

ENGINE LUBRICATION & COOLING SYSTEMS

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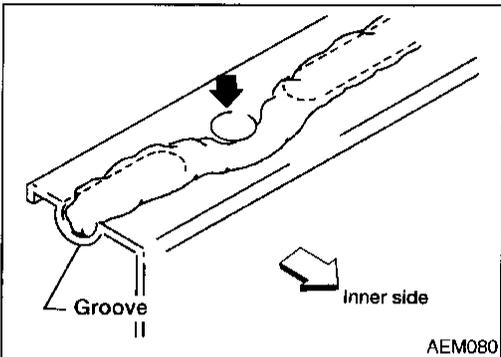
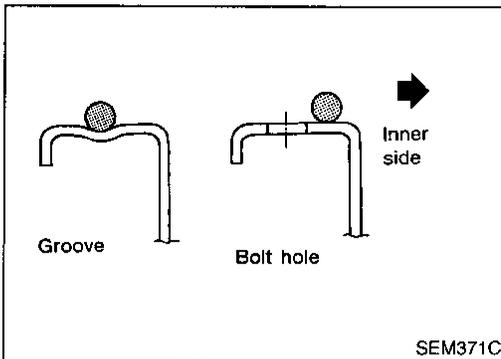
SECTION LC

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ENGINE LUBRICATION SYSTEM

Precautions



Precautions

LIQUID GASKET APPLICATION PROCEDURE

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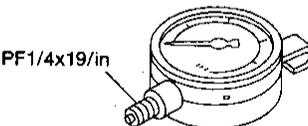
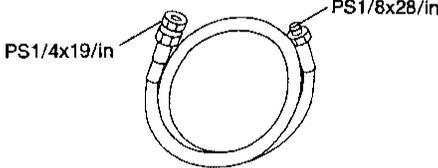
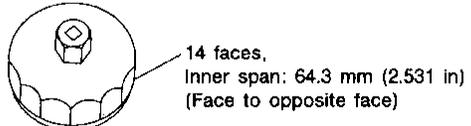
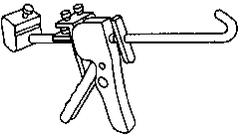
1. Use a scraper to remove all traces of old liquid gasket from mating surface and grooves. Also, completely clean any oil from these areas.
2. Apply a continuous bead of liquid gasket to mating surfaces. (Use Genuine RTV silicone sealant Part No. 999MP-A7007 or equivalent.)
 - Be sure liquid gasket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

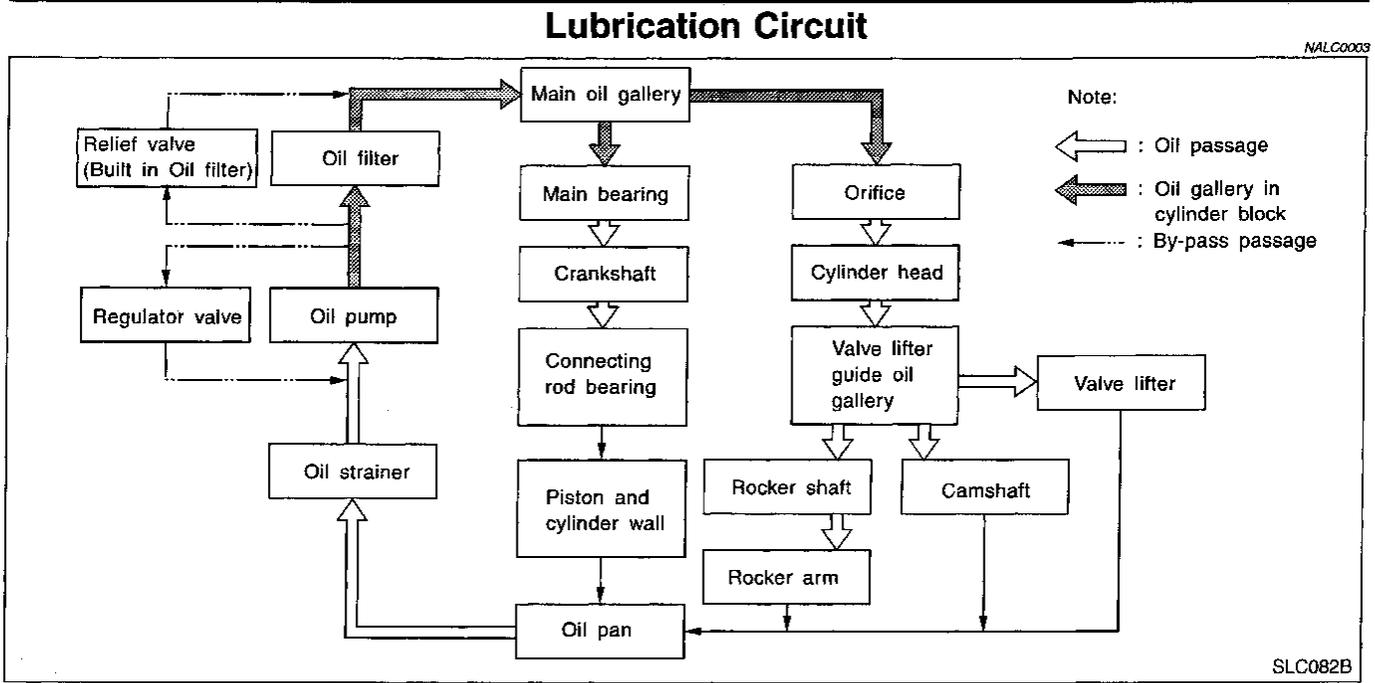
Preparation

SPECIAL SERVICE TOOLS

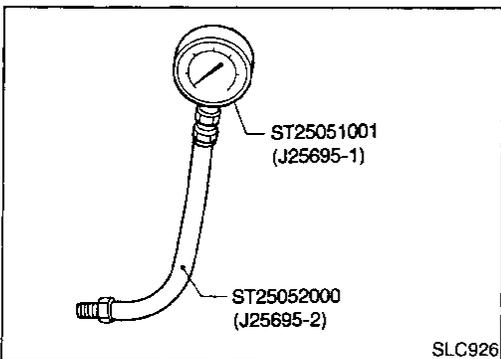
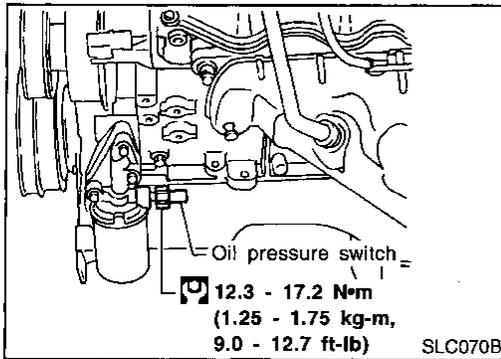
The actual shapes of Kent-Moore tools may differ from those of special service tools illustrated here.

