ENGINE LUBRICATION & COOLING SYSTEMS

SECTION LC

MODIFICATION NOTICE:

- Wiring diagrams have been changed for KA24DE and QD & TD engine models.
- VG33E engine has been introduced for Australia.
- A/T models with QD32 engine have been introduced for Latin America. For information not included here, refer to information for QD32 engine in D22 series Supplement-II Service Manual (Pub. No. SM9E-D22BG0).

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VG33E

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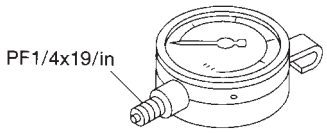
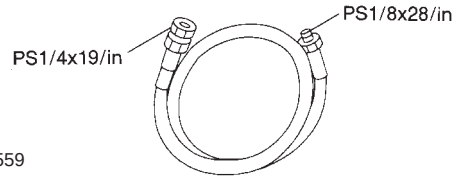
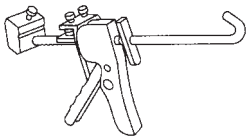
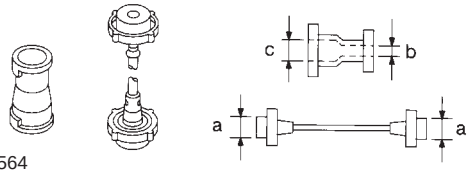
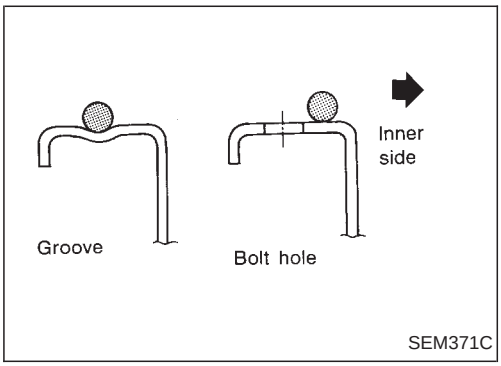
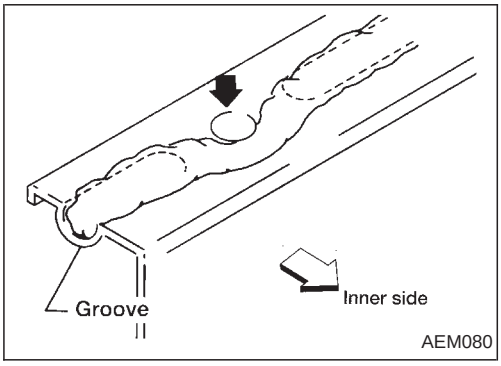
Special Service Tools

Tool number Tool name	Description	
ST25051001 Oil pressure gauge	 NT558	Measuring oil pressure **Maximum measuring range:** **2,452 kPa (24.5 bar, 25 kg/cm^2, 356 psi)**
ST25052000 Hose	 NT559	Adapting oil pressure gauge to cylinder block
WS39930000 Tube presser	 NT052	Pressing the tube of liquid gasket
EG17650301 Radiator cap tester adapter	 NT564	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)





