

# ENGINE LUBRICATION & COOLING SYSTEMS

## SECTION **LC**

GI

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**LC**

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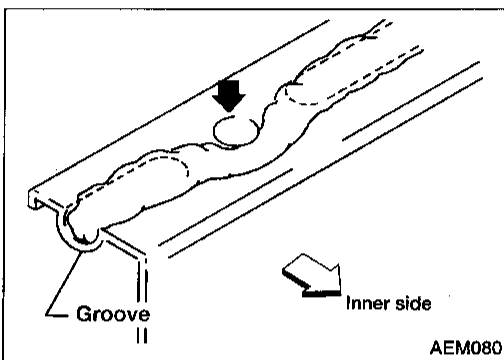
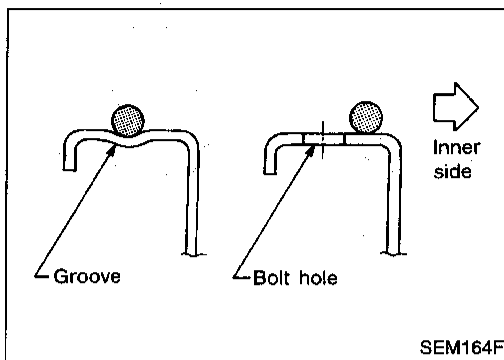
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## PRECAUTIONS



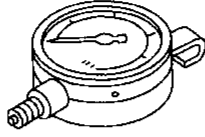
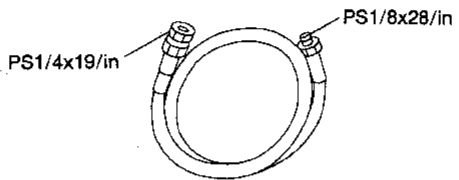
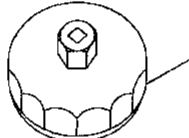
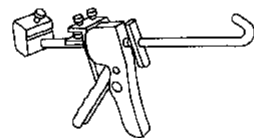
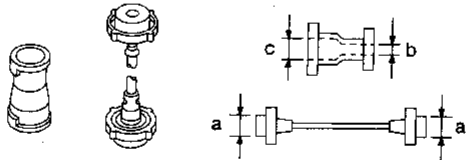

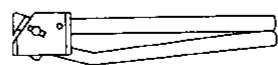
### Liquid Gasket Application Procedure

- 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 RTV silicone sealant Part No. 999MP-A7007 or equivalent.)
  - For oil pan, be sure liquid gasket diameter is 3.5 to 4.5 mm (0.138 to 0.177 in).
  - For areas except oil pan, be sure liquid gasket diameter is 2.0 to 3.0 mm (0.079 to 0.118 in).
- 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