NALC0002

| Tool number (Kent-Moore No.) Tool name | Description |
|--|--|
| ST25051001 (J25695-1) Oil pressure gauge |  <p>Measuring oil pressure Maximum measuring range: 2,452 kPa (25 kg/cm², 356 psi)</p> <p>NT558</p> |
| ST25052000 (J25695-2) Hose |  <p>Adapting oil pressure gauge to cylinder block</p> <p>NT559</p> |
| KV10115801 (J38956) Oil filter wrench |  <p>Removing oil filter</p> <p>14 faces, Inner span: 64.3 mm (2.531 in) (Face to opposite face)</p> <p>NT362</p> |
| WS39930000 () Tube presser |  <p>Pressing the tube of liquid gasket</p> <p>NT052</p> |



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Oil Pressure Check

NALC0004

WARNING:

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

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 ² , psi) |
|------------------|---|
| Idle speed | More than 59 (0.6, 9) |
| 2,000 | 412 - 451 (4.2 - 4.6, 60 - 65) |

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

6. Install oil pressure switch with sealant.

ENGINE LUBRICATION SYSTEM

Oil Pump

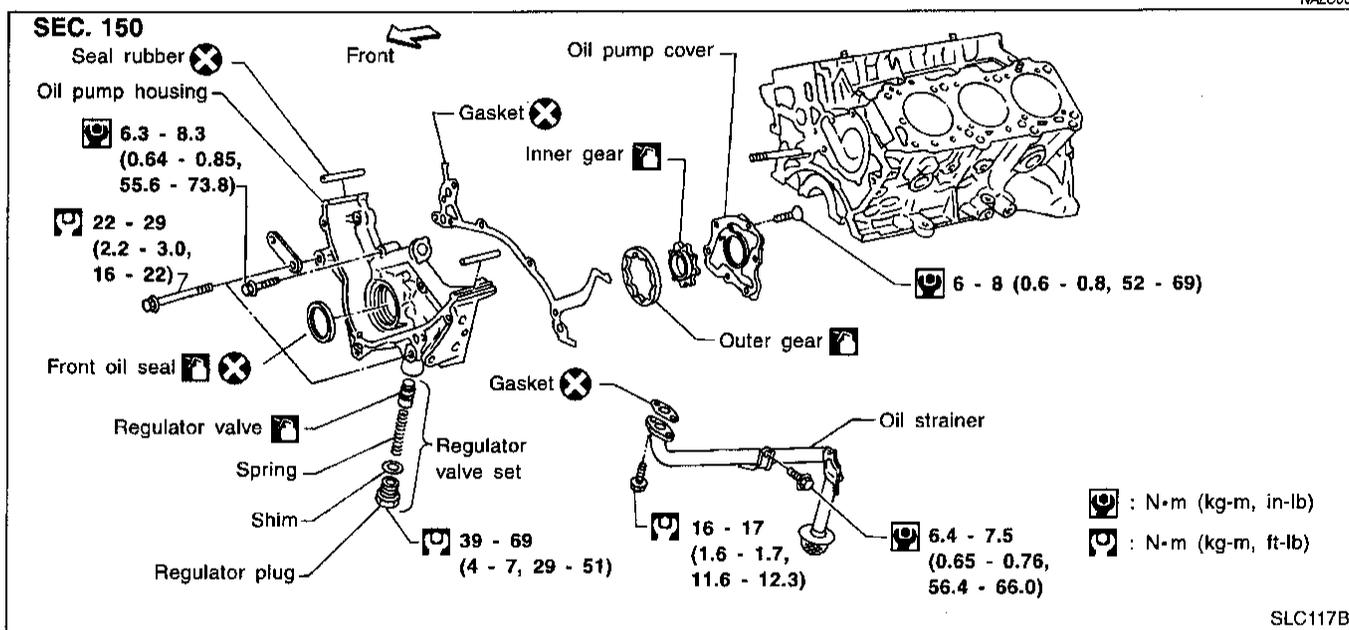
REMOVAL AND INSTALLATION

NALC0005

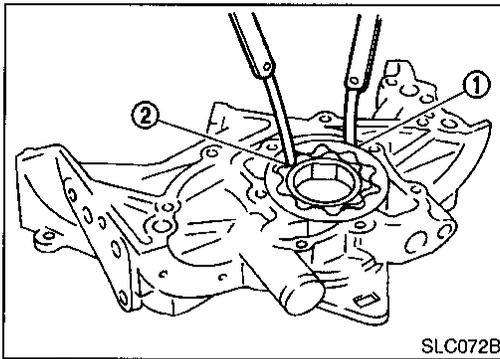
1. Drain engine oil.
2. Drain engine coolant from drain plug on radiator.
3. Remove air duct (from mass air flow sensor to throttle body).
4. Remove cooling fan.
5. Remove radiator hoses (upper and lower) and fan shroud. Refer to "Radiator".
6. Remove drive belts. Refer to MA section ("Checking Drive Belts").
7. Remove crankshaft pulley and front upper and lower belt covers. Refer to EM section ("TIMING BELT").
8. Remove oil pan. Refer to EM section ("OIL PAN").
9. Remove oil strainer.
10. Remove oil pump assembly.

DISASSEMBLY AND ASSEMBLY

NALC0005



- Always replace with new oil seal and gasket.
- When installing oil pump, apply engine oil to inner and outer gears.
- Be sure that O-ring is properly installed.



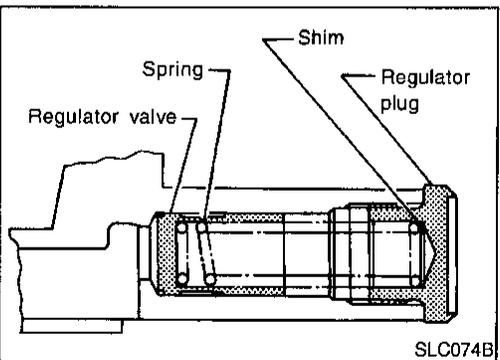
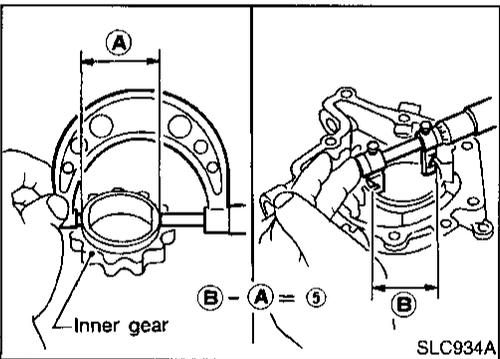
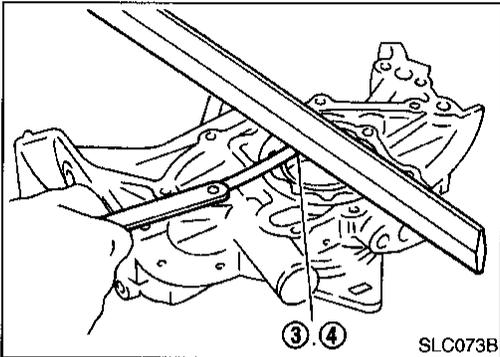
INSPECTION