Liquid Gasket Application Procedure

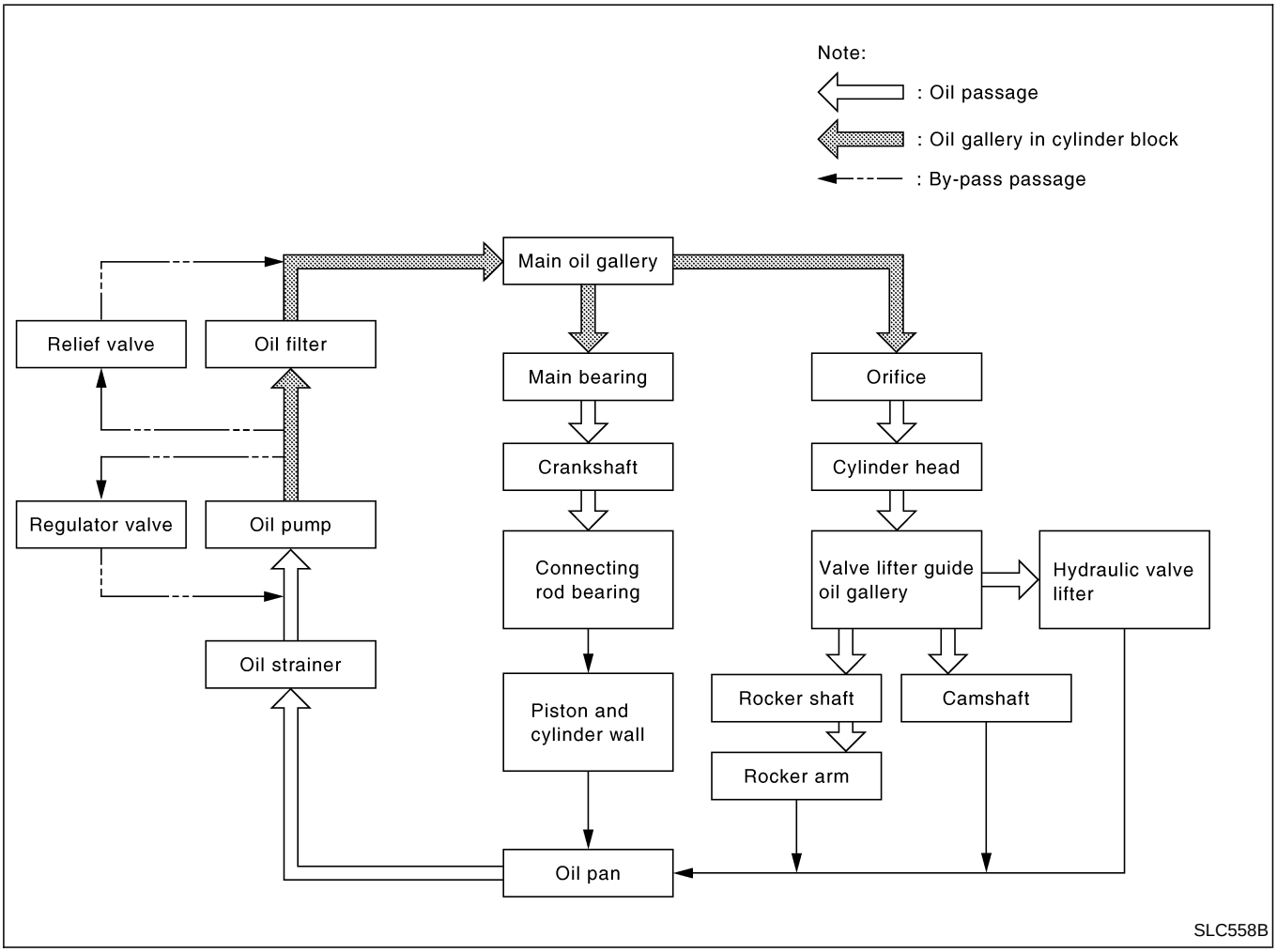
a. Use a scraper to remove all traces of old liquid gasket from mating surfaces and grooves. Also completely clean any oil stains from these portions.

b. 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).**

c. Apply liquid gasket to inner sealing surface around hole perimeter area.
(Assembly should be done within 5 minutes after coating.)

d. Wait at least 30 minutes before refilling engine oil and engine coolant.

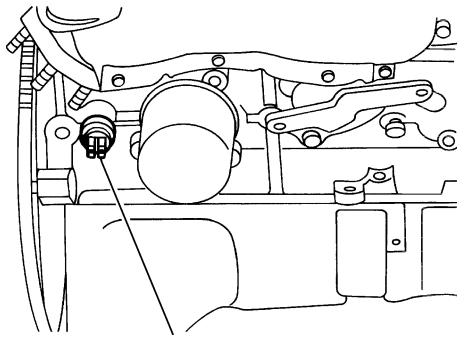
Lubrication Circuit



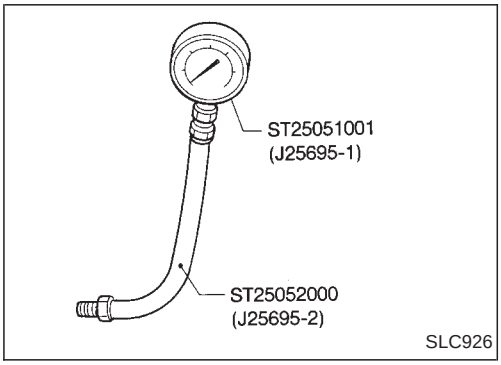
Oil Pressure Check

WARNING:

