

ENGINE LUBRICATION & COOLING SYSTEMS

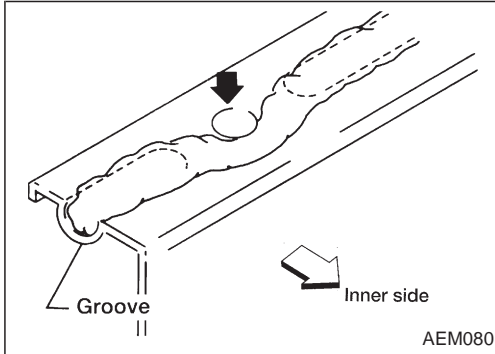
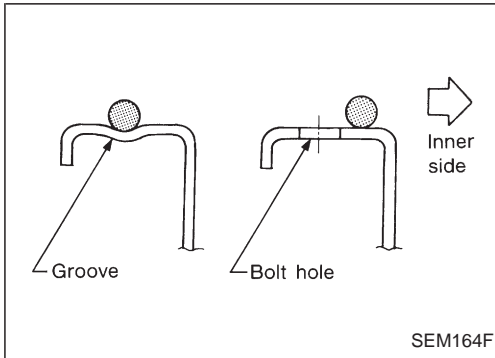
SECTION LC

LC

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PRECAUTIONS AND PREPARATION



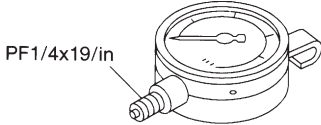
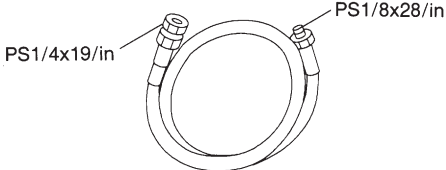
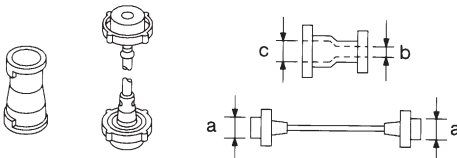
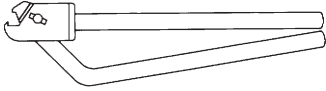
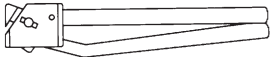
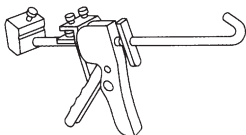
Liquid Gasket Application Procedure

- 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.)
 - 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.

PRECAUTIONS AND PREPARATION

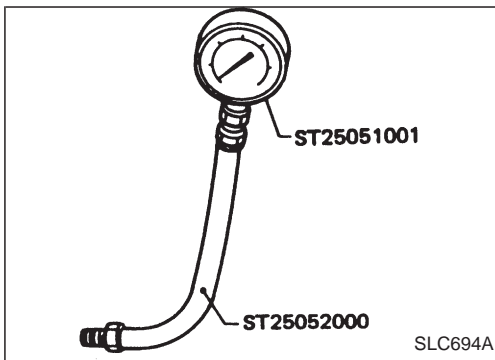
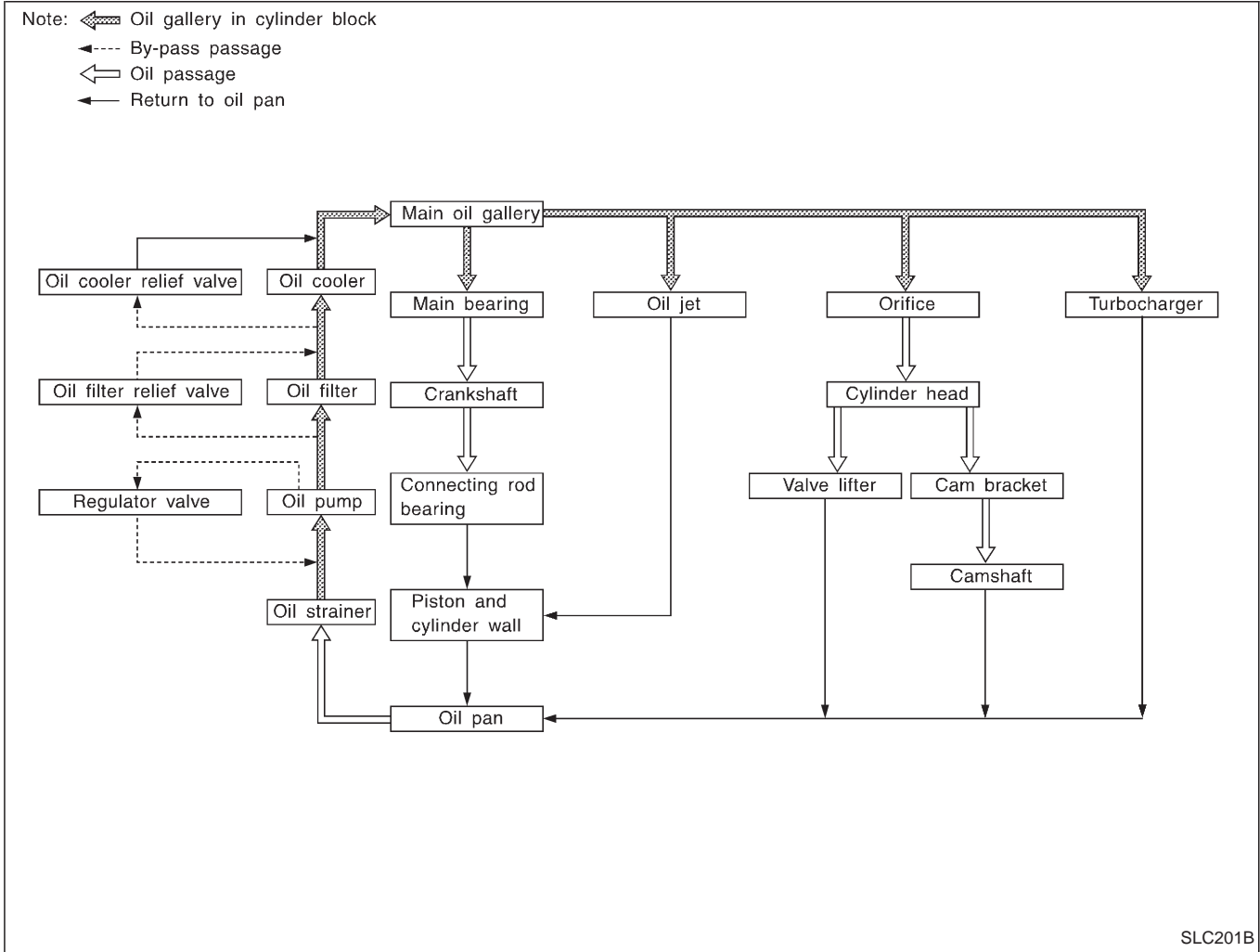
Special Service Tools

*: Special tool or commercial equivalent

Tool number Tool name	Description
ST25051001* Oil pressure gauge	Measuring oil pressure Maximum measuring range: 2,452 kPa (24.5 bar, 25 kg/cm², 356 psi)
NT558	
ST25052000* Hose	Adapting oil pressure gauge to cylinder block
NT559	
EG17650301 Radiator cap tester adapter	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)
NT564	
KV99103510 Radiator plate pliers A	Installing radiator upper and lower tanks
NT224	
KV99103520 Radiator plate pliers B	Removing radiator upper and lower tanks
NT225	
WS39930000 Tube presser	Pressing the tube of liquid gas- ket
NT052	

ENGINE LUBRICATION SYSTEM

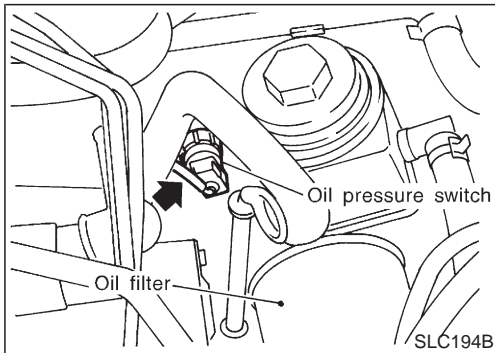
Lubrication Circuit



Oil Pressure Check

WARNING:

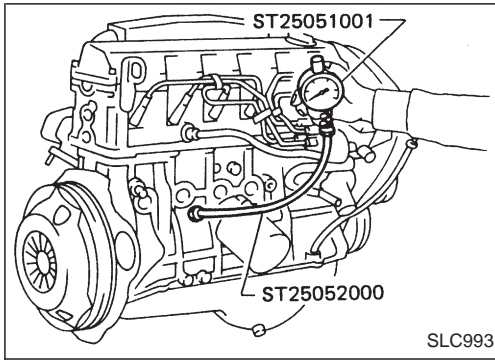
- Be careful not to burn yourself, as the engine and oil may be hot.
- Oil pressure check should be done in "Neutral" gear position.