Using a feeler gauge, straightedge and micrometers, check the following clearances:

Unit: mm (in)

| | |
|---|---------------------------------|
| Body to outer gear radial 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 axial clearance 3 | 0.05 - 0.09 (0.0020 - 0.0035) |
| Body to outer gear axial clearance 4 | 0.050 - 0.110 (0.0020 - 0.0043) |
| Inner gear to brazed portion of housing clearance 5 | 0.045 - 0.091 (0.0018 - 0.0036) |

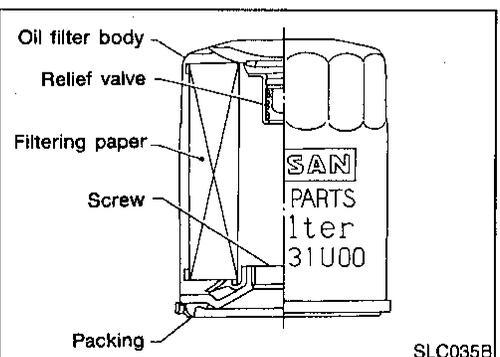
- If the tip clearance (2) exceeds the limit, replace gear set.
- If body to gear clearances (1, 3, 4, 5) exceed the limit, replace oil pump body assembly.



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.



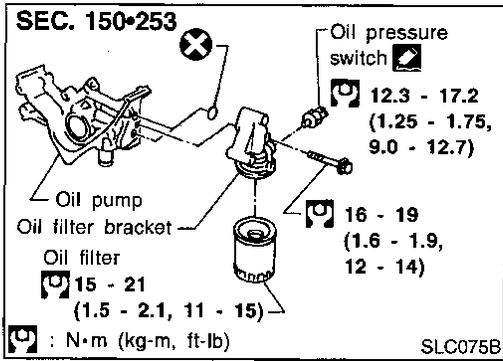
OIL FILTER

The oil filter is a small, full-flow cartridge type and is provided with a relief valve.

- The new and previous oil filter designs differ from each other and are not interchangeable.
- Use Tool KV10115801 (J38956) for removing oil filter.

ENGINE LUBRICATION SYSTEM

Oil Pump (Cont'd)



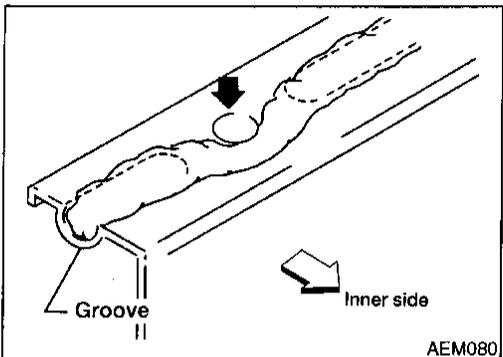
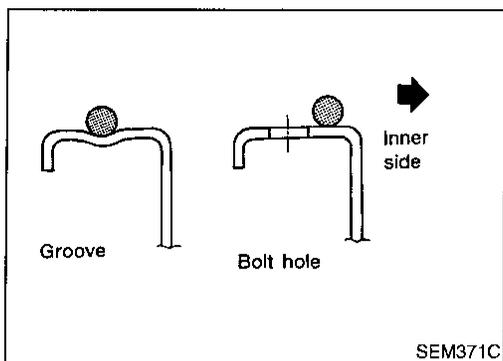
OIL FILTER BRACKET

NALC0010

1. Remove oil filter.
2. Disconnect oil pressure switch and connector.
3. Remove oil filter bracket.

ENGINE COOLING SYSTEM

Precautions



Precautions

LIQUID GASKET APPLICATION PROCEDURE

NALC0014

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

Preparation

SPECIAL SERVICE TOOLS

NALC0015

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

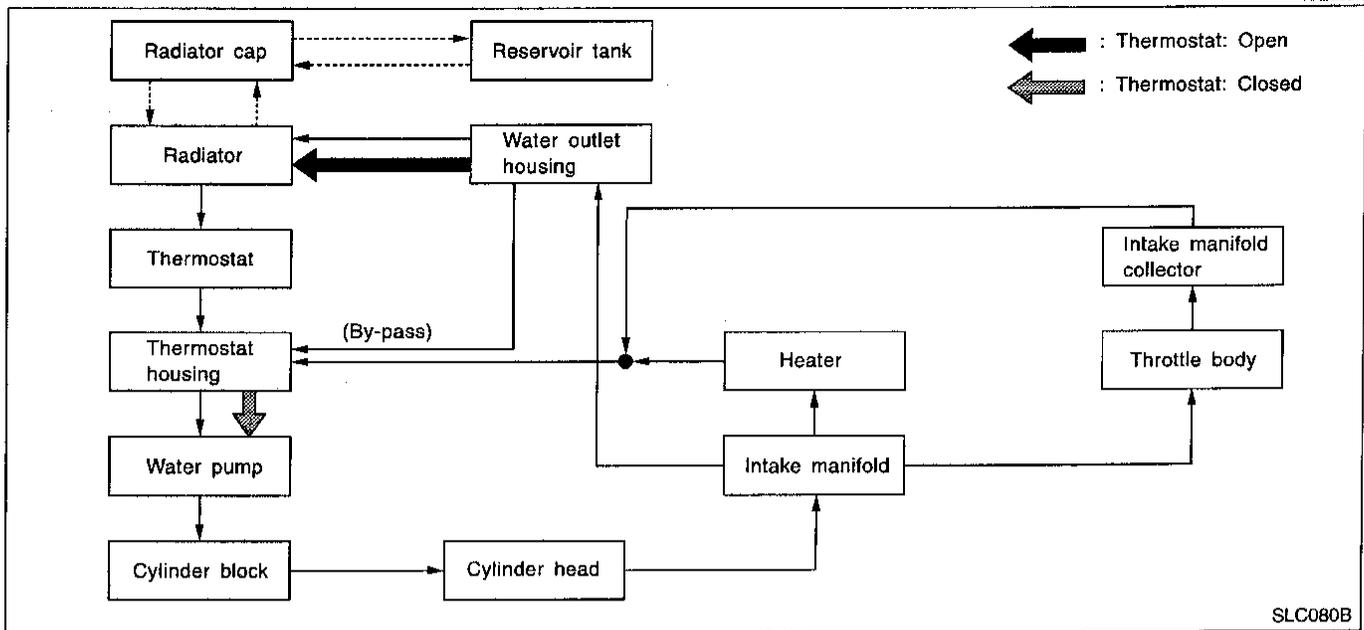
| Tool number (Kent-Moore No.) Tool name | Description |
|--|---|
| EG17650301 (J33984-A) Radiator cap tester adapter | <p>Adapting radiator cap tester to radiator filler neck a: 28 (1.10) dia. b: 31.4 (1.236) dia. c: 41.3 (1.626) dia. Unit: mm (in)</p> |
| WS39930000 (—) Tube presser | <p>Pressing the tube of liquid gasket</p> |
| KV99103510 (—) Radiator plate pliers A | <p>Installing radiator upper and lower tanks</p> |
| KV99103520 (—) Radiator plate pliers B | <p>Removing radiator upper and lower tanks</p> |