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



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



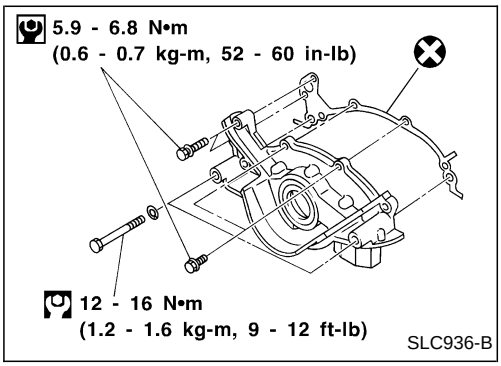
3. Install pressure gauge (SST).
4. Start engine and warm it up to normal operating temperature.
5. Check oil pressure with engine running under no-load.

Engine rpm	Approximate discharge pressure kPa (bar, kg/cm^2, psi)
Idle speed	More than 59 (0.59, 0.6, 9)
3,200	363 - 451 (3.63 - 4.51, 3.7 - 4.6, 53 - 65)

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

6. Install oil pressure switch with sealant.

Use genuine liquid gasket or equivalent.



Oil Pump

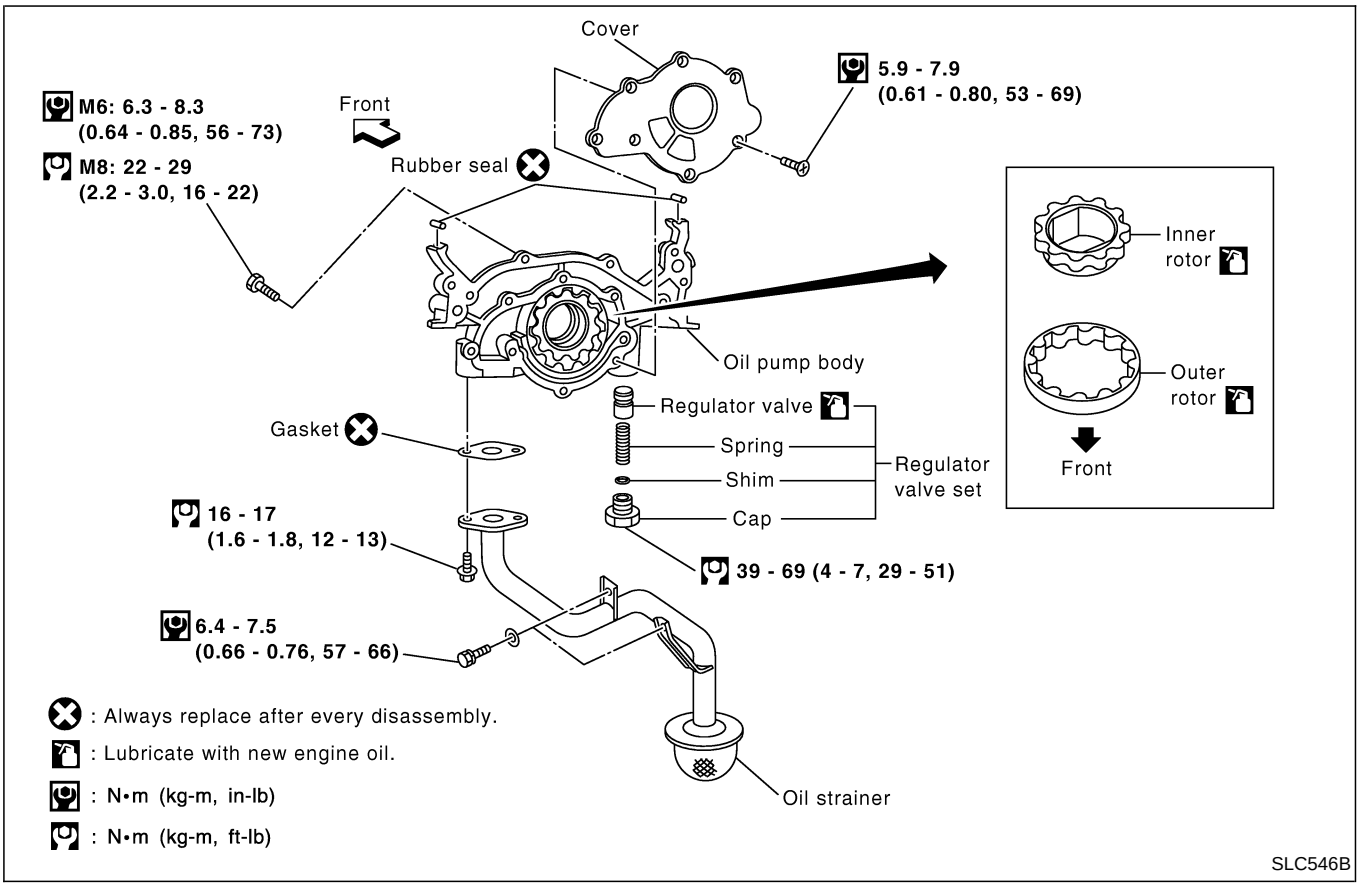
REMOVAL

1. Drain engine oil. Refer to “Changing Engine Oil” in MA section.
2. Drain engine coolant from drain plug on radiator. Refer to “Changing Engine Coolant” in MA section.
3. Remove air duct (from mass air flow sensor to throttle body).
4. Remove cooling fan. Refer to LC-15, “Cooling Fan”.
5. Remove radiator hoses (upper and lower) and fan shroud. Refer to LC-13, “Radiator”.