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 rpm	Approximate discharge pressure kPa (bar, kg/cm ² , psi)
Idle speed 3,000	More than 78 (0.78, 0.8, 11) 318.7 - 424.6 (3.19 - 4.25, 3.25 - 4.33, 46.2 - 61.6)

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

6. Install oil pressure switch with sealant.

Use proper liquid sealant.

Oil pressure switch:

⊙ : 10 - 16 N·m (1.0 - 1.6 kg-m, 87 - 139 in-lb)

Oil Pump

REMOVAL AND INSTALLATION

1. Disconnect battery terminal.
2. Drain engine oil.
3. Drain coolant from radiator and cylinder block. Refer to MA section ("Changing Engine Coolant", "ENGINE MAINTENANCE").
4. Remove radiator shroud.
5. Remove drive belts. Refer to MA section ("Checking Drive Belts").
6. Remove crankshaft pulley and front upper and lower belt covers. Refer to EM section ("TIMING BELT").
7. Remove oil pan. Refer to EM section ("OIL PAN").
8. Remove oil strainer.
9. Remove oil pump assembly.
10. 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.

ENGINE LUBRICATION SYSTEM

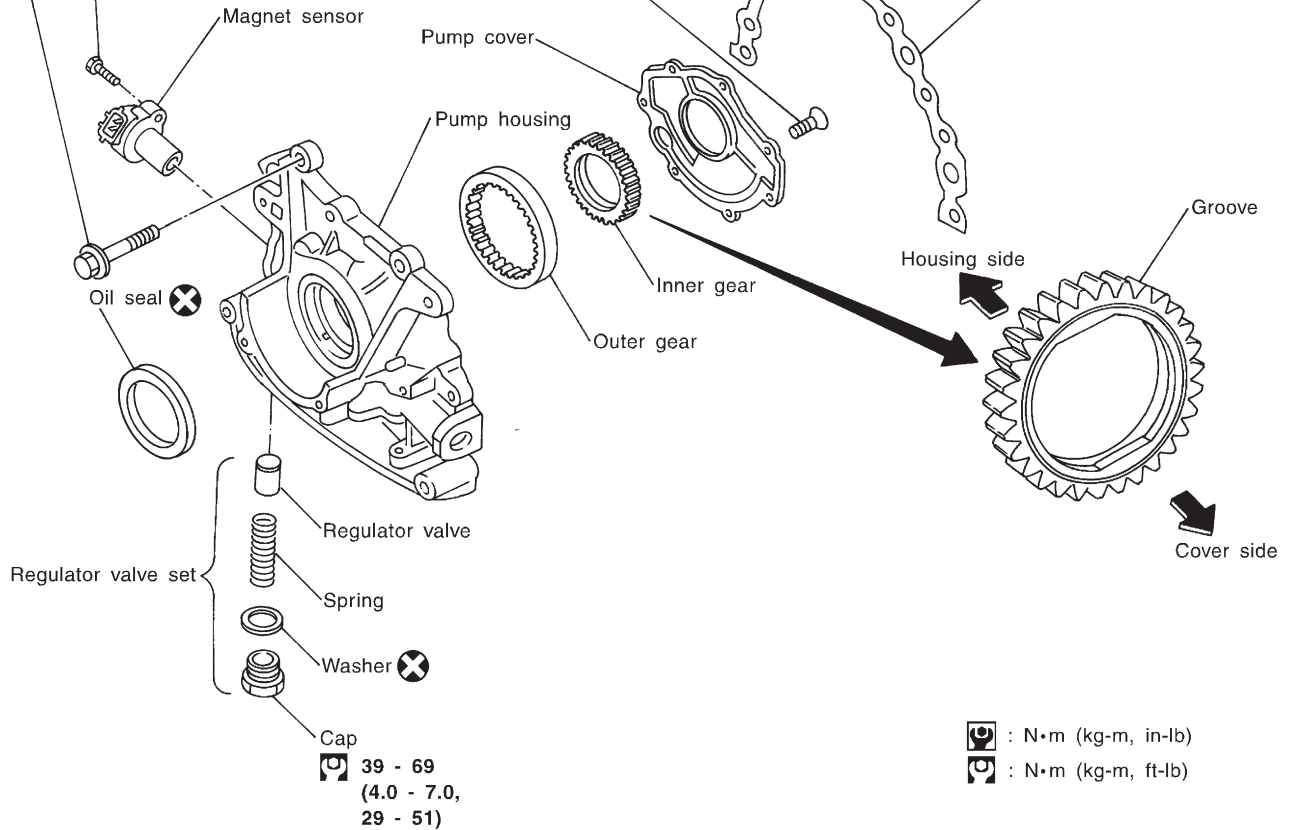
Oil Pump (Cont'd)

SEC. 150

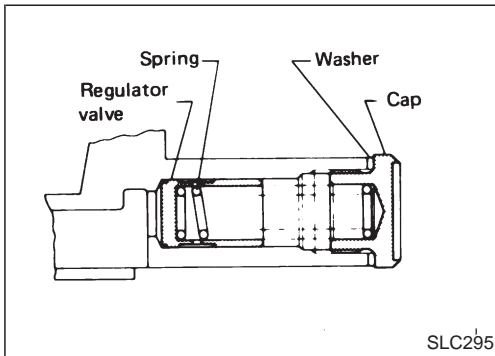
10 - 12 (1.0 - 1.2, 87 - 104)

9.2 - 11 (0.94 - 1.1, 81.6 - 95.5)

Screw
 4 - 5
(0.4 - 0.5, 35 - 43)



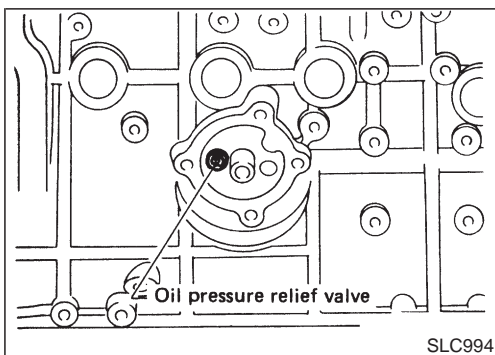
SLC195B



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 to make sure that it falls smoothly into the valve hole by its own weight.

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



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 a screwdriver. Install a new valve in place by tapping it.

ENGINE LUBRICATION SYSTEM

Oil Pump (Cont'd)

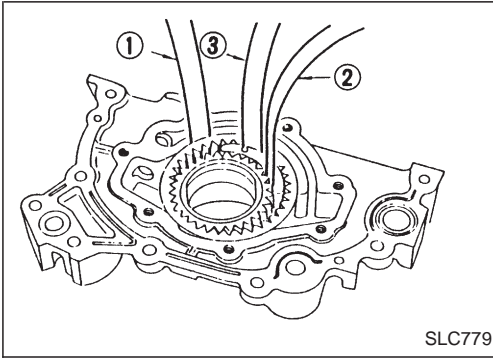
OIL PUMP INSPECTION

Using a feeler gauge, check the following clearance.