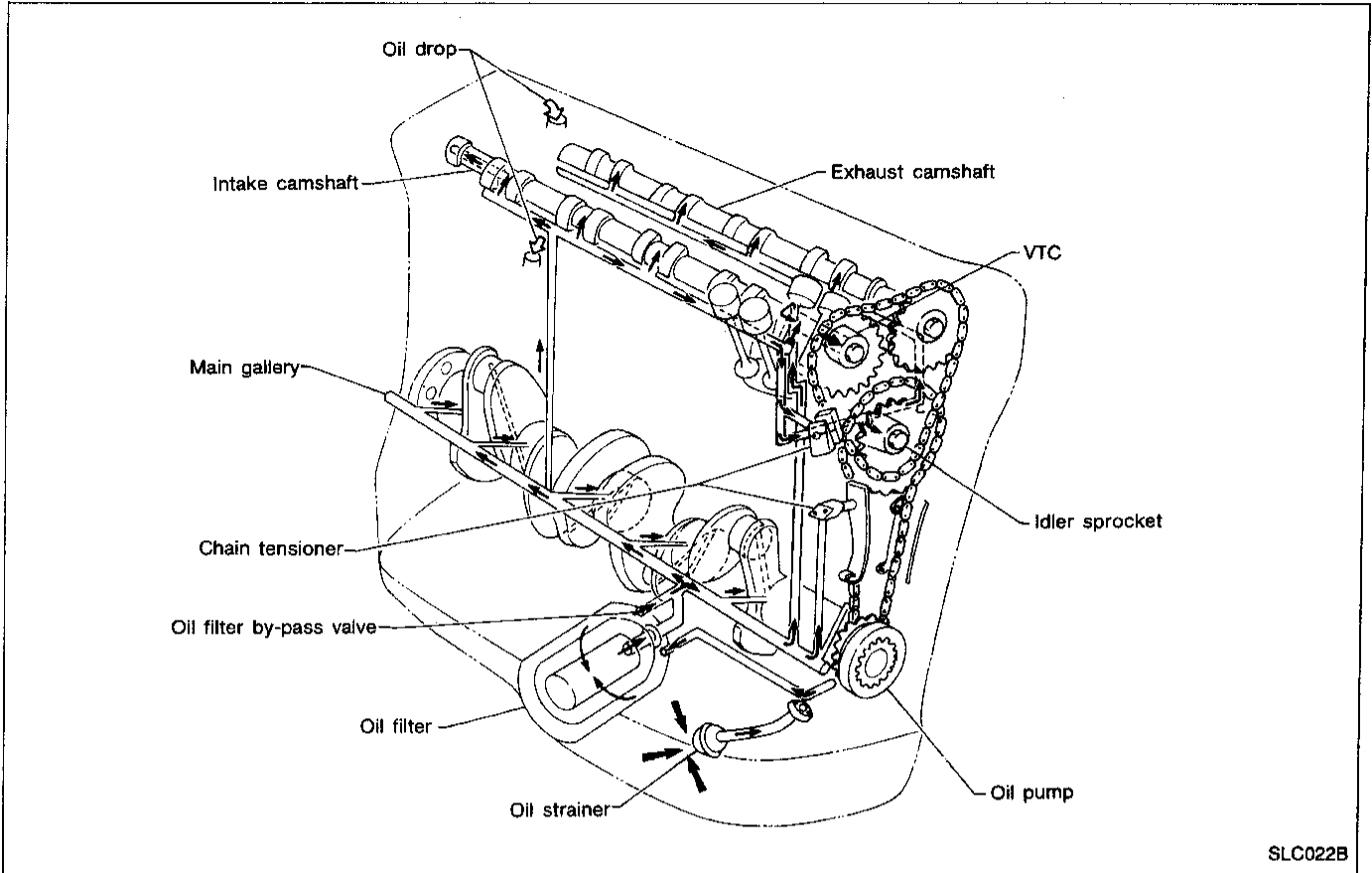
## Special Service Tools

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

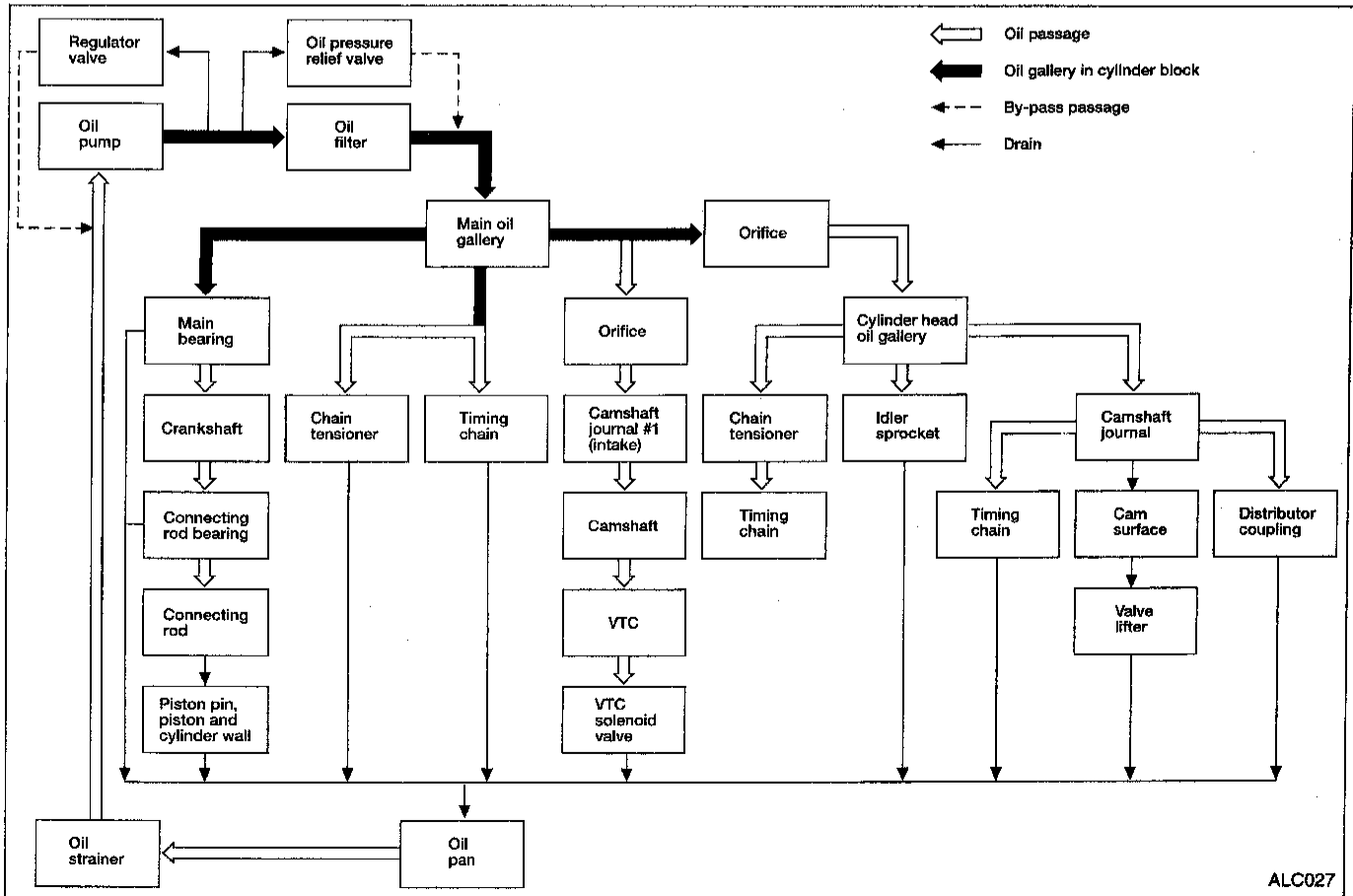
Tool number (Kent-Moore No.) Tool name	Description		GI
ST25051001 (J25695-1) Oil pressure gauge	 <p style="text-align: right;">Measuring oil pressure</p> <p>NT050</p>		MA
ST25052000 (J25695-2) Hose	 <p style="text-align: right;">Adapting oil pressure gauge to cylinder block</p> <p>NT559</p>		EM
KV10105900 (J34274) Oil filter wrench	 <p style="text-align: right;">Removing oil filter</p> <p>15 faces Inner span 80 mm (3.15 in) (Face to opposite face)</p> <p>NT646</p>		LC
WS39930000 ( — ) Tube presser	 <p style="text-align: right;">Pressing the tube of liquid gasket</p> <p>NT052</p>		EC
EG17650301 (J33984-A) Radiator cap tester adapter	 <p style="text-align: right;">Adapting radiator cap tester to radiator filler neck</p> <p>a: 28 (1.10) dia. b: 31.4 (1.236) dia. c: 41.3 (1.626) dia. Unit: mm (in)</p> <p>NT564</p>		FE
KV99103510 ( — ) Radiator plate pliers A	 <p style="text-align: right;">Installing radiator upper and lower tanks</p> <p>NT224</p>		CL
KV99103520 ( — ) Radiator plate pliers B	 <p style="text-align: right;">Removing radiator upper and lower tanks</p> <p>NT225</p>		MT

# ENGINE LUBRICATION SYSTEM

## Lubrication Circuit

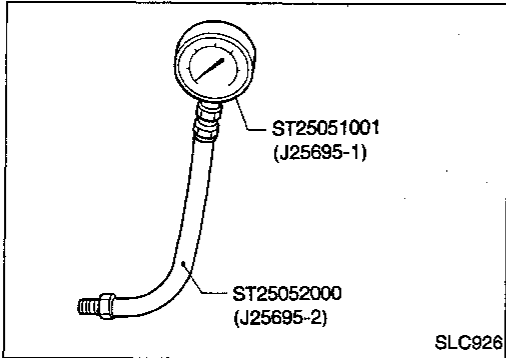
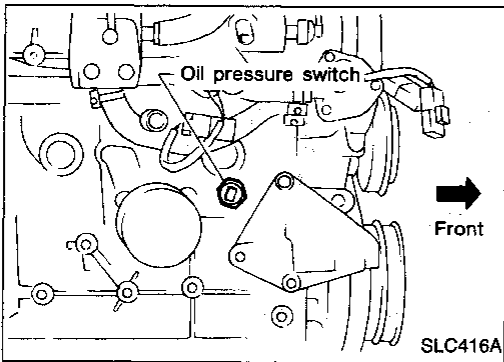


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# ENGINE LUBRICATION SYSTEM



## Oil Pressure Check

### WARNING:

- Be careful not to burn yourself, as the engine and oil may be hot.
- For M/T models, put gearshift lever in Neutral "N" position. For A/T models, put selector lever in Park "P" 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 (kg/cm <sup>2</sup> , psi)
Idle speed	49 - 186 (0.5 - 1.9, 7 - 27)
3,000	343 - 441 (3.5 - 4.5, 50 - 64)