ENGINE COOLING SYSTEM

Cooling Circuit

Cooling Circuit

NALC0016



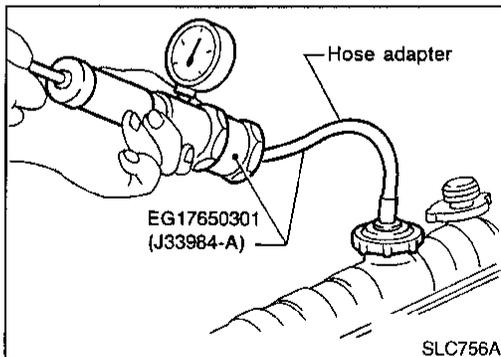
System Check

NALC0017

WARNING:

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

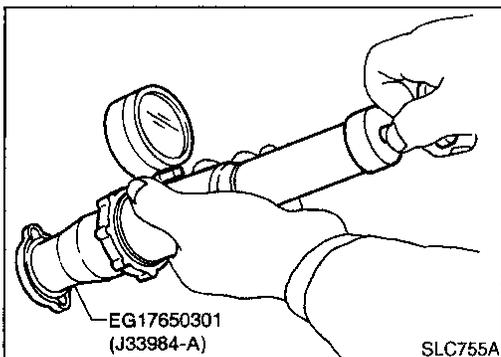
Wrap a thick cloth around the cap. Slowly turn it a quarter turn to allow built-up pressure to escape. Carefully remove the cap by turning it all the way.



CHECKING COOLING SYSTEM HOSES

NALC0017S01

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



CHECKING RADIATOR CAP

NALC0017S02

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

Radiator cap relief pressure:

Standard

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

Limit

59 - 98 kPa (0.6 - 1.0 kg/cm², 9 - 14 psi)

CHECKING COOLING SYSTEM FOR LEAKS

NALC0017503

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

Testing pressure: 157 kPa (1.6 kg/cm², 23 psi)

CAUTION:

Higher pressure than specified may cause radiator damage.

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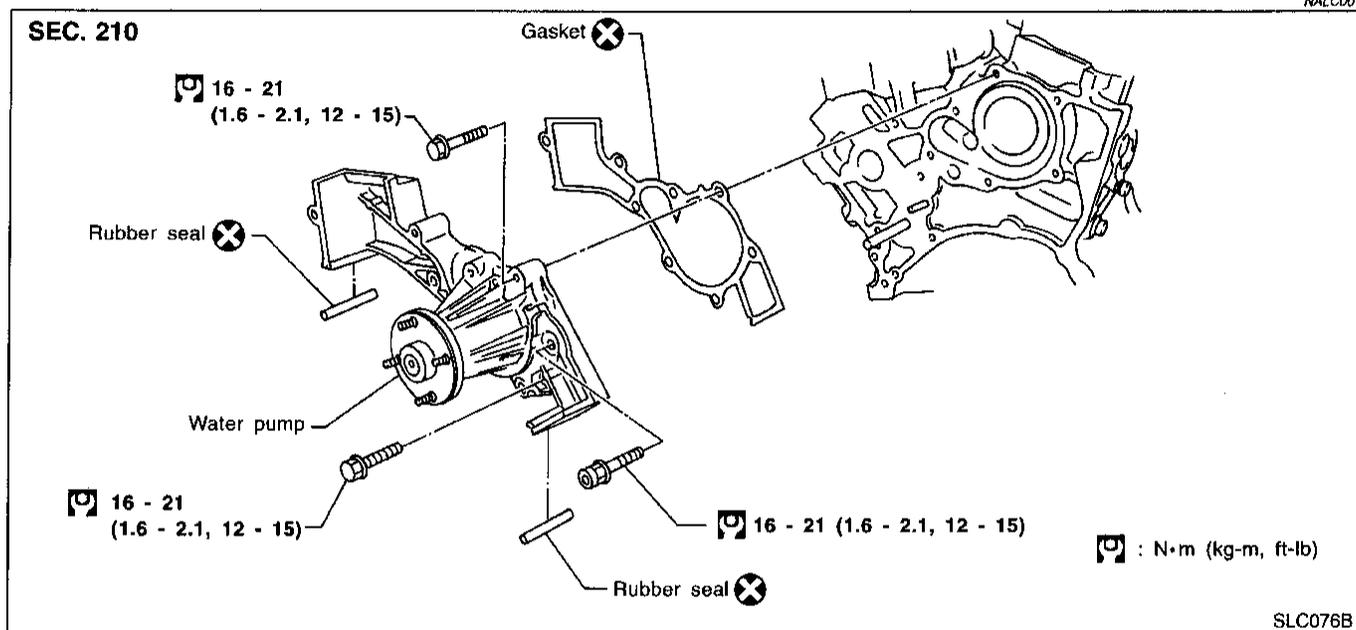
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Water Pump REMOVAL AND INSTALLATION

NALC0018



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CAUTION:

- When removing water pump assembly, be careful not to get coolant on timing 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.
- To avoid deforming timing cover, make sure there is adequate clearance between it and the hose clamp.

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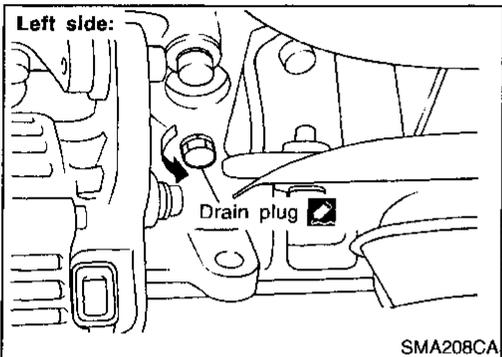
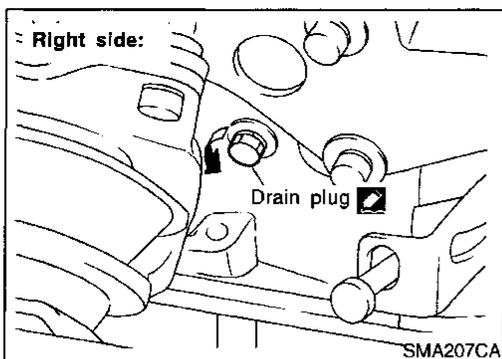
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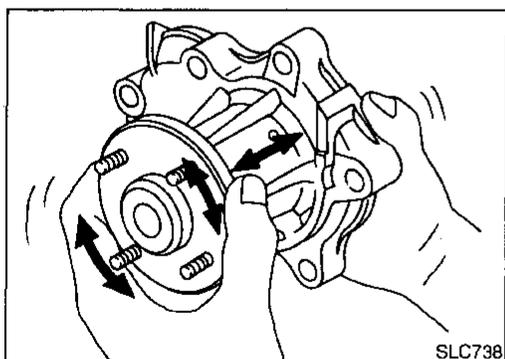
ENGINE COOLING SYSTEM

Water Pump (Cont'd)



1. Drain coolant from drain plugs on both sides of cylinder block and radiator. Refer to MA section ("Changing Engine Coolant").