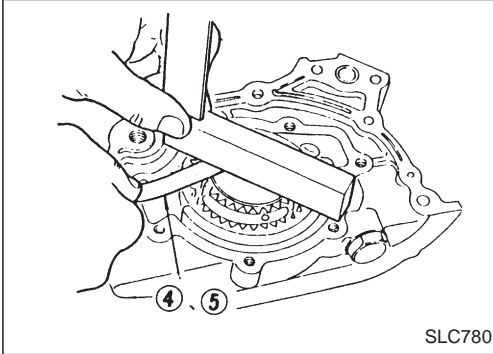
Unit: mm (in)

Body to outer gear clearance ①	0.11 - 0.20 (0.0043 - 0.0079)
Inner gear to crescent clearance ②	0.216 - 0.326 (0.0085 - 0.0128)
Outer gear to crescent clearance ③	0.21 - 0.32 (0.0083 - 0.0126)
Housing to inner gear clearance ④	0.05 - 0.09 (0.0020 - 0.0035)
Housing to outer gear clearance ⑤	0.05 - 0.11 (0.0020 - 0.0043)
Inner gear to brazed portion of housing clearance ⑥ = A - B	0.106 - 0.152 (0.0042 - 0.0060)

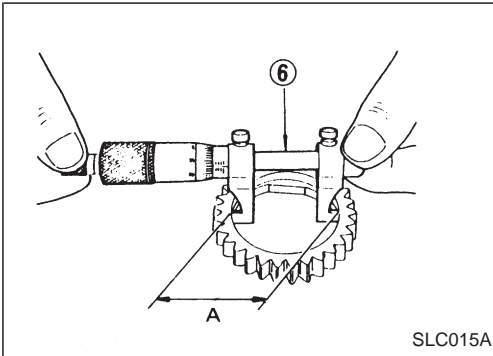
If it exceeds the limit, replace gear set or entire oil pump assembly.



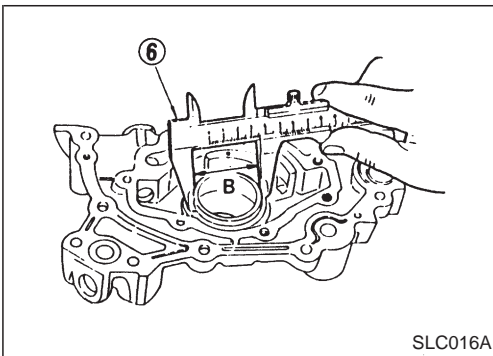
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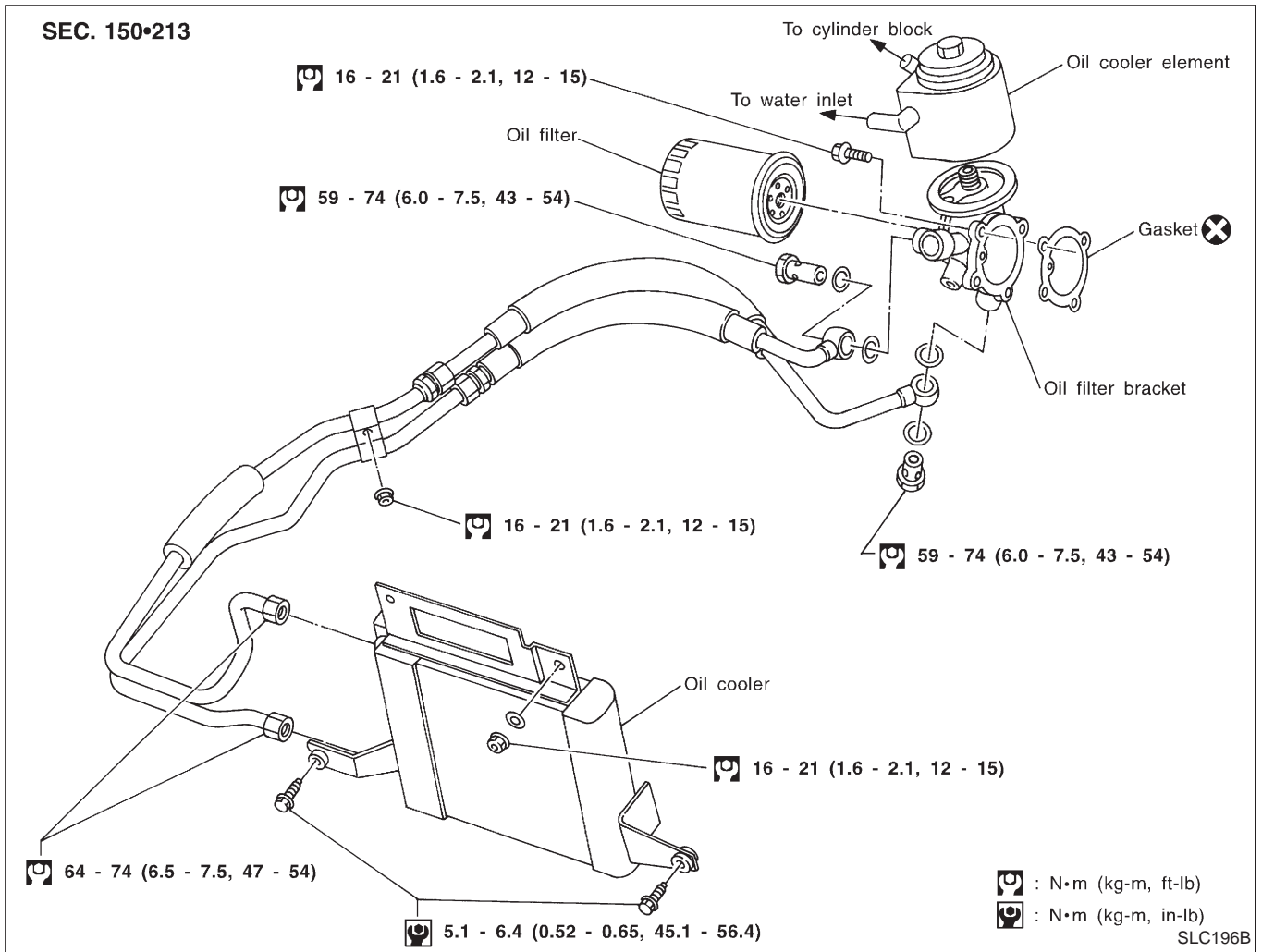
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ENGINE LUBRICATION SYSTEM

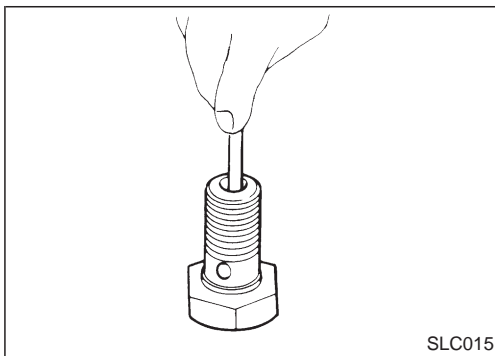
Oil Cooler REMOVAL AND INSTALLATION



Install oil cooler as shown in the figure.

INSPECTION

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



Oil Jet

INSPECTION

1. Push cut-off valve of oil jet bolt with a clean resin or brass rod and make sure that cut-off valve moves smoothly with proper repulsion.
2. Make sure that the oil jet passage is not clogged. Clean with a wire if necessary.

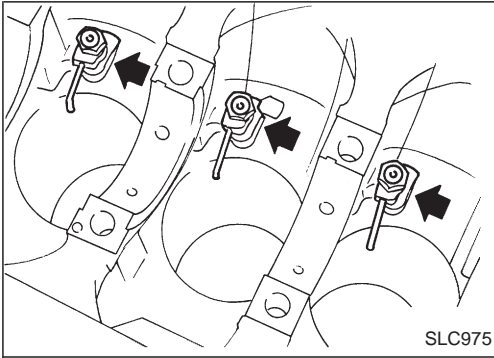
ENGINE LUBRICATION SYSTEM

Oil Jet (Cont'd)