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

6. Install oil pressure switch with sealant.

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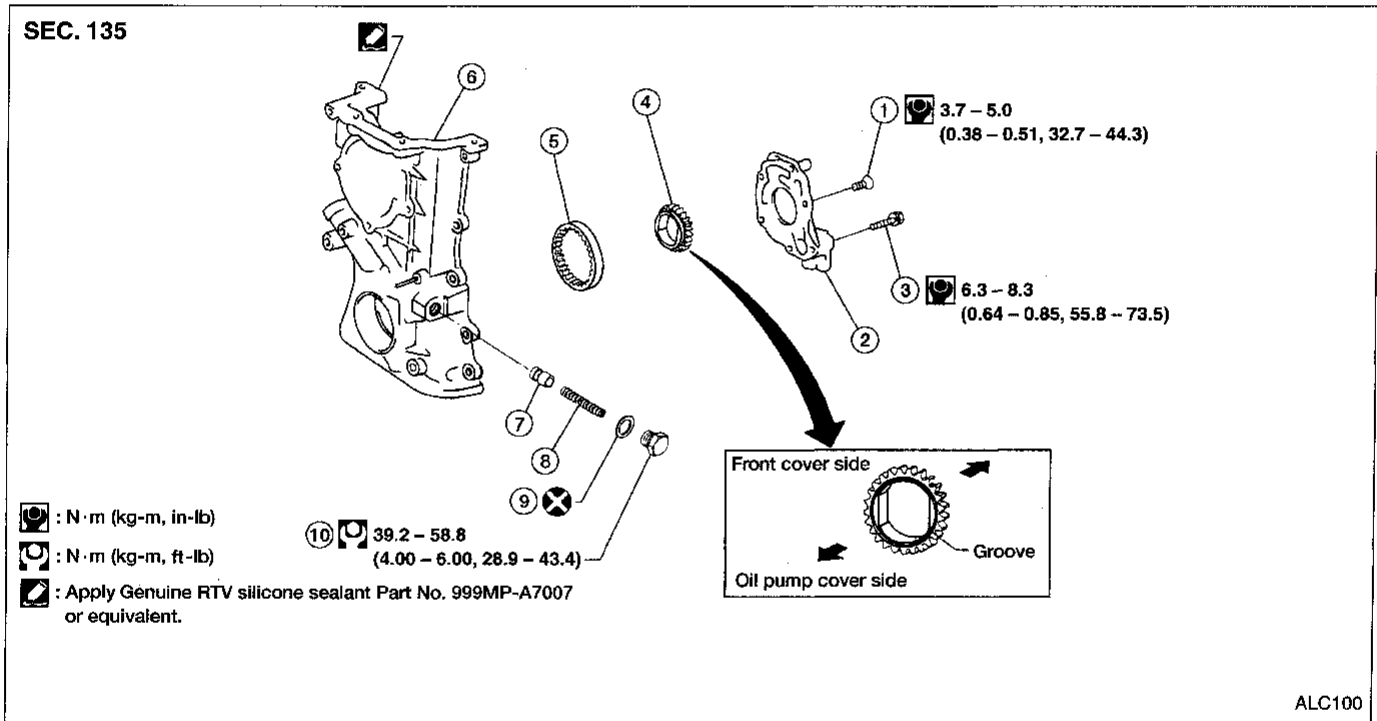
# ENGINE LUBRICATION SYSTEM

## Oil Pump

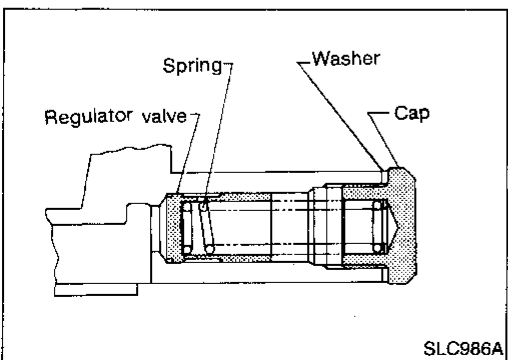
### REMOVAL AND INSTALLATION

- Always replace oil seal with a new one. Refer to EM section ("OIL SEAL REPLACEMENT").
  - When installing oil pump, apply engine oil to gears.
  - Make sure that O-ring is fitted properly.
1. Drain engine oil.
  2. Remove drive belts.
  3. Remove cylinder head. Refer to EM section ("TIMING CHAIN").
  4. Remove oil pan. Refer to EM section ("OIL PAN").
  5. Remove oil strainer.
  6. Remove front cover.
  7. Install front cover. Refer to EM section ("TIMING CHAIN").
  8. Reinstall parts in reverse order of removal.

### DISASSEMBLY AND ASSEMBLY



- |                  |                   |          |
|------------------|-------------------|----------|
| ① Screw          | ⑤ Outer gear      | ⑧ Spring |
| ② Oil pump cover | ⑥ Front cover     | ⑨ Washer |
| ③ Bolt           | ⑦ Regulator valve | ⑩ Cap    |
| ④ Inner gear     |                   |          |



### REGULATOR VALVE INSPECTION

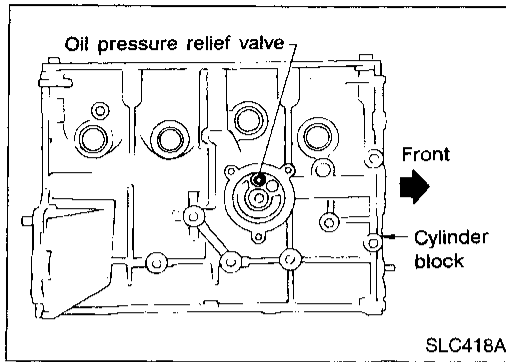
1. Visually inspect components for wear and damage.
  2. Check oil pressure regulator valve sliding surface and valve spring.
  3. Coat regulator valve with engine oil. Check that it falls smoothly into the valve hole by its own weight.
- If damaged, replace regulator valve set or oil pump assembly.

# ENGINE LUBRICATION SYSTEM

## Oil Pump (Cont'd)

### 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 by tapping it in place.



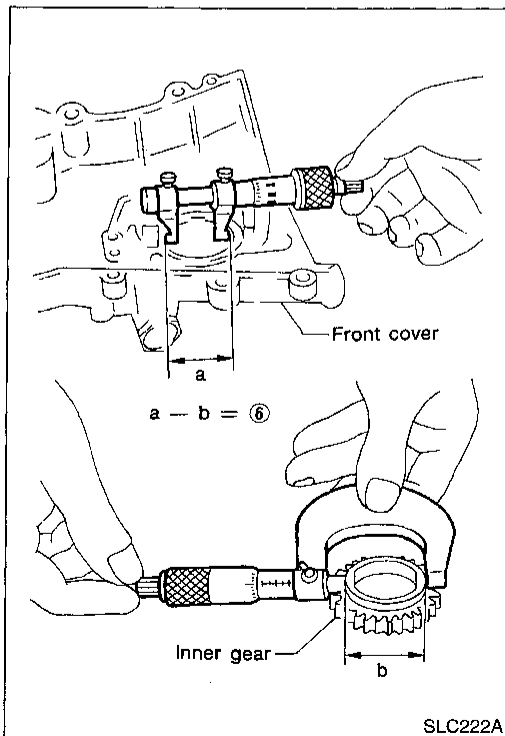
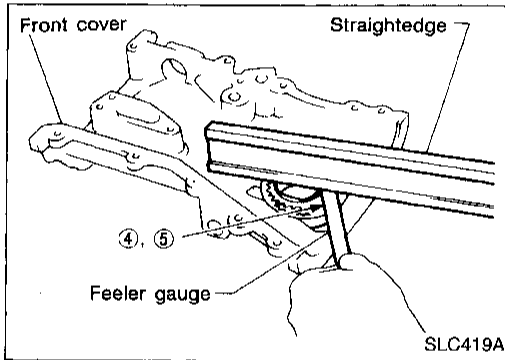
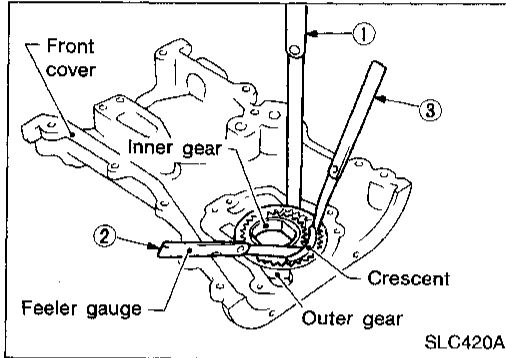
### OIL PUMP INSPECTION

Using a feeler gauge, check the following clearances.