6. Remove drive belts. Refer to “Checking Drive Belts” in MA section.
7. Remove crankshaft pulley and front upper and lower belt covers. Refer to “TIMING BELT” in EM section.
8. Remove oil pan. Refer to “OIL PAN” in EM section.
9. Remove oil strainer.
10. Remove oil pump assembly.

INSTALLATION

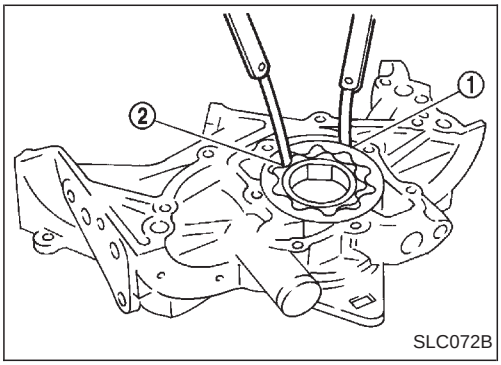
Install in the reverse order of removal.

DISASSEMBLY AND ASSEMBLY



- **Always replace with new oil seal and gasket.**
- **When installing oil pump, apply engine oil to inner and outer rotors.**

Oil Pump (Cont'd)

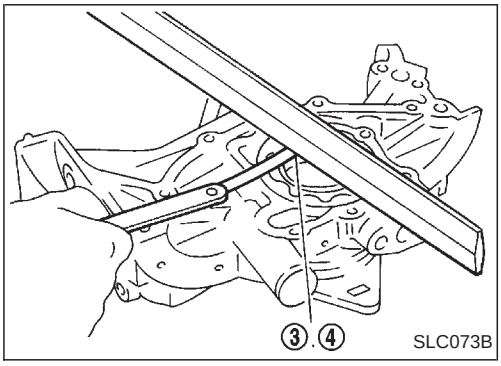


INSPECTION

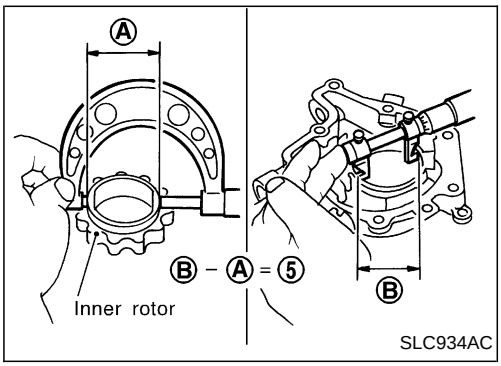
Using a feeler gauge, straightedge and micrometers, check the following clearance:

Unit: mm (in)

Body to outer rotor radial clearance ①	0.114 - 0.200 (0.0045 - 0.0079)
Inner rotor to outer rotor tip clearance ②	Below 0.18 (0.0071)
Body to inner rotor axial clearance ③	0.05 - 0.09 (0.0020 - 0.0035)
Body to outer rotor axial clearance ④	0.050 - 0.110 (0.0020 - 0.0043)
Inner rotor to brazed portion of housing clearance ⑤	0.045 - 0.091 (0.0018 - 0.0036)