2. Remove radiator hoses (upper and lower) and fan shroud. Refer to "Radiator".
3. Remove drive belts. Refer to MA section ("Checking Drive Belts").
4. Remove water pump pulley.
5. Remove crankshaft pulley and front (upper and lower) belt cover. Refer to EM section ("TIMING BELT").
6. Remove water pump.

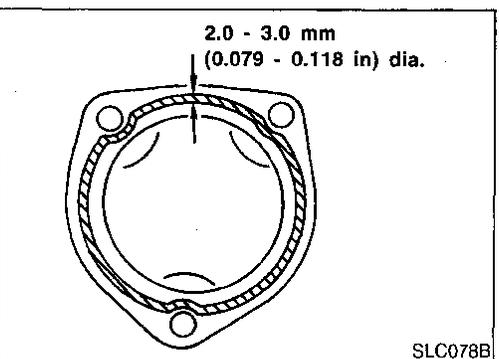
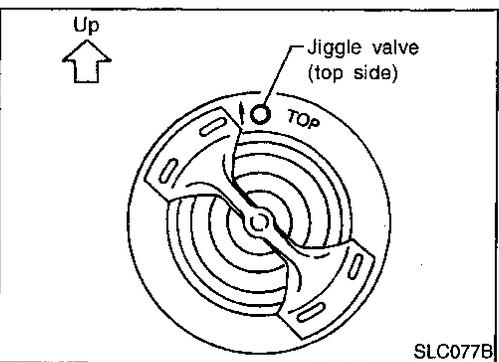
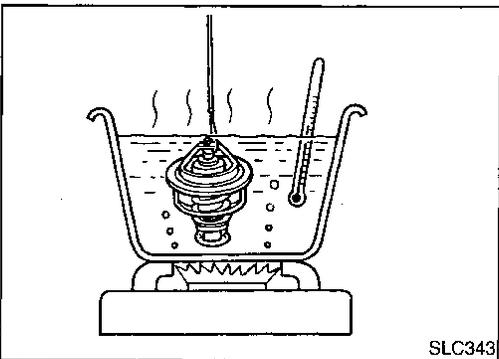
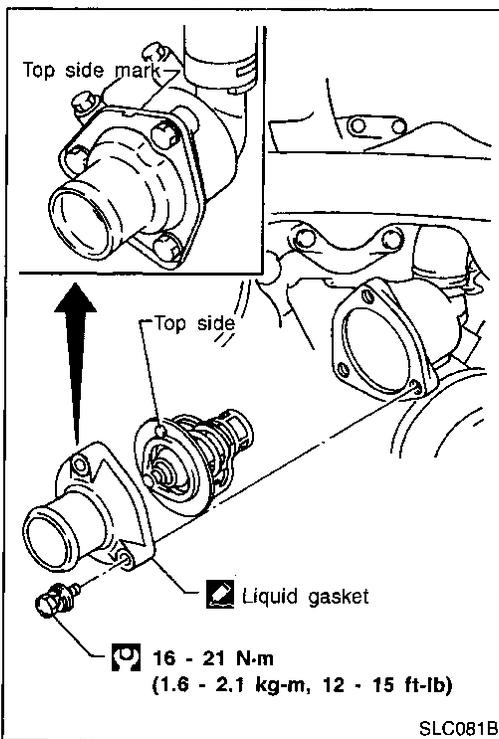


INSPECTION

1. Check for badly rusted or corroded body assembly and vanes. NALC0019
2. Check for rough operation due to excessive end play.

Thermostat REMOVAL

1. Drain engine coolant from drain plugs on radiator. NALC0020
2. Remove radiator hoses (upper and lower) and fan shroud.
3. Remove drive belts.
4. Remove pulley bracket.
5. Remove water inlet and thermostat assembly.



INSPECTION

NALC0021

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

2. Check valve opening temperature and valve lift.

| | | |
|---------------------------|---------------|----------------------------|
| Valve opening temperature | °C (°F) | 82 (180) |
| Valve lift | mm/°C (in/°F) | More than 10/95 (0.39/203) |