#### Standard clearance:

Unit: mm (in)

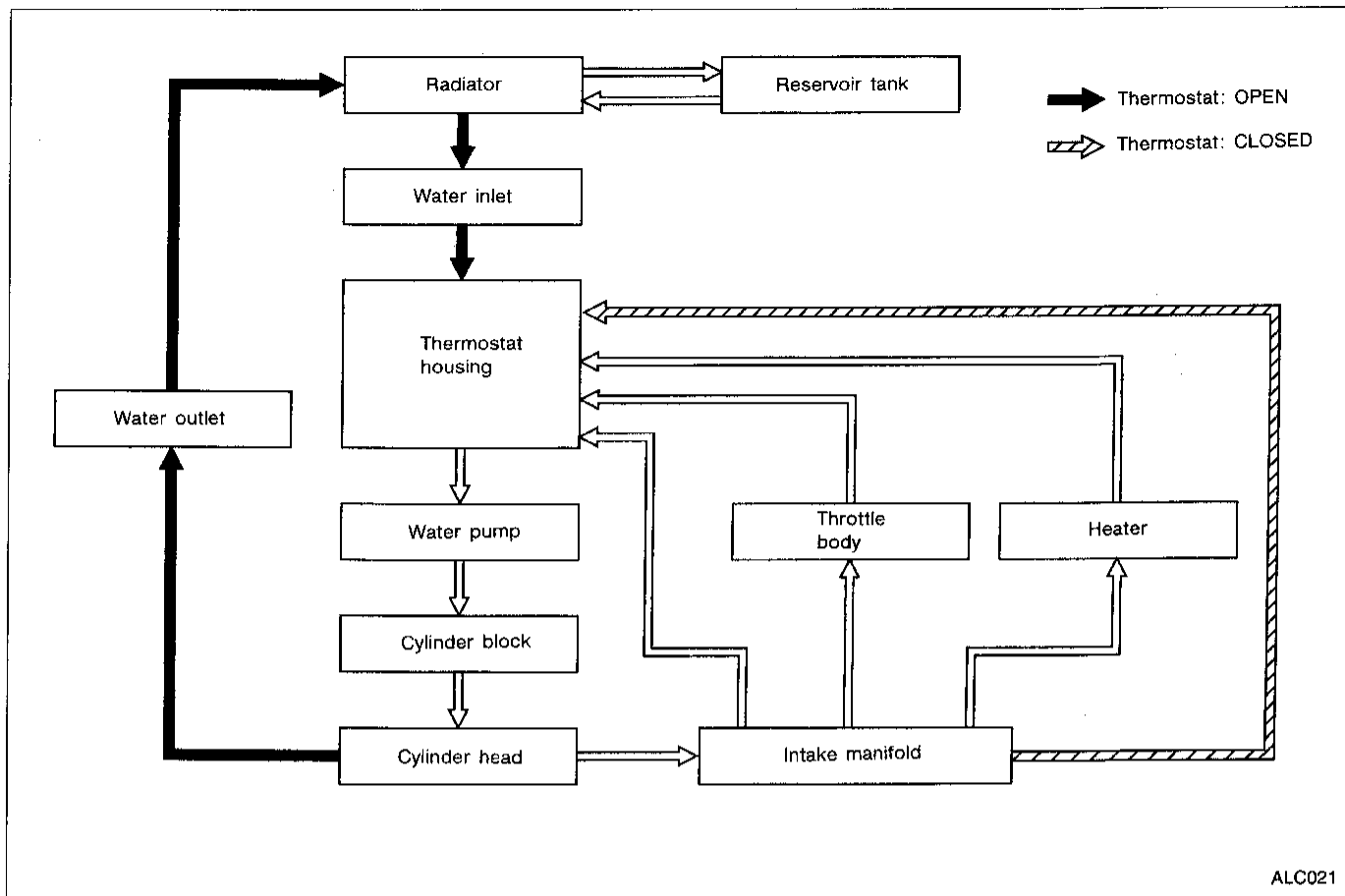
Body to outer gear radial clearance ①	0.110 - 0.200 (0.0043 - 0.0079)
Inner gear to crescent clearance ②	0.217 - 0.327 (0.0085 - 0.0129)
Outer gear to crescent clearance ③	0.21 - 0.32 (0.0083 - 0.0126)
Cover to inner gear clearance ④	0.05 - 0.09 (0.0020 - 0.0035)
Cover to outer gear axial clearance ⑤	0.05 - 0.11 (0.0020 - 0.0043)
Inner gear to brazed portion of housing clearance ⑥	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 , ⑥ ) exceed the limit, replace front cover assembly.

# ENGINE COOLING SYSTEM

## Cooling Circuit



## System Check

### WARNING:

Never remove the radiator cap when the engine is hot. Serious burns could occur from high pressure fluid escaping from the radiator.

Wrap a thick cloth around the cap. Slowly turn it a quarter turn to allow built-up pressure to escape. Carefully remove the cap by turning it all the way.

## CHECKING COOLING SYSTEM HOSES

Check hoses for the following:

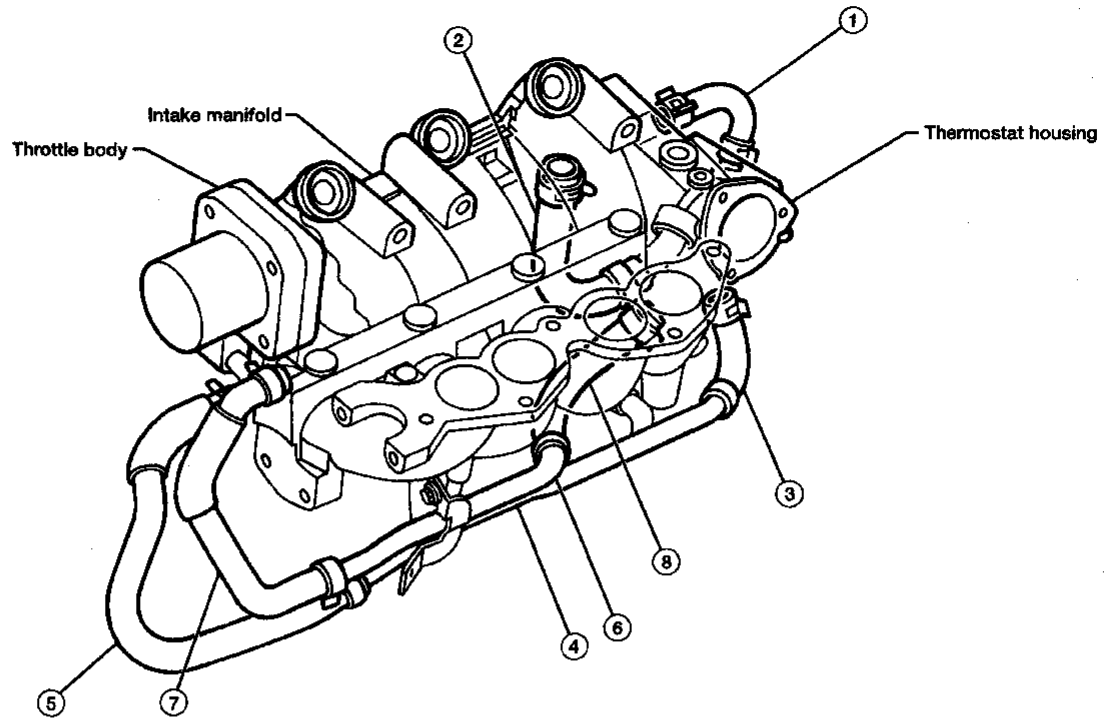
- Improper attachment
- Leaks
- Cracks
- Damage
- Chafing
- Deterioration