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

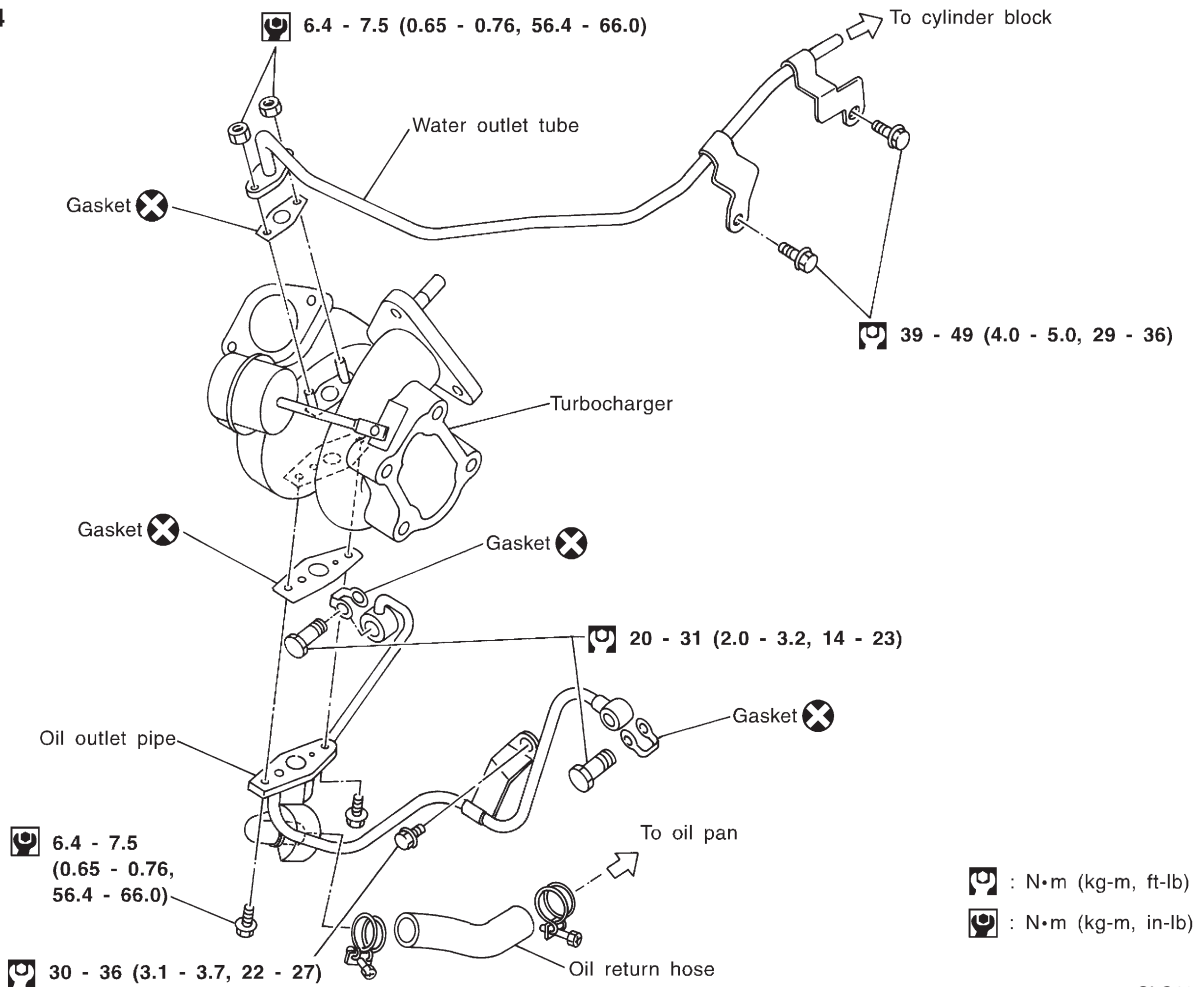
Oil jet bolt:

: 30 - 40 N·m (3.1 - 4.1 kg-m, 22 - 30 ft-lb)



Turbocharger

SEC. 144

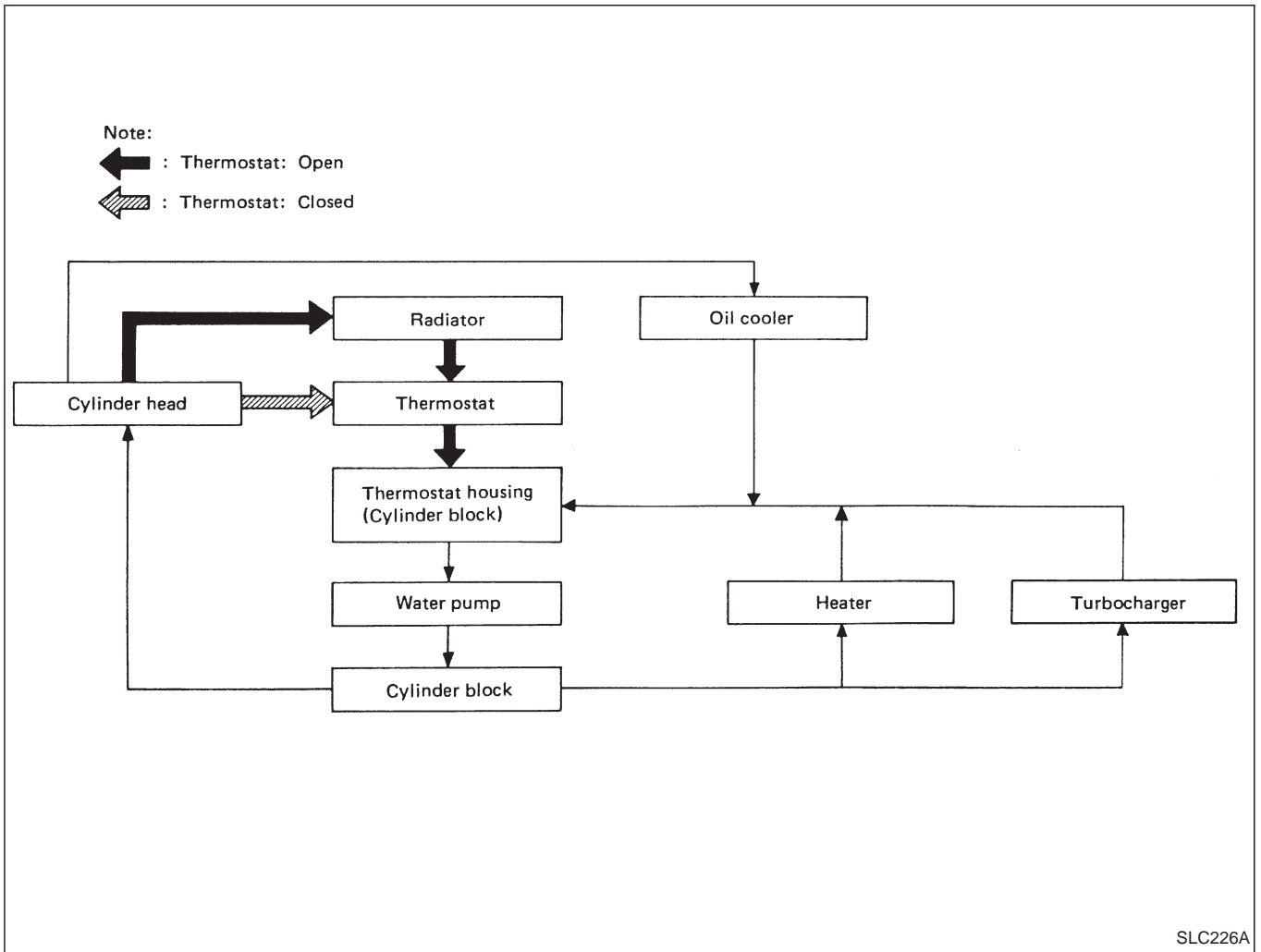


SLC197B

- Before removing water tube, drain coolant first.
- Be careful not to deform tubes.
- After installation, run engine for a few minutes, and check for oil leakage.

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 cap and carefully loosen it a quarter turn to release built-up pressure. Then remove the cap completely.

CHECKING COOLING SYSTEM HOSES

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

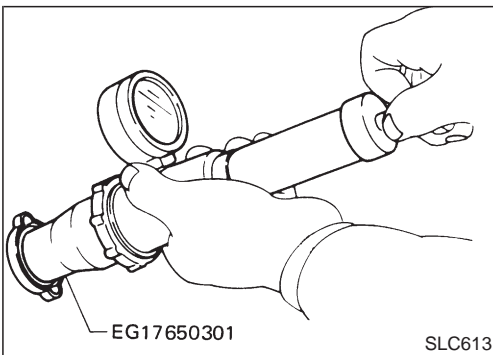
CHECKING RADIATOR CAP

Apply pressure to radiator cap by means of a cap tester to see if it is satisfactory.