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

INSTALLATION

NALC0022

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

2. When installing water inlet apply liquid gasket as shown.
 - 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.

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ENGINE COOLING SYSTEM

Radiator

Radiator

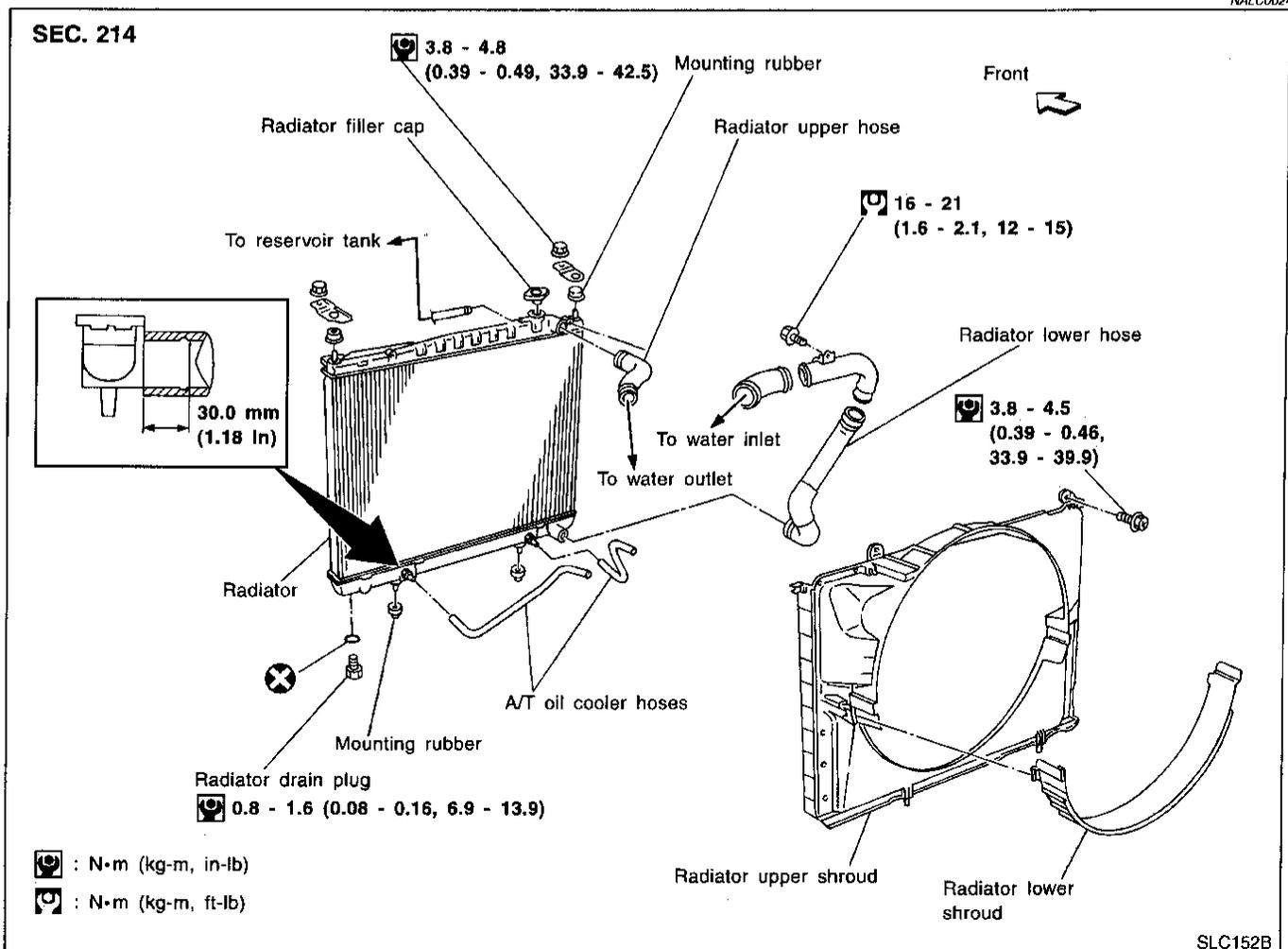
REMOVAL AND INSTALLATION

NALC0023

1. Remove under cover.
2. Drain coolant from radiator drain plug.
3. Remove air duct. (From mass air flow sensor to throttle body)
4. Disconnect radiator upper and lower hoses.
5. Remove A/T oil cooler hoses. (A/T models only)
6. Remove radiator lower shroud.
7. Disconnect reservoir tank hose.
8. Remove radiator.
9. After repairing or replacing radiator, install any part removed in reverse order of removal.

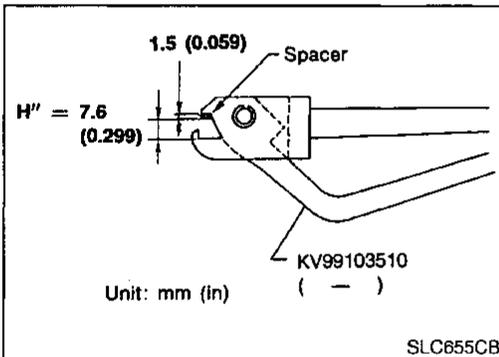
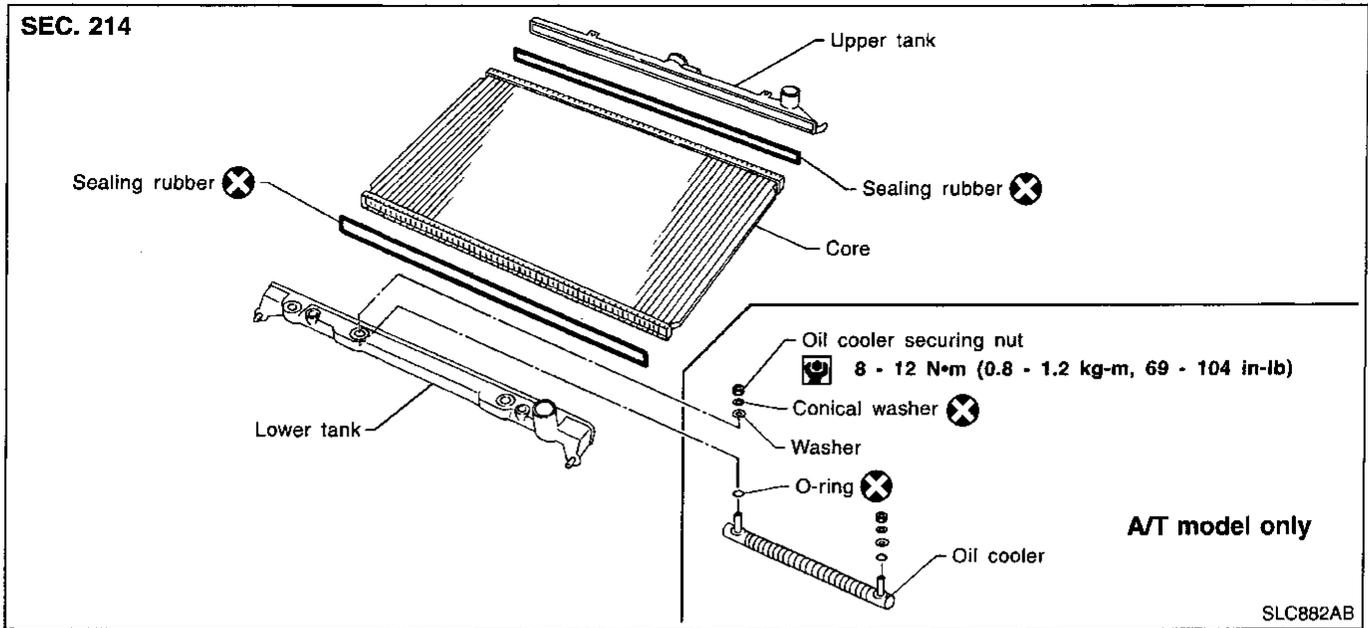
COMPONENTS

NALC0024

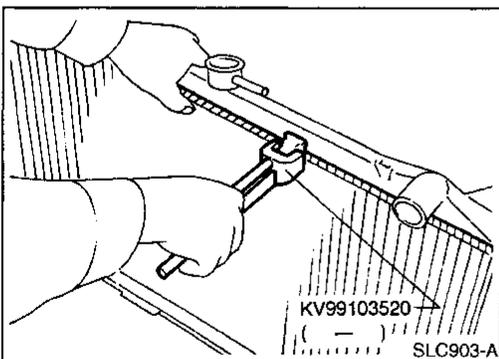


PREPARATION

NALC0025



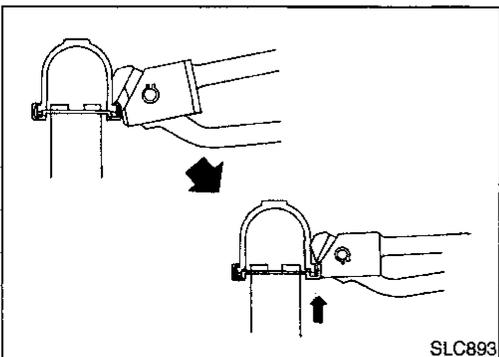
1. Attach the spacer to the tip of the radiator plate pliers A. Spacer specification: 1.5 mm (0.059 in) thick x 18 mm (0.71 in) wide x 8.5 mm (0.335 in) long.
2. Make sure that when radiator plate pliers A are closed dimension H'' is approx. 7.6 mm (0.299 in).
3. Adjust dimension H'' with the spacer,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



DISASSEMBLY

NALC0026

1. Remove tank with Tool.

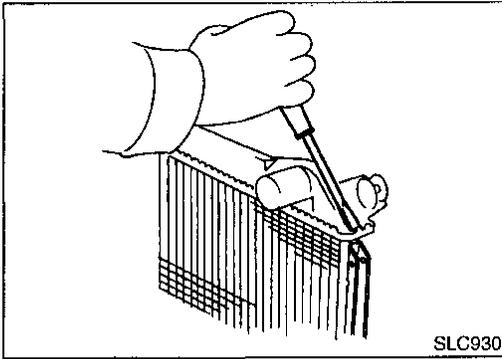


- Grip the crimped edge and bend it upwards so that Tool slips off.