# ENGINE COOLING SYSTEM

## Water Hose Drawing

SEC. 211



- ① Intake manifold to Thermostat housing (upper)
- ② Intake manifold to Thermostat housing (lower)
- ③ Water jacket to Water pipe lower

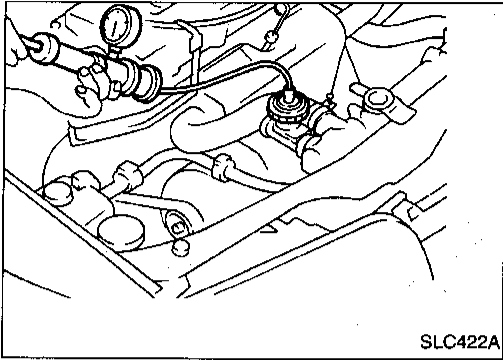
- ④ Water pipe lower to Throttle body
- ⑤ Water pipe lower to Throttle body
- ⑥ Water pipe upper

- ⑦ Throttle body to Water pipe upper
- ⑧ Water pipe upper to Thermostat housing

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## ENGINE COOLING SYSTEM



### Water Hose Drawing (Cont'd)

#### CHECKING COOLING SYSTEM FOR LEAKS

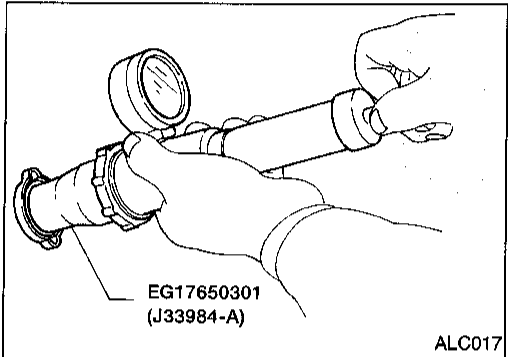
To check for leakage, apply pressure to the cooling system with a tester.

Testing pressure:

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

#### CAUTION:

Higher pressure than specified may cause radiator damage.



#### CHECKING RADIATOR CAP

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

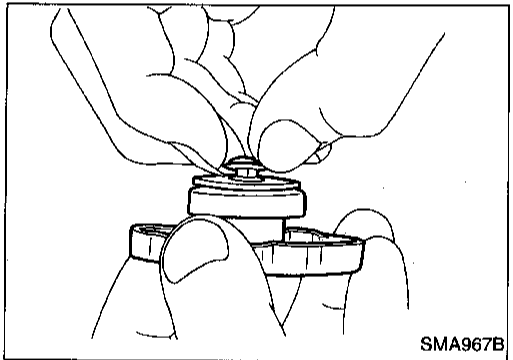
Radiator cap relief pressure:

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)



Pull the negative pressure valve to open it.

Check that it closes completely when released.

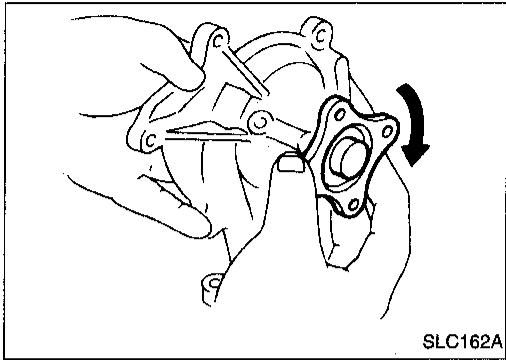


# ENGINE COOLING SYSTEM

## Water Pump (Cont'd)

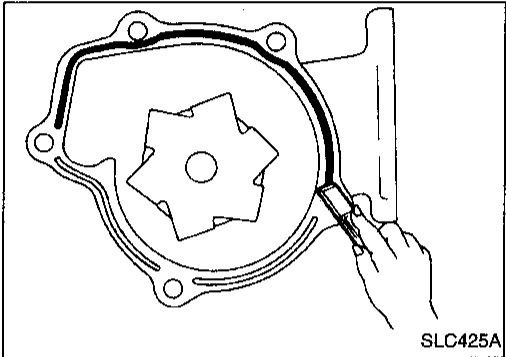
### INSPECTION

- Check body assembly and vane for rust or corrosion.
- Check for rough operation due to excessive end play.



### INSTALLATION

1. Use a scraper to remove liquid gasket from water pump and thermostat housing.
- Also remove old liquid gasket from mating surface of cylinder block.

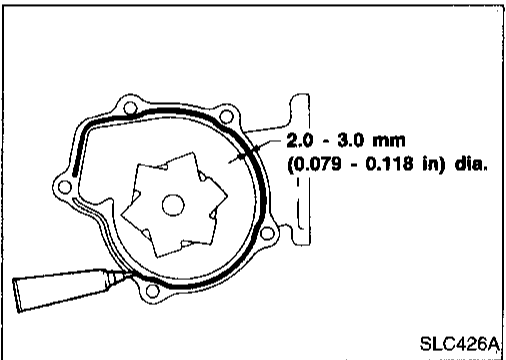


2. Apply a continuous bead of liquid gasket to mating surface of water pump.

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

When installing drive belts, refer to MA section ("Checking Drive Belts", "ENGINE MAINTENANCE").

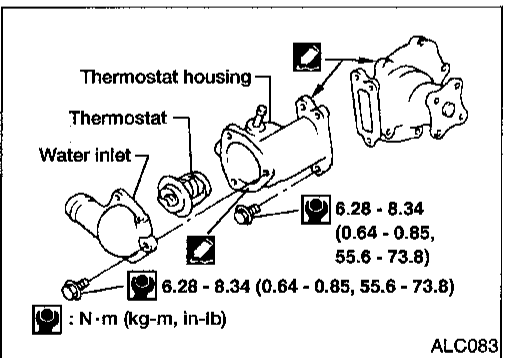
When filling radiator with coolant, refer to MA section ("Changing Engine Coolant", "ENGINE MAINTENANCE").