Radiator cap relief pressure:

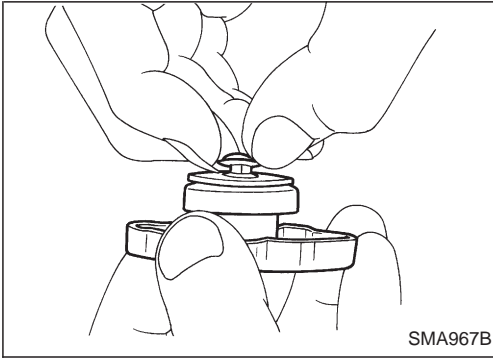
78 - 98 kPa

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



ENGINE COOLING SYSTEM

System Check (Cont'd)



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

CHECKING COOLING SYSTEM FOR LEAKS

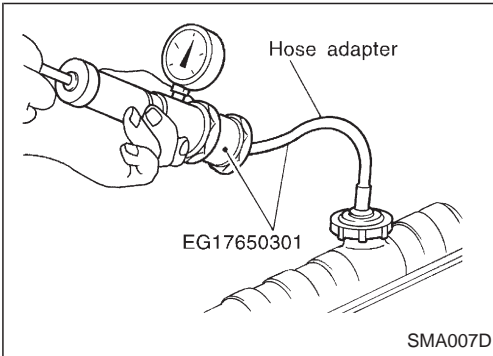
Apply pressure to the cooling system by means of a tester to check for leakage.

Testing pressure:

98 kPa (0.98 bar, 1.0 kg/cm², 14 psi)

CAUTION:

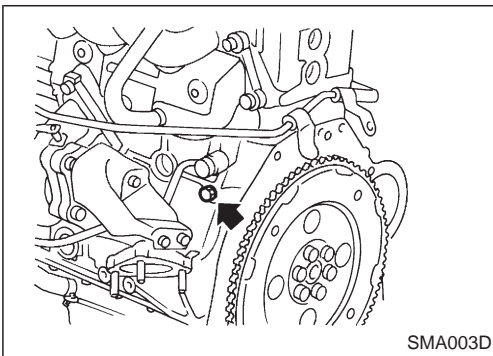
Use of pressure higher than the specified value may cause damage to radiator.




Water Pump

CAUTION:

- When removing water pump assembly, be careful not to get coolant on drive belts.
- 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.

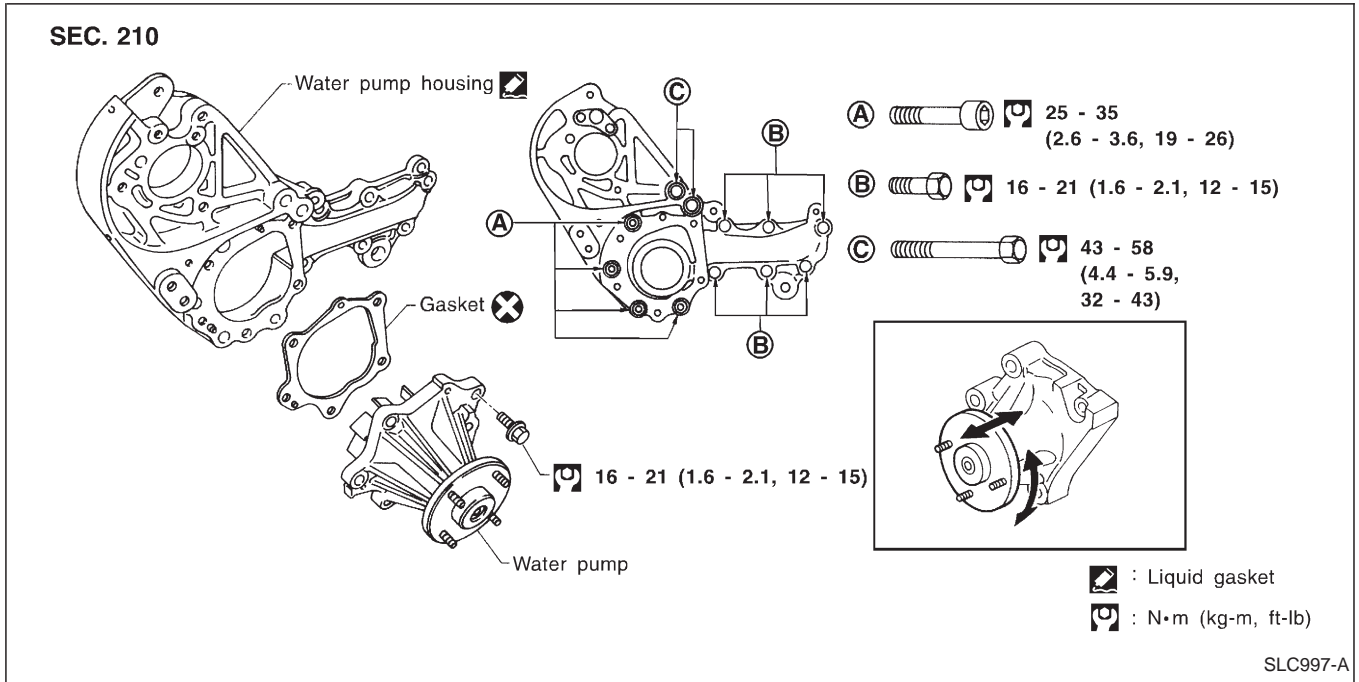


REMOVAL

1. Drain coolant from radiator and cylinder block.
Cylinder block drain plug (Use proper sealant):
: 34 - 44 N·m (3.5 - 4.5 kg-m, 25 - 33 ft-lb)
Refer to MA section ("Changing Engine Coolant", "ENGINE MAINTENANCE").
2. Remove radiator shroud.
3. Remove drive belts. Refer to MA section ("Checking Drive Belts").
4. Remove fan coupling with fan.
5. Remove water pump.

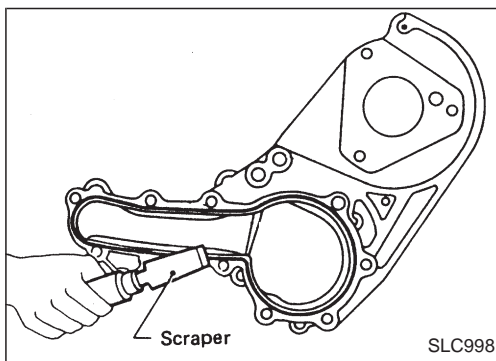
ENGINE COOLING SYSTEM

Water Pump (Cont'd)



INSPECTION

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

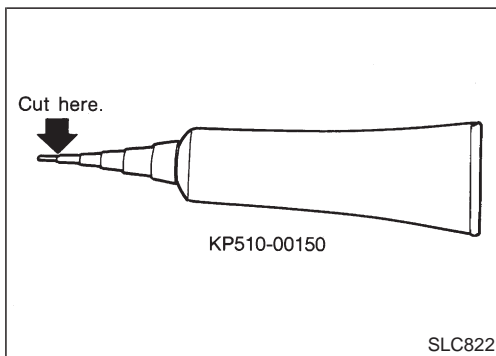


INSTALLATION

- Remove liquid gasket from mating surface of pump housing using a scraper.

Be sure liquid gasket in grooves is also removed.