Do not bend excessively.

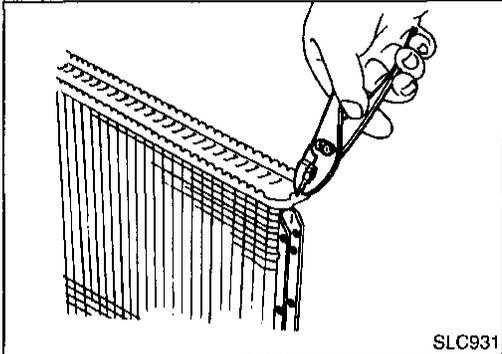
ENGINE COOLING SYSTEM

Radiator (Cont'd)

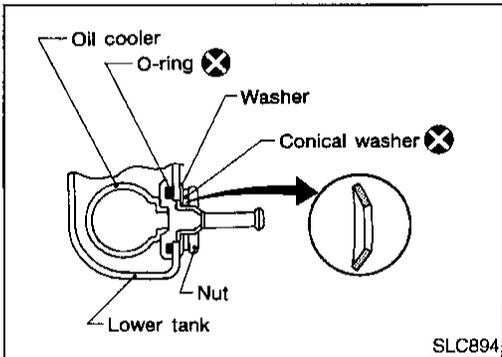


- In areas where Tool cannot be used, use a screwdriver to bend the edge up.

Be careful not to damage tank.



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

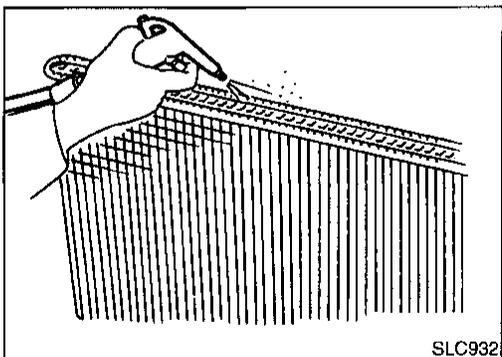


ASSEMBLY

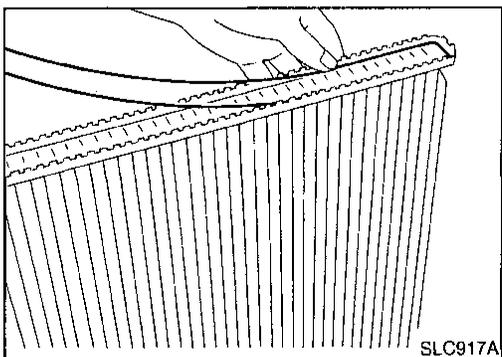
1. Install oil cooler. (A/T models only)

Pay attention to direction of conical washer.

NALC0027



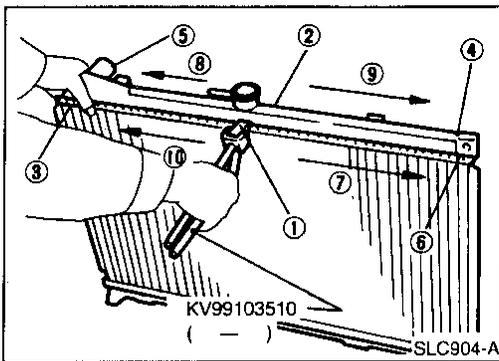
2. Clean contact portion of tank.



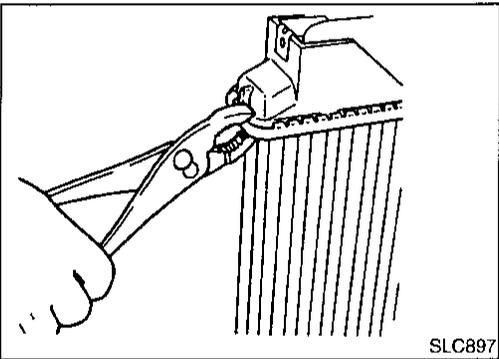
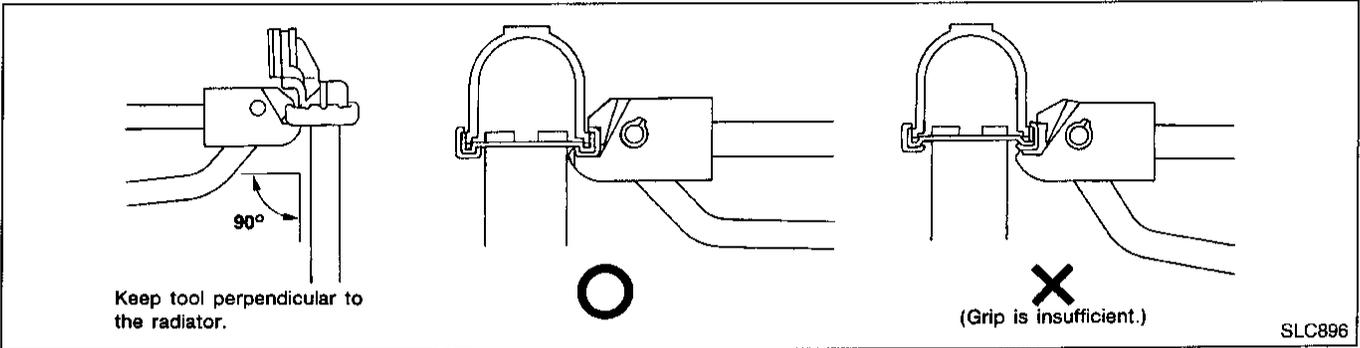
3. Install sealing rubber.
Push it in with fingers.
Be careful not to twist sealing rubber.