## Thermostat

Be careful not to spill coolant over engine compartment. Use a rag to absorb coolant.

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

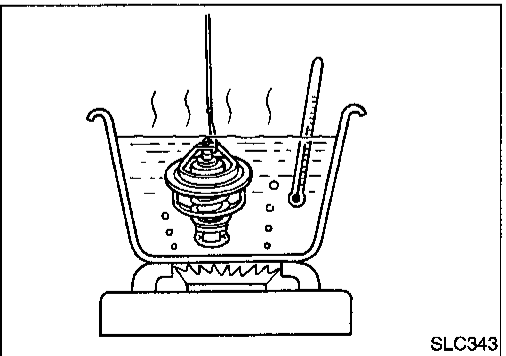


### INSPECTION

1. Check for valve seating condition at normal room temperature. It should seat tightly.
2. Check valve opening temperature and 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.

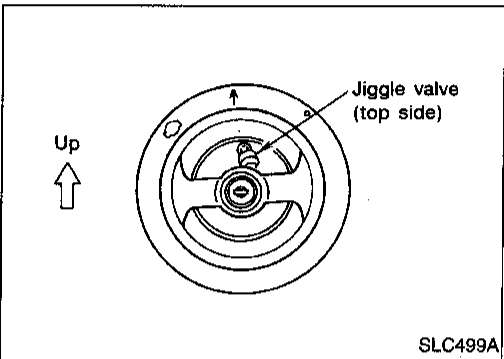
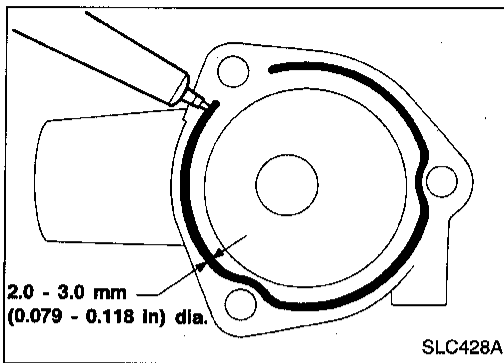


# ENGINE COOLING SYSTEM

## Thermostat (Cont'd)

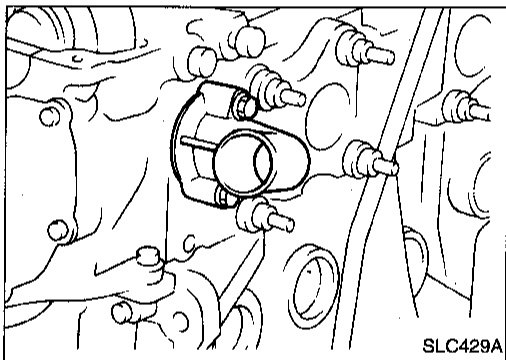
### INSTALLATION

- When installing water inlet apply liquid gasket as shown.
- Use **Genuine RTV silicone sealant Part No. 999 MP-A7007** or equivalent. GI



- Install thermostat with jiggle valve or air bleeder at upper side.

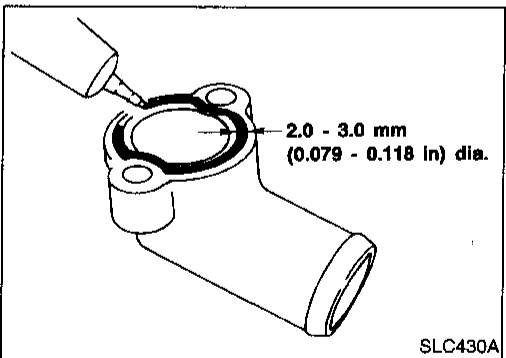
**After installation, run engine for a few minutes, and check for leaks.** EC



## Water Outlet

### INSPECTION

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



### INSTALLATION

1. Use a scraper to remove old liquid gasket from water outlet. CL
- **Also remove traces of liquid gasket from mating surface of cylinder head.** MT
2. Apply a continuous bead of liquid gasket to mating surface of water outlet. AT
- **Use Genuine RTV silicone sealant Part No. 999 MP-A7007** or equivalent. FA

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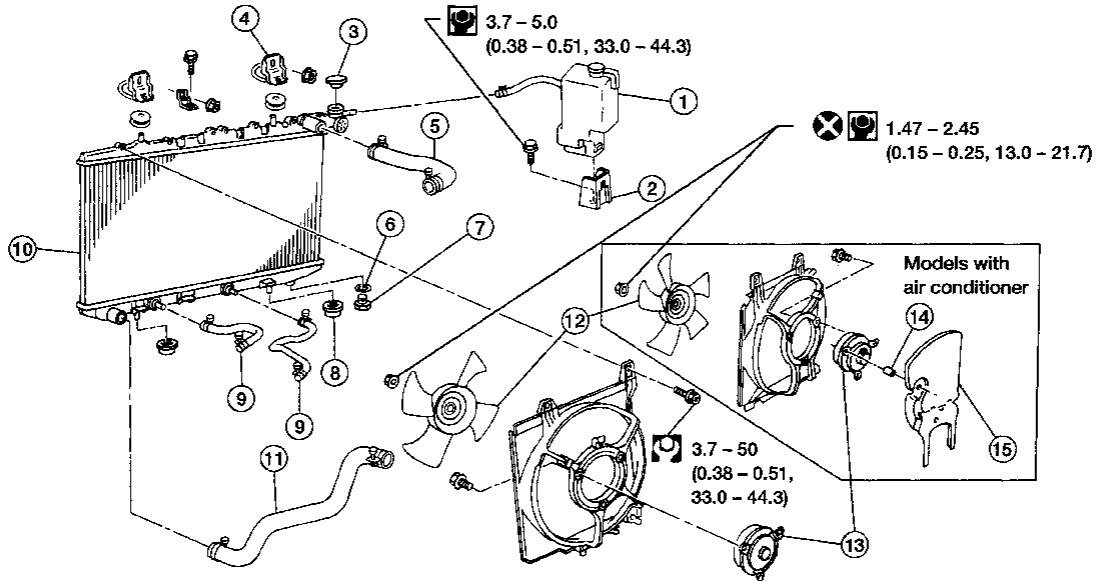
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# ENGINE COOLING SYSTEM

## Radiator

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- |                          |                                 |                            |
|--------------------------|---------------------------------|----------------------------|
| ① Reservoir tank         | ⑥ Washer                        | ⑪ Lower radiator hose      |
| ② Reservoir tank bracket | ⑦ Radiator drain plug           | ⑫ Cooling fan              |
| ③ Radiator cap           | ⑧ Mounting rubber               | ⑬ Cooling fan motor        |
| ④ Mounting bracket       | ⑨ Oil cooler hoses (A/T models) | ⑭ Shield spacer            |
| ⑤ Upper radiator hose    | ⑩ Radiator                      | ⑮ Cooling fan motor shield |