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

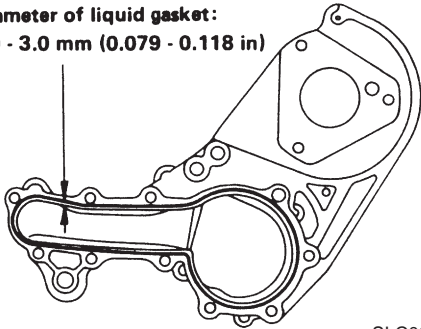


- Cut off tip of nozzle of liquid gasket tube at point shown in figure.
- **Use Genuine Liquid Gasket or equivalent.**

ENGINE COOLING SYSTEM

Water Pump (Cont'd)

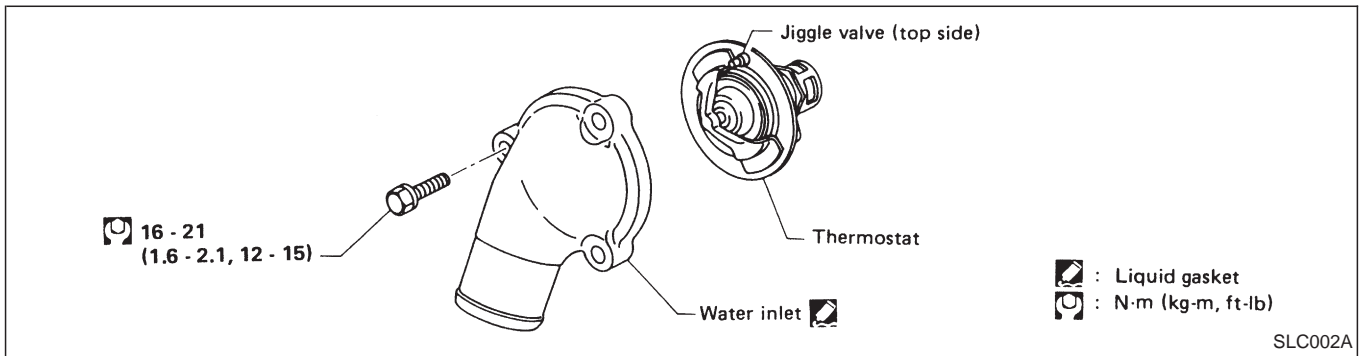
Diameter of liquid gasket:
2.0 - 3.0 mm (0.079 - 0.118 in)



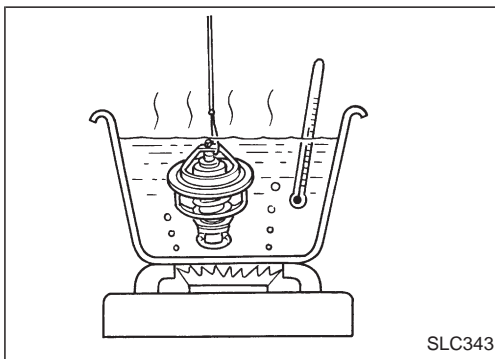
SLC001A

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

Thermostat



SLC002A



SLC343

INSPECTION

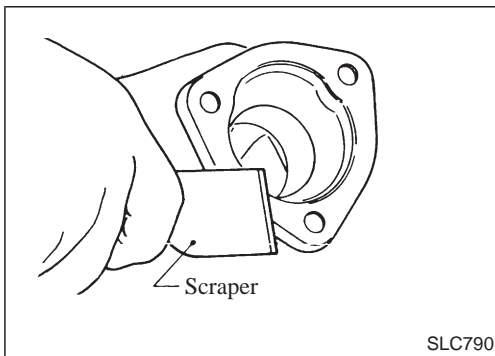
1. Check valve seating condition at ordinary temperatures. It should seat tightly.
2. Check valve opening temperature and maximum valve lift.

Valve opening temperature	C° (°F)	82.0 (180)
Maximum valve lift	mm/°C (in/°F)	10/90 (0.39/194)

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

INSTALLATION

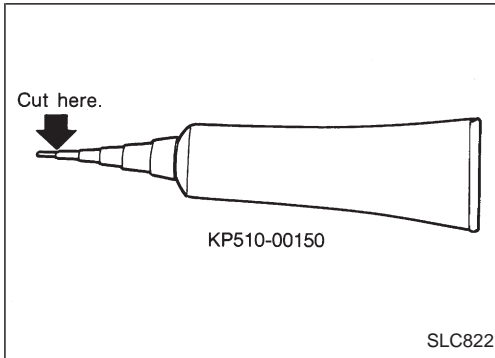
- Remove liquid gasket from mating surface of thermostat using a scraper.
- Similarly, remove liquid gasket from mating surface of cylinder block.
- Clean all traces of liquid gasket using white gasoline.



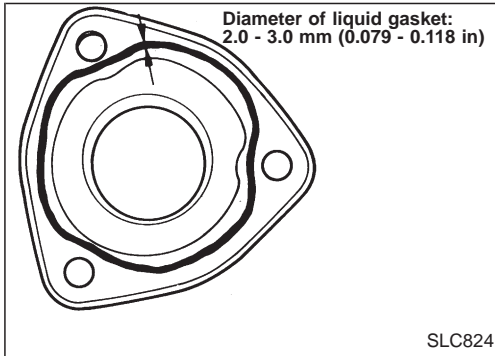
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ENGINE COOLING SYSTEM

Thermostat (Cont'd)



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



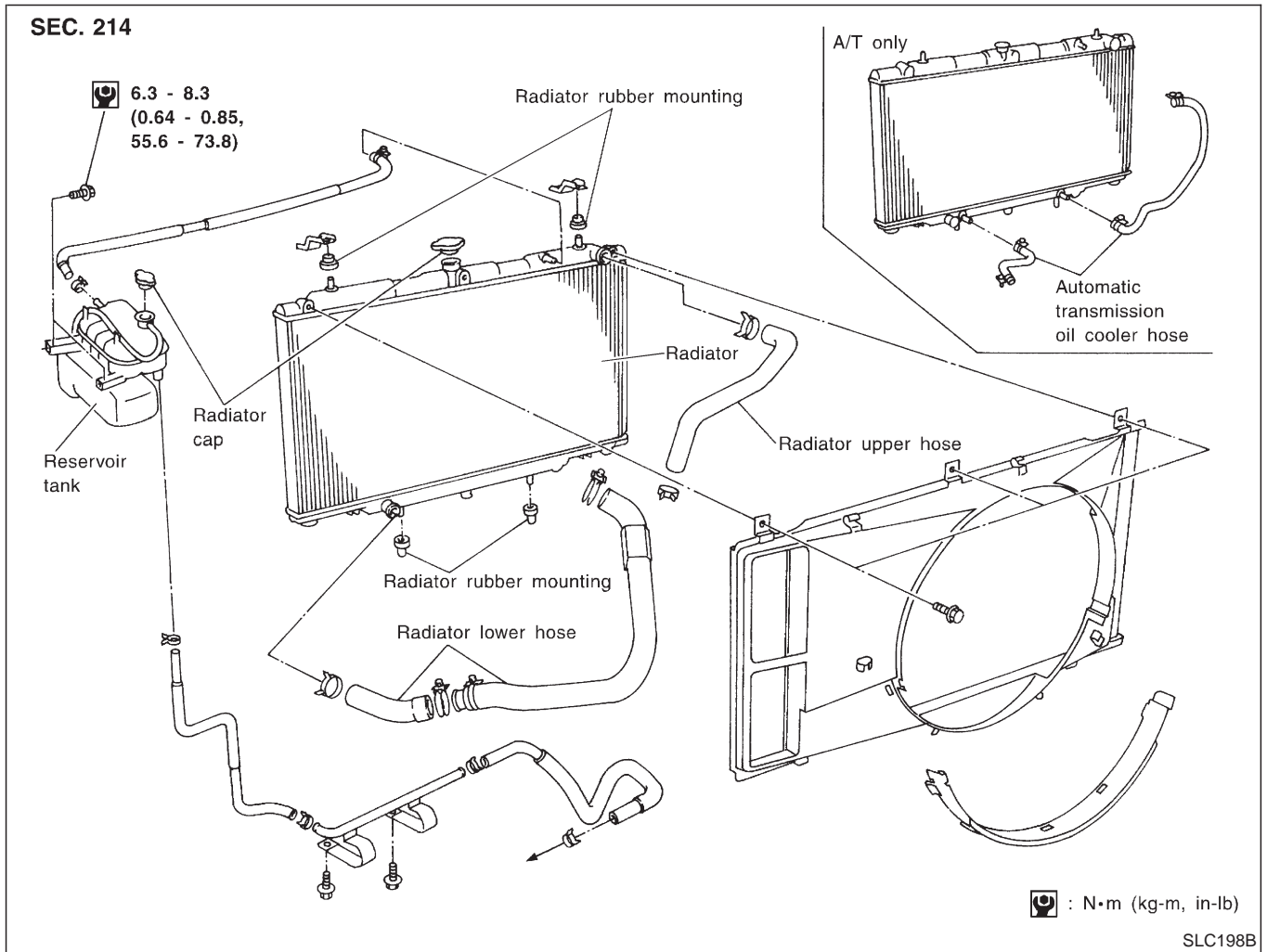
- Apply a continuous bead of liquid gasket to mating surface of water inlet.
 - a. Be sure diameter of liquid gasket is within 2.0 to 3.0 mm (0.079 to 0.118 in).
 - b. Attach water inlet to cylinder block within five minutes after applying liquid gasket.
 - c. After installing water inlet, wait at least 30 minutes before refilling coolant and starting engine.

