------|--|---------------------------------------|---|
| Cooling system parts malfunction        | Poor heat transfer                    | Water pump malfunction             | Worn or loose drive belt                             | —                                     |   |
|   |                                       | Thermostat stuck closed            | —  |                                       |   |
|   |                                       | Damaged fins                       | Dust contamination or paper clogging                 |                                       | — |
|   |                                       |                                    | Mechanical damage                                    |                                       |   |
|   |                                       | Clogged radiator cooling tube      | Excess foreign material (rust, dirt, sand, etc.)     |                                       |   |
|   | Reduced air flow                      | Cooling fan does not operate       | —  | —                                     |   |
|   |                                       | High resistance to fan rotation    |  |                                       |   |
|   |                                       | Damaged fan blades                 |  |                                       |   |
|   |                                       | Damaged radiator shroud            | —  | —                                     |   |
|   |                                       | Improper coolant mixture ratio     | —  | —                                     |   |
|   |                                       | Poor coolant quality               | —  | —                                     |   |
|   | Insufficient coolant                  | Coolant leaks                      | Cooling hose   | Loose clamp                           |   |
|   |                                       |                                    |  | Cracked hose                          |   |
|   |                                       |                                    | Water pump   | Poor sealing                          |   |
|   |                                       |                                    | Radiator cap   | Loose                                 |   |
| Poor sealing                            |                                       |                                    |  |                                       |   |
| Radiator                                |                                       |                                    | O-ring for damage, deterioration or improper fitting |                                       |   |
|   |                                       | Cracked radiator tank              |  |                                       |   |
|   |                                       | Cracked radiator core              |  |                                       |   |
|   | Reservoir tank                        | Cracked reservoir tank             |  |                                       |   |
| Overflowing reservoir tank              | Exhaust gas leaks into cooling system | Cylinder head deterioration        |  |                                       |   |
|   |                                       | Cylinder head gasket deterioration |  |                                       |   |
| Except cooling system parts malfunction | —                                     | Overload on engine                 | Abusive driving                                      | High engine rpm under no load         |   |
|   |                                       |                                    |  | Driving in low gear for extended time |   |
|   |                                       |                                    |  | Driving at extremely high speed       |   |
|   |                                       |                                    | Powertrain system malfunction                        | —                                     |   |
|   |                                       |                                    | Installed improper size wheels and tires             |                                       |   |
|   | Dragging brakes                       |                                    |  |                                       |   |
|   | Improper ignition timing              |                                    |  |                                       |   |
|   | Blocked or restricted air flow        | Blocked bumper                     | —  | —                                     |   |
|   |                                       | Blocked radiator grille            | Installed car brassiere                              |                                       |   |
|   |                                       |                                    | Mud contamination or paper clogging                  |                                       |   |
| Blocked radiator                        |                                       | —                                  |  |                                       |   |
| Blocked condenser                       |                                       | —                                  |  |                                       |   |
| Installed large fog lamp                | —                                     |                                    |  |                                       |   |



# SERVICE DATA AND SPECIFICATIONS (SDS)

## Engine Lubrication System

### Oil pressure check

| Engine speed<br>rpm | Approximate discharge<br>pressure kPa (kg/cm <sup>2</sup> , psi) |
|---------------------|--|
| Idle speed          | More than 78 (0.8, 11)   |
| 3,200               | 314 - 392 (3.2 - 4.0, 46 - 57)                                   |

### Regulator valve inspection

Unit: mm (in)

|  |                                 |
|--|---------------------------------|
| Regulator valve to oil pump<br>cover clearance | 0.040 - 0.097 (0.0016 - 0.0038) |
|--|---------------------------------|

### Oil pump inspection

Unit: mm (in)

|  |                                 |
|--|---------------------------------|
| Body to outer gear clearance                         | 0.114 - 0.200 (0.0045 - 0.0079) |
| Inner gear to outer gear tip<br>clearance            | Below 0.18 (0.0071)             |
| Body to inner gear clearance                         | 0.05 - 0.09 (0.0020 - 0.0035)   |
| Body to outer gear clearance                         | 0.05 - 0.11 (0.0020 - 0.0043)   |
| Inner gear to brazed portion of<br>housing clearance | 0.045 - 0.091 (0.0018 - 0.0036) |

## Engine Cooling System

### Radiator

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

|                            |          |                              |
|----------------------------|----------|------------------------------|
| Cap relief<br>pressure     | Standard | 78 - 98 (0.8 - 1.0, 11 - 14) |
|                            | Limit    | 59 - 98 (0.6 - 1.0, 9 - 14)  |
| Testing pressure for leaks |          | 157 (1.6, 23)                |

### Thermostat

|                                   |                           |
|-----------------------------------|---------------------------|
| Valve opening temperature °C (°F) | 76.5 (170)                |
| Valve lift mm/°C (in/°F)          | More than 8/90 (0.31/194) |

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