ENGINE COOLING SYSTEM

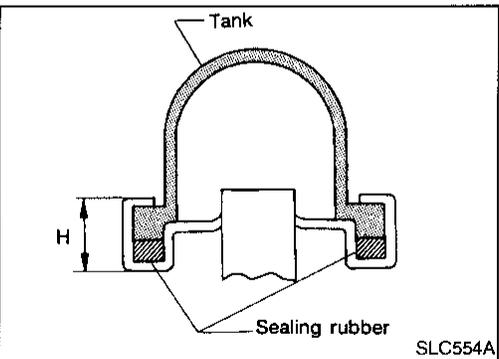
Radiator (Cont'd)



4. Caulk tank in specified sequence with Tool.



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

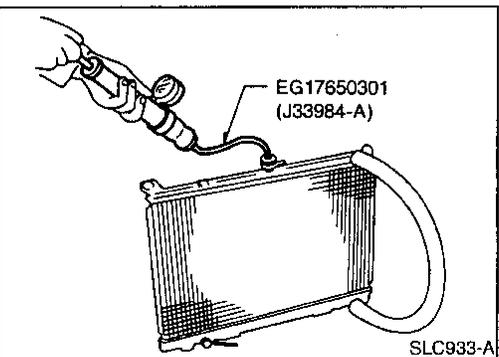


5. Make sure that the rim is completely crimped down.

Standard height "H":
8.0 - 8.4 mm (0.315 - 0.331 in)

6. Confirm that there is no leakage.

Refer to Inspection.



INSPECTION

1. Apply pressure with Tool.

Specified pressure value:
157 kPa (1.6 kg/cm², 23 psi)

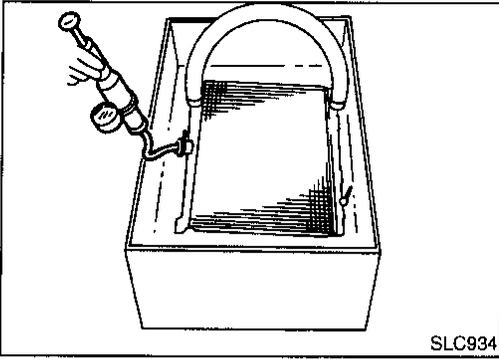
WARNING:

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)

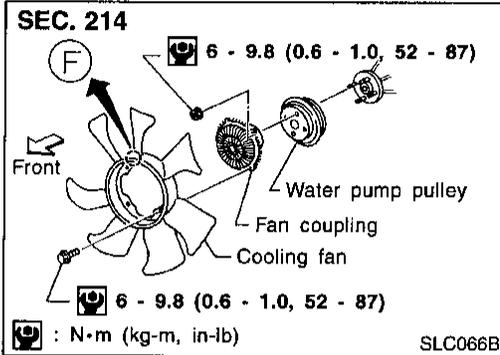
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ENGINE COOLING SYSTEM

Radiator (Cont'd)



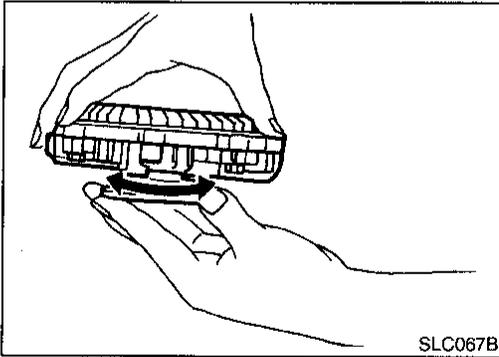
2. Check for leakage.



Cooling Fan (Crankshaft driven)

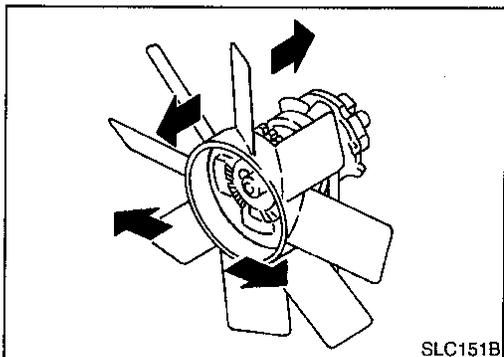
REMOVAL AND INSTALLATION

- Do not release the drive belt tension by removing the fan/water pump pulley. NALC0029
- Fan coupling cannot be disassembled and should be replaced as a unit. If front mark **F** is present, install fan so that side marked **F** faces the front.
- Install the drive belt only after the fan and fan coupling to water pump flange bolts/nuts have been properly torqued.
- Proper alignment of these components is essential. Improper alignment will cause them to wobble and may eventually cause the fan to separate from the water pump causing extensive damage.



INSPECTION

Check fan coupling for rough operation, wobbling, oil leakage or bent bimetal. NALC0030



After assembly, verify the fan does not wobble or flap while the engine is running.

WARNING:

- When the engine is running, keep hands and clothing away from moving parts such as drive belts and fan.

ENGINE COOLING SYSTEM

Refilling Engine Coolant

Refilling Engine Coolant

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

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Overheating Cause Analysis

NALC0032

| | | Symptom | Check items | | |
|----------------------------------|---------------------------------------|--|--|--------------|---|
| Cooling system parts malfunction | Poor heat transfer | Water pump malfunction | — | — | |
| | | 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 | |
| Radiator | | | Poor sealing | — | |
| | | | O-ring for damage, deterioration or improper fitting | | |
| | | Cracked radiator tank | | | |
| Reservoir tank | | Cracked radiator core | — | | |
| | Cracked reservoir tank | | | | |
| Overflowing reservoir tank | Exhaust gas leaks into cooling system | Cylinder head deterioration | — | | |
| | | Cylinder head gasket deterioration | | | |

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ENGINE COOLING SYSTEM

Overheating Cause Analysis (Cont'd)

| | Symptom | | Check items | |
|---|--------------------------------|-------------------------|--|---------------------------------------|
| 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)

Oil Pressure

Oil Pressure

NALC0011

| Engine speed rpm | Approximate discharge pressure kPa (kg/cm ² , psi) |
|------------------|---|
| Idle speed | More than 59 (0.6, 9) |
| 2,000 | 412 - 451 (4.2 - 4.6, 60 - 65) |

GI

MA

EM

Regulator Valve

NALC0012
Unit: mm (in)

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

LC

Oil Pump

NALC0013
Unit: mm (in)

| | |
|---|---------------------------------|
| Body to outer gear radial clearance | 0.114 - 0.200 (0.0045 - 0.0079) |
| Inner gear to outer gear tip clearance | Below 0.18 (0.0071) |
| Body to inner gear axial clearance | 0.05 - 0.09 (0.0020 - 0.0035) |
| Body to outer gear axial clearance | 0.050 - 0.110 (0.0020 - 0.0043) |
| Inner gear to brazed portion of housing clearance | 0.045 - 0.091 (0.0018 - 0.0036) |

EC

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Thermostat

NALC0033

| | |
|-----------------------------------|----------------------------|
| Valve opening temperature °C (°F) | 82 (180) |
| Valve lift mm/°C (in/°F) | More than 10/95 (0.39/203) |

AT

TF

Radiator

NALC0034
Unit: kPa (kg/cm², psi)

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

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