### Cooling fan control system

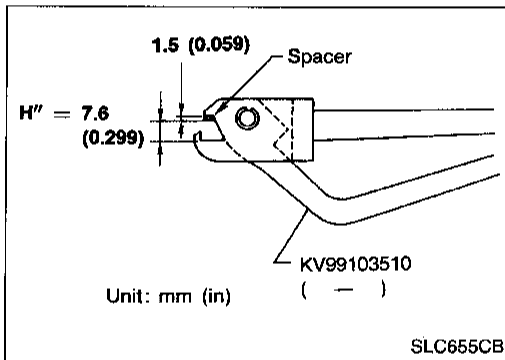
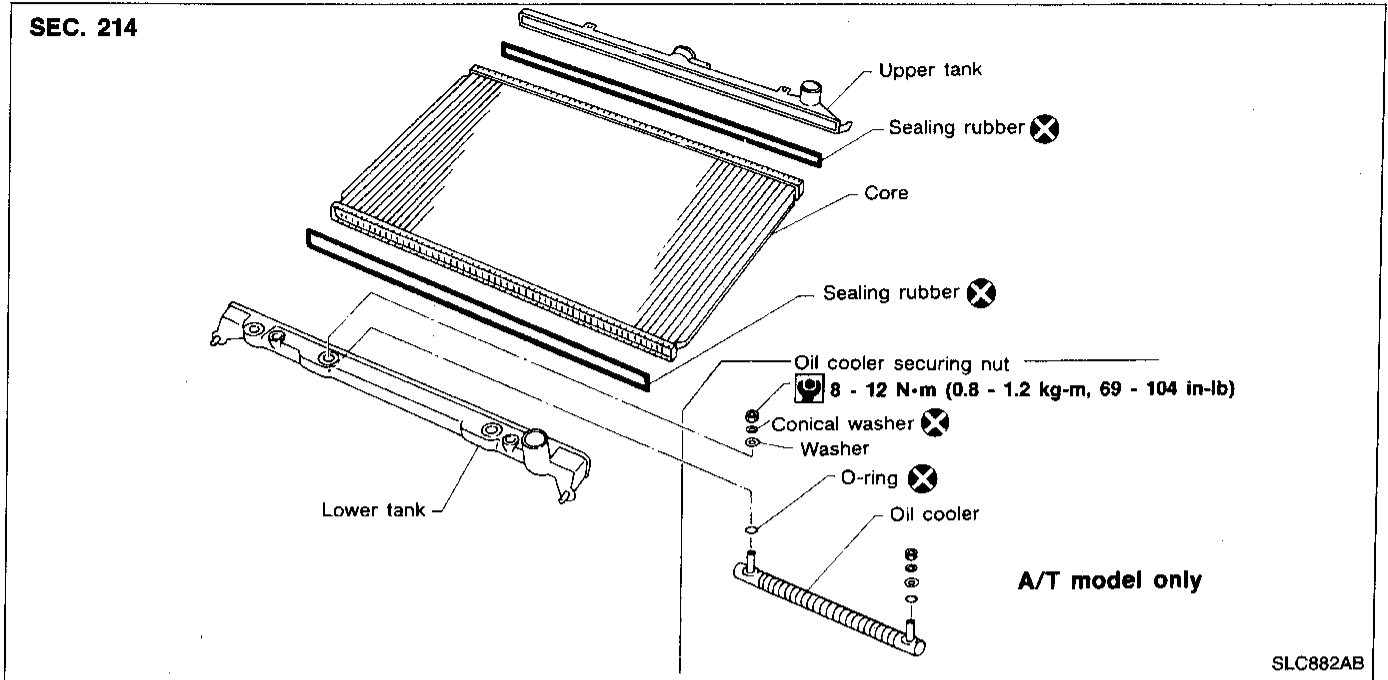
Cooling fans are controlled by the ECM. For details, refer to EC section ("Cooling Fan", "TROUBLE DIAGNOSIS FOR DTC P1900").

### Refilling engine coolant

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

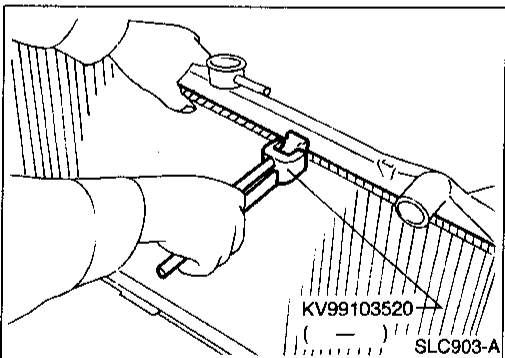
# ENGINE COOLING SYSTEM

## Radiator (Aluminum type)



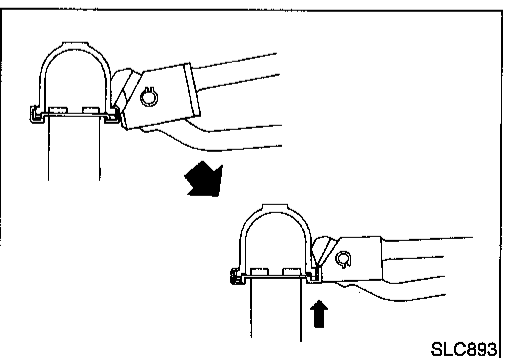
### PREPARATION

1. Attach the 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.

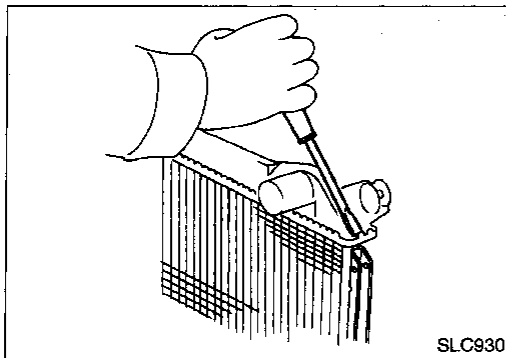


- Grip the crimped edge and bend it upwards so that Tool slips off.

**Do not bend excessively.**

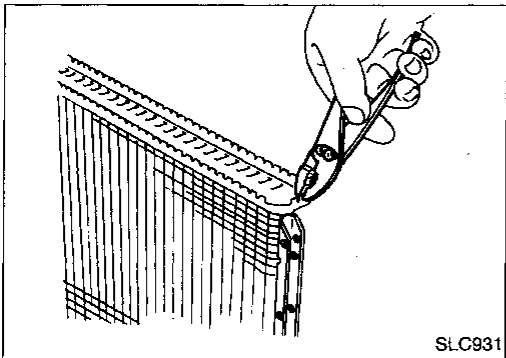
## ENGINE COOLING SYSTEM

### Radiator (Aluminum type) (Cont'd)

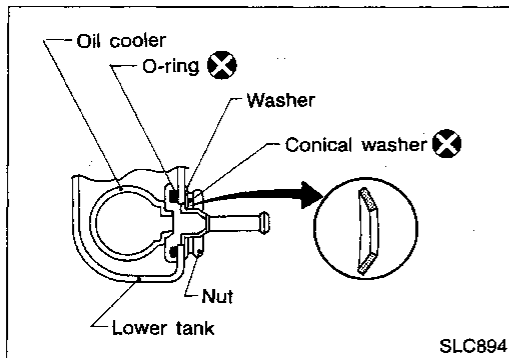


- In areas where Tool cannot be used, use a screwdriver to bend the edge up.