ENGINE COOLING SYSTEM

Radiator

REMOVAL AND INSTALLATION

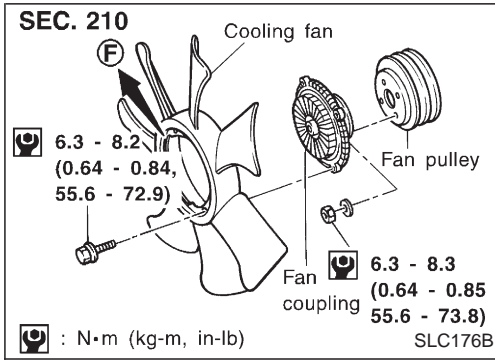
1. Remove under cover.
2. Drain coolant from radiator drain plug.
3. Disconnect radiator upper and lower hoses.
4. Remove radiator lower shroud.
5. Disconnect reservoir tank hose.
6. Remove radiator.
7. After repairing or replacing radiator, install any part removed in reverse order of removal.



Refilling Engine Coolant

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

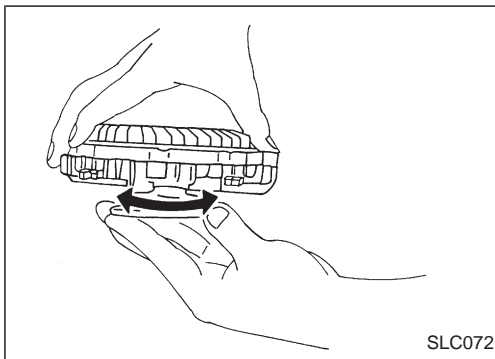
ENGINE COOLING SYSTEM



Cooling Fan (Crankshaft driven)

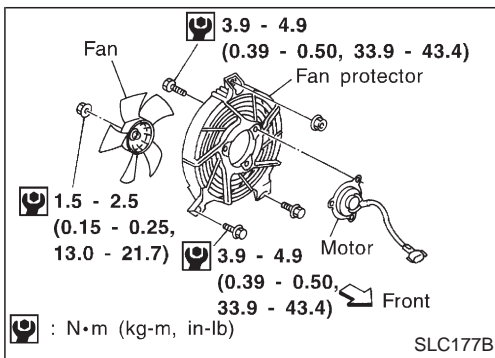
DISASSEMBLY AND INSTALLATION

- Do not release the drive belt tension by removing the fan/water pump pulley.
- 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 damage, oil leakage and bent bimetal.



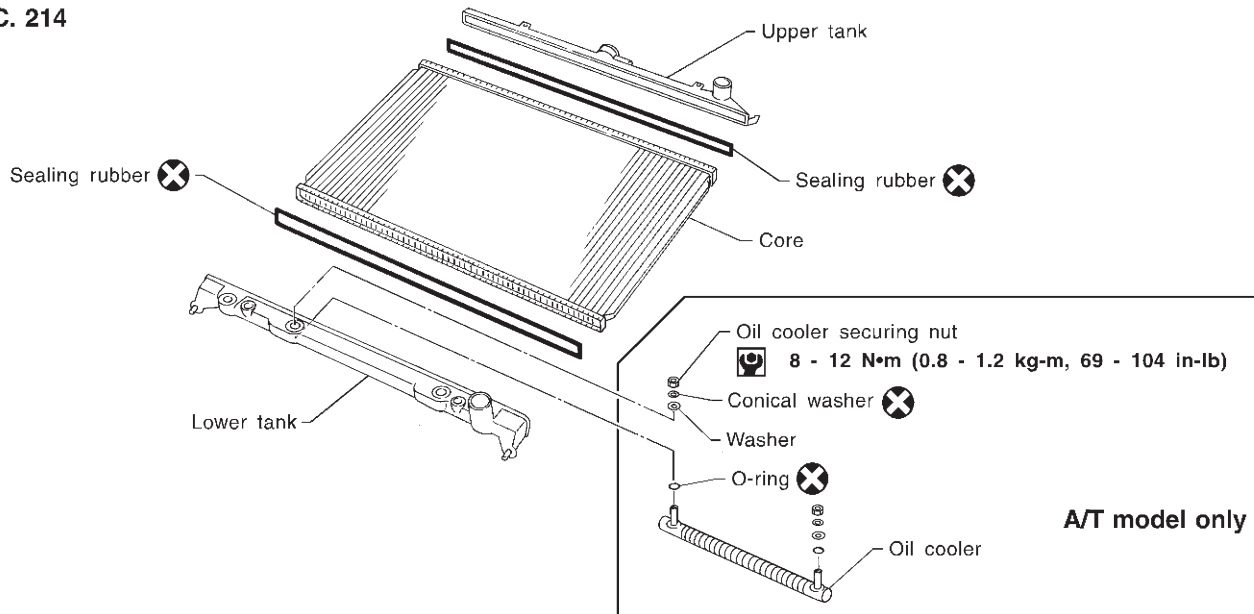
Cooling Fan (Motor driven)

Cooling fan is controlled by ECM. For details, refer to "Cooling Fan", "TROUBLE DIAGNOSIS FOR DTC 28" in EC section.

ENGINE COOLING SYSTEM

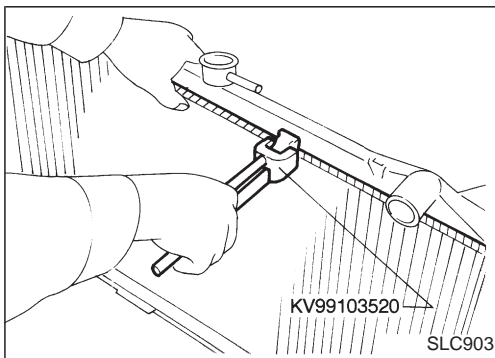
Radiator (Aluminum type)

SEC. 214



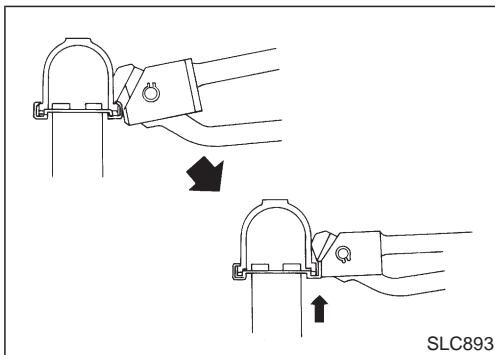
SLC882AB

Aluminum radiator can be disassembled by using special procedures and special service tools.



DISASSEMBLY

1. Remove tank with Tool.



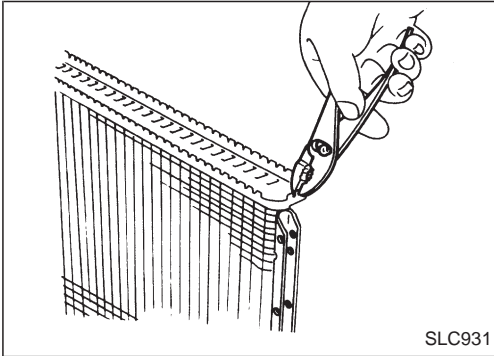
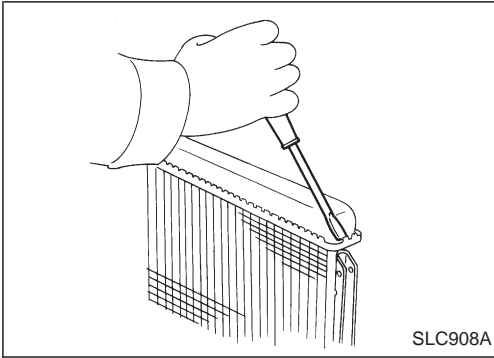
- Grip the crimped edge and bend it upwards so that Tool slips off.
Do not bend excessively.

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.