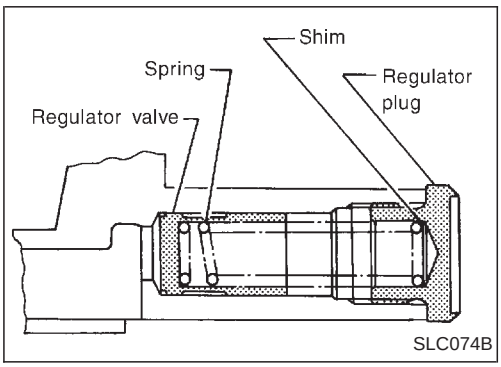
- **If the tip clearance (②) exceeds the limit, replace rotor set.**
- **If body to rotor clearance (① , ③ , ④ , ⑤) exceed the limit, replace oil pump body assembly.**



REGULATOR VALVE INSPECTION

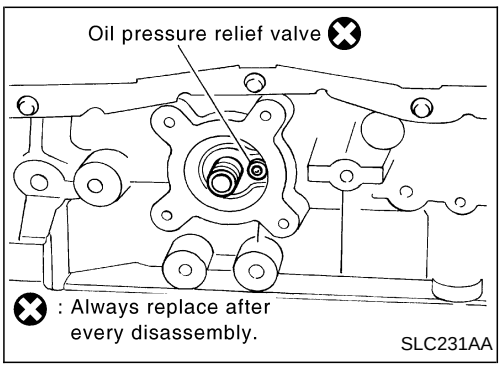
1. Visually inspect components for wear and damage.
2. Check oil pressure regulator valve sliding surface and valve spring.
3. Coat regulator valve with engine oil. Check that it falls smoothly into the valve hole by its own weight.

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

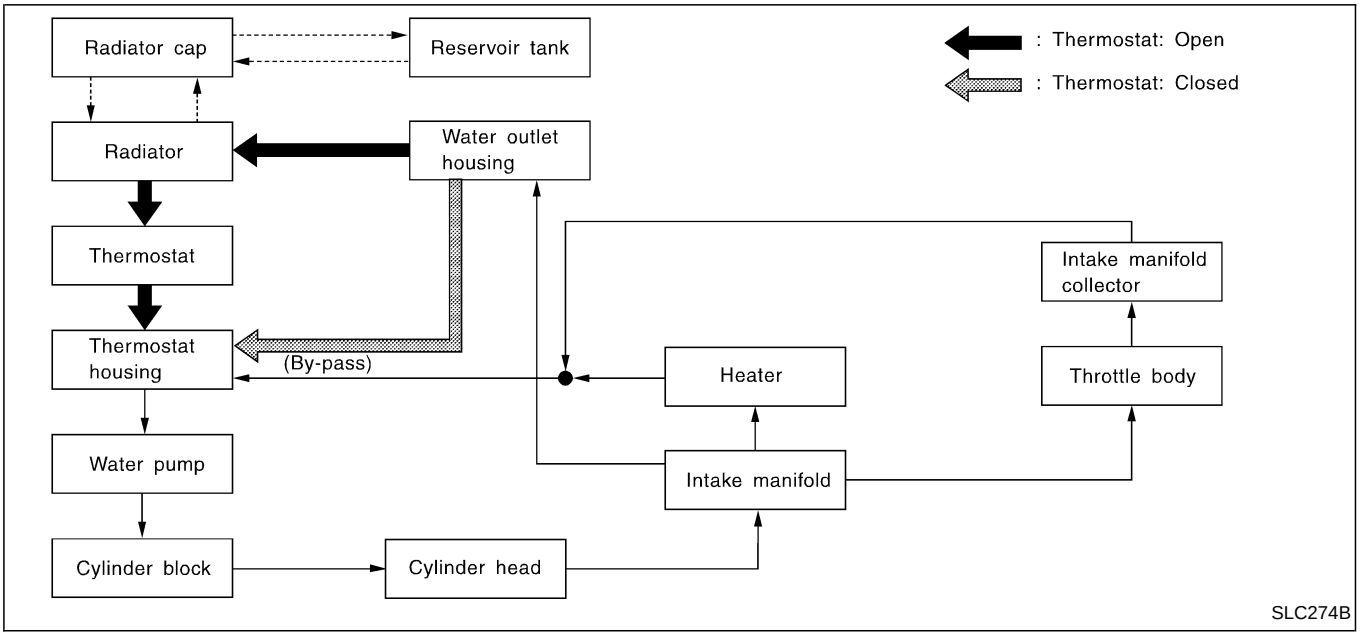


OIL PRESSURE RELIEF VALVE INSPECTION

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 suitable tool.
Install a new valve by tapping it.