**Be careful not to damage tank.**



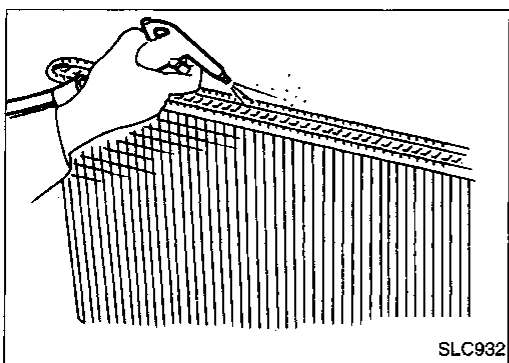
2. Make sure the edge stands straight up.
3. Remove oil cooler from tank. (A/T models only)



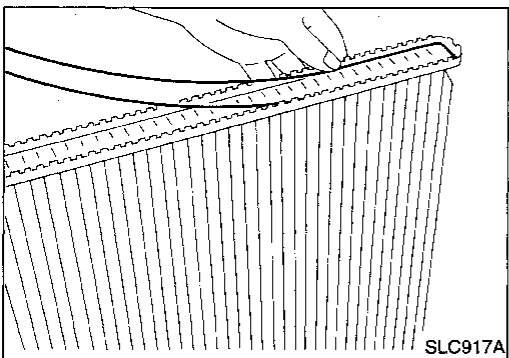
### ASSEMBLY

1. Install oil cooler. (A/T models only)

**Pay attention to direction of conical washer.**



2. Clean contact portion of tank.

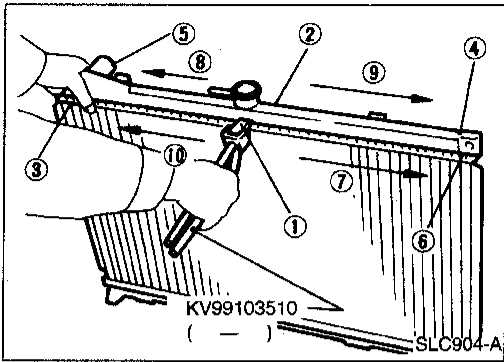


3. Install sealing rubber.  
**Push it in with fingers.**  
**Be careful not to twist sealing rubber.**

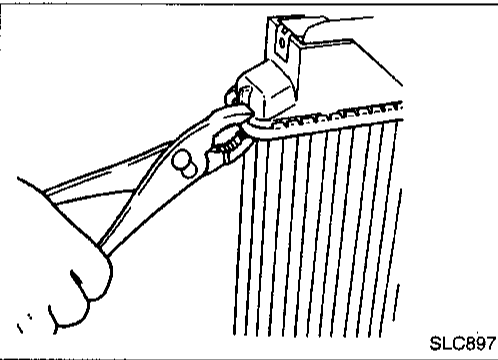
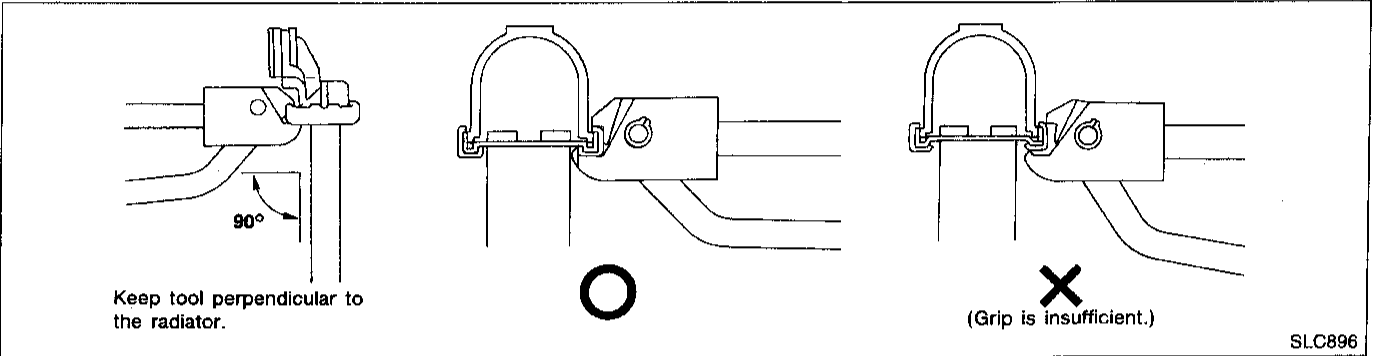


# ENGINE COOLING SYSTEM

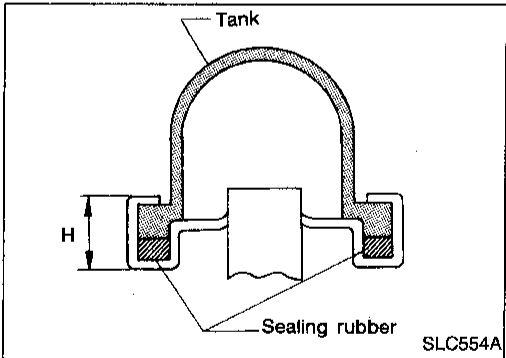
## Radiator (Aluminum type) (Cont'd)



4. Caulk tank in sequence with Tool.



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



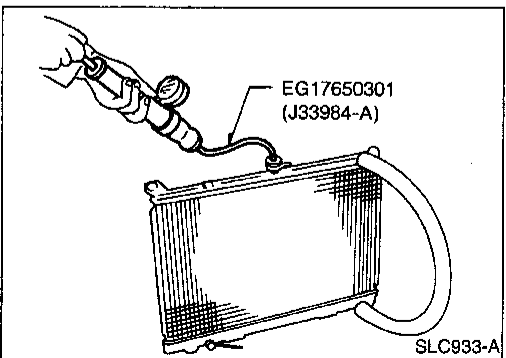
5. Make sure that the rim is completely crimped down.

**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)

# 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	—	Abusive driving	High engine rpm under no load	
			Driving in low gear for extended time	
			Driving at extremely high speed	
		Overload on engine	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	Approximate discharge pressure kPa (kg/cm <sup>2</sup> , psi)
Idle speed	49 - 186 (0.5 - 1.9, 7 - 27)
3,000 rpm	343 - 441 (3.5 - 4.5, 50 - 64)

### Oil pump

Unit: mm (in)

Body to outer gear radial clearance	0.110 - 0.200 (0.0043 - 0.0079)	GI
Inner gear to crescent clearance	0.217 - 0.327 (0.0085 - 0.0129)	MA
Outer gear to crescent clearance	0.21 - 0.32 (0.0083 - 0.0126)	EM
Cover to inner gear clearance	0.05 - 0.09 (0.0020 - 0.0035)	LC
Cover to outer gear axial clearance	0.05 - 0.11 (0.0020 - 0.0043)	EC
Inner gear to brazed portion of housing clearance	0.045 - 0.091 (0.0018 - 0.0036)	

## Engine Cooling System

### Thermostat

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

### Radiator

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

Cap relief pressure	Standard	78 - 98 (0.8 - 1.0, 11 - 14)	CL
	Limit	59 - 98 (0.6 - 1.0, 9 - 14)	
Leakage test pressure		157 (1.6, 23)	MT

FE

GL

MT

AT

FA

RA

BR

ST

RS

BT

HA

EL

IDX