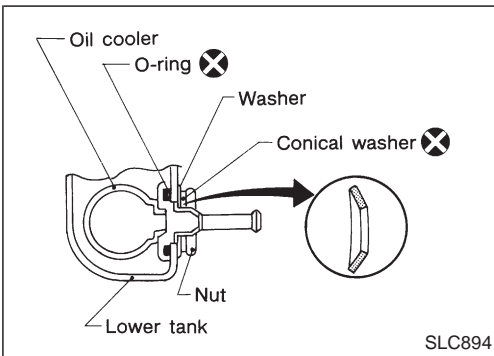


2. Make sure the edge stands straight up.
3. Remove oil cooler from tank. (A/T model only)

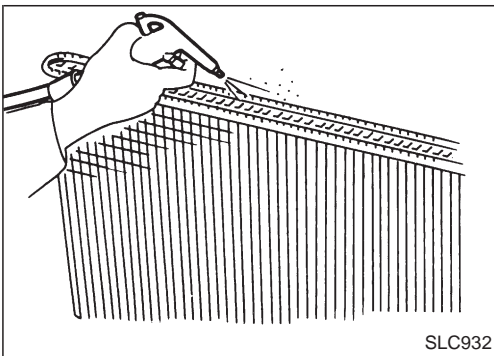
ASSEMBLY

1. Install oil cooler.

Pay attention to direction of conical washer.



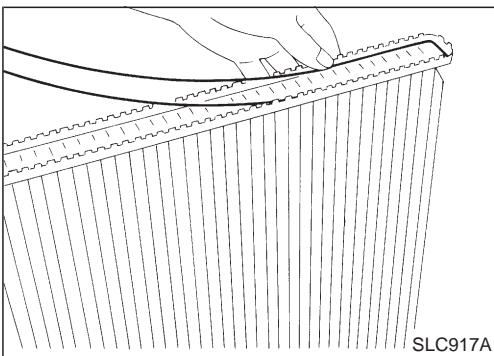
2. Clean contact portion of tank.



3. Install sealing rubber.

Push it in with fingers.

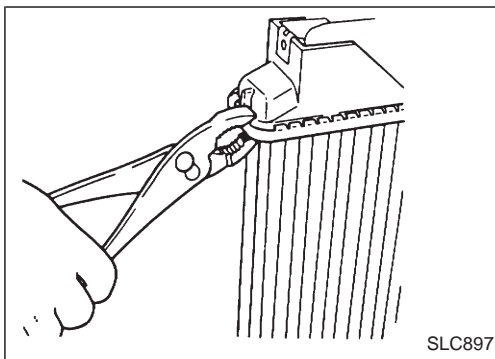
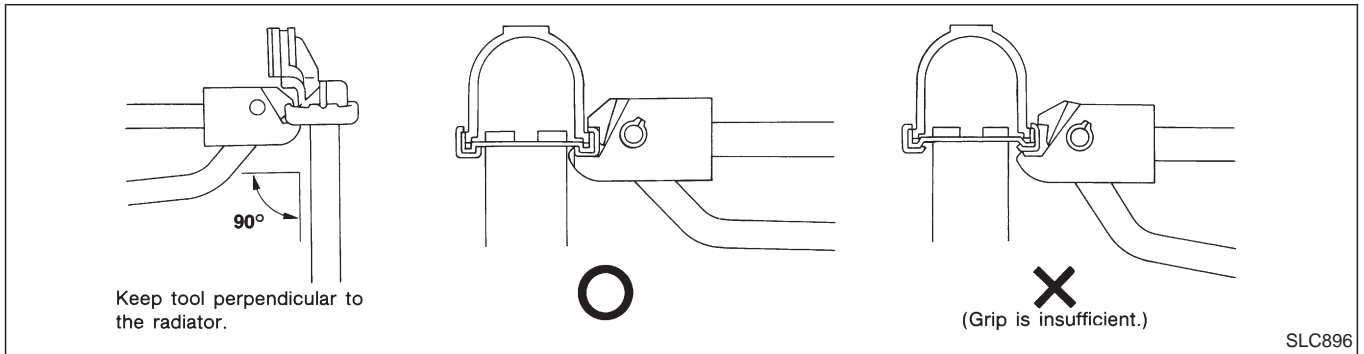
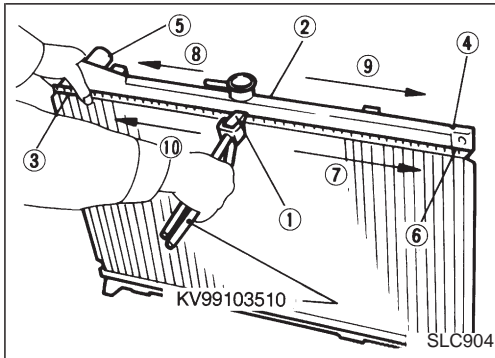
Be careful not to twist sealing rubber.



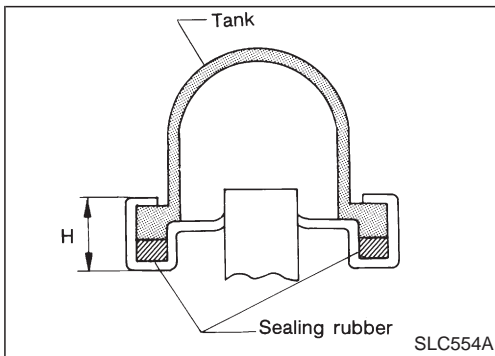
ENGINE COOLING SYSTEM

Radiator (Aluminum type) (Cont'd)

4. Caulk tank in 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":
10.0 - 11.0 mm (0.394 - 0.433 in)
6. Confirm that there is no leakage.
Refer to Inspection.

ENGINE COOLING SYSTEM

Radiator (Aluminum type) (Cont'd)

INSPECTION

1. Apply pressure with Tool.

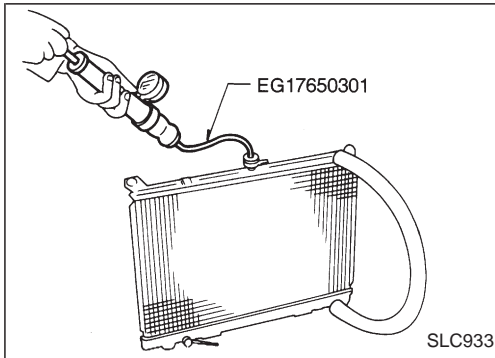
Specified pressure value:

98 kPa (0.98 bar, 1.0 kg/cm², 14 psi)

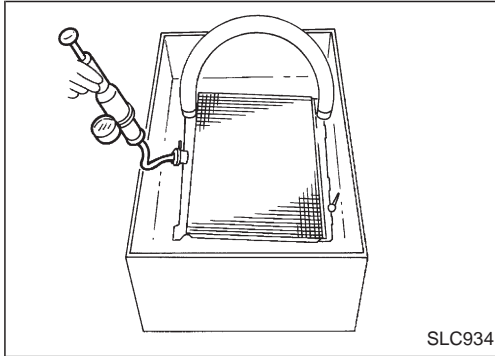
WARNING:

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.



SLC933



SLC934

2. Check for leakage.

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	—	—
		Fan coupling 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 rpm	Approximate discharge pressure kPa (bar, kg/cm ² , psi)
Idle speed 3,000	More than 78 (0.78, 0.8, 11) 318.7 - 424.6 (3.19 - 4.25, 3.25 - 4.33, 46.2 - 61.6)

Oil pump

Unit: mm (in)

Body to outer gear clearance ①	0.11 - 0.20 (0.0043 - 0.0079)
Inner gear to crescent clearance ②	0.216 - 0.326 (0.0085 - 0.0128)
Outer gear to crescent clearance ③	0.21 - 0.32 (0.0083 - 0.0126)
Housing to inner gear clearance ④	0.05 - 0.09 (0.0020 - 0.0035)
Housing to outer gear clearance ⑤	0.05 - 0.11 (0.0020 - 0.0043)
Inner gear to brazed portion of housing clearance ⑥	0.106 - 0.152 (0.0042 - 0.0060)

Engine Cooling System

Thermostat

Valve opening temperature	C° (°F)	82.0 (180)
Maximum valve lift	mm/°C (in/°F)	10/95 (0.39/203)

Radiator

Unit: kPa (bar, kg/cm², psi)

Cap relief pressure	78 - 98 (0.78 - 0.98, 0.8 - 1.0, 11 - 14)
Leakage test pressure	157 (1.57, 1.6, 23)