Cooling Circuit



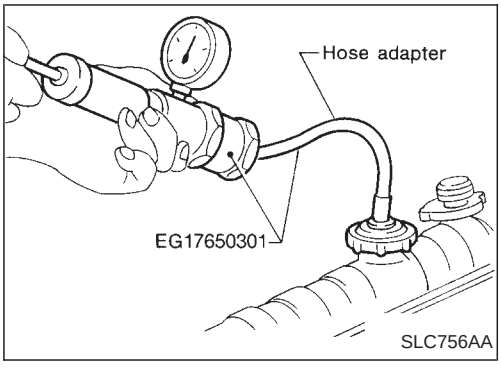
System Check

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 the cap by turning it a quarter turn to allow built-up pressure to escape. Then turn it all the way off.**

CHECKING COOLING SYSTEM HOSES

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



CHECKING COOLING SYSTEM FOR LEAKS

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

WARNING:

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

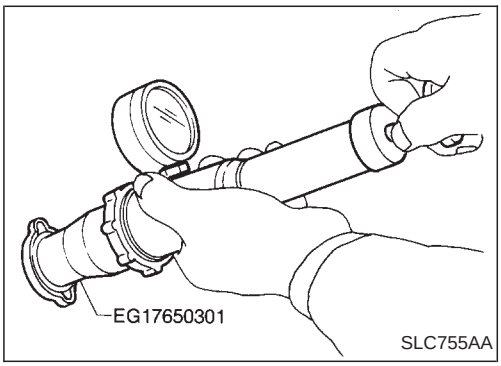
CAUTION:

Higher pressure than specified may cause radiator damage.

Testing pressure: 157 kPa (1.57 bar, 1.6 kg/cm^2, 23 psi)

System Check (Cont'd)

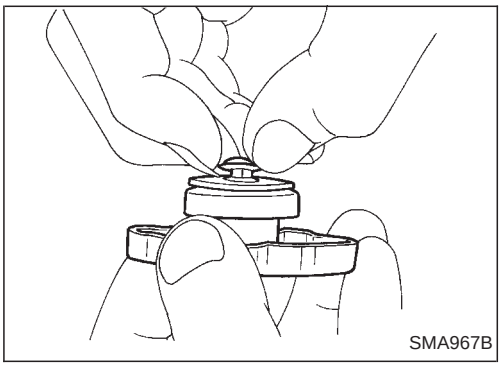
CHECKING RADIATOR CAP



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

   Radiator cap relief pressure:
   Standard
   78.4 - 98 kPa (0.78 - 0.98 bar, 0.8 - 1.0 kg/cm^2, 11 - 14 psi)

- When connecting the radiator cap to the tester, apply engine coolant to the cap seal part.
- Replace the radiator cap if there is an abnormality in the negative-pressure valve, or if the open-valve pressure is outside of the standard values.



2. Pull the negative pressure valve to open it.
   Make sure it closes completely when released.

- Make sure that there is no dirt or damage on the valve seat of the radiator cap negative-pressure valve.
- Make sure that there are no abnormalities in the opening and closing conditions of the negative-pressure valve.

CHECKING RADIATOR

Check radiator for mud or clogging. If necessary, clean radiator as follows.

- Be careful not to bend or damage the radiator fins.
- When radiator is cleaned without removal, remove all surrounding parts such as cooling fan, radiator shroud and horns.
- Tape the harness connectors to prevent water from entering.

1. Apply water by hose to the back side of the radiator core vertically downward.
2. Apply water again to all radiator core surfaces once per minute.
3. Stop washing when water flows clear coming out from the radiator.
4. Blow air into the back side of radiator core vertically downward.

- Use compressed air lower than 490 kPa (4.9 bar, 5 kg/cm^2, 71 psi) and keep the air hose end more than 30 cm (11.8 in) away from the core.

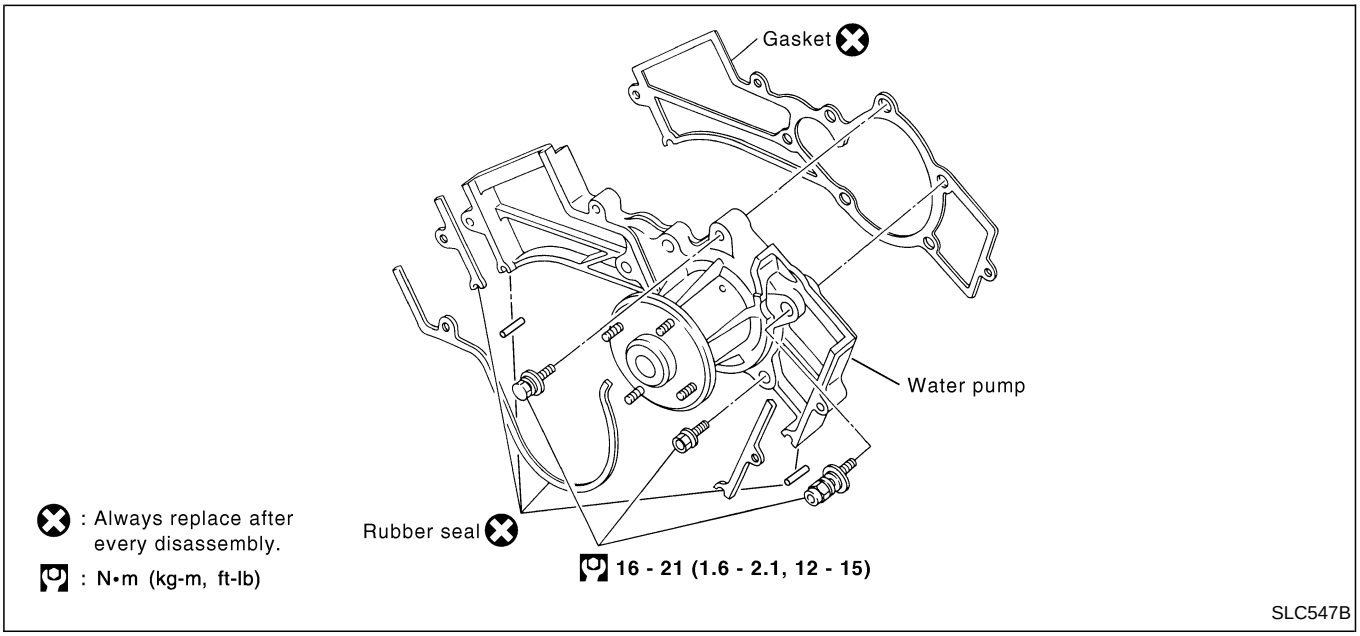
5. Blow air again into all the radiator core surfaces once per minute until no water blows out and the core is dry.

Refilling Engine Coolant

For details on refilling the engine cooling system, refer to "REFILLING ENGINE COOLANT" in MA section.

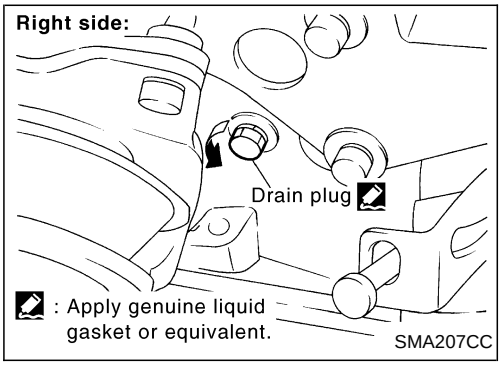
Water Pump

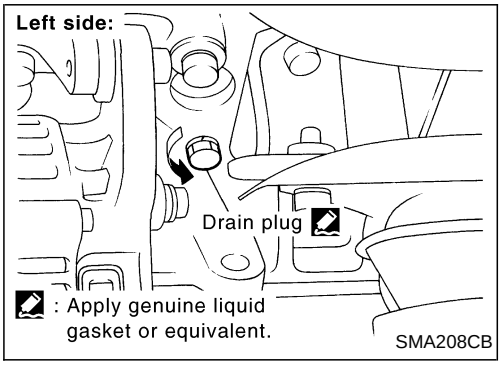
REMOVAL



CAUTION:

- **When removing water pump assembly, be careful not to get engine 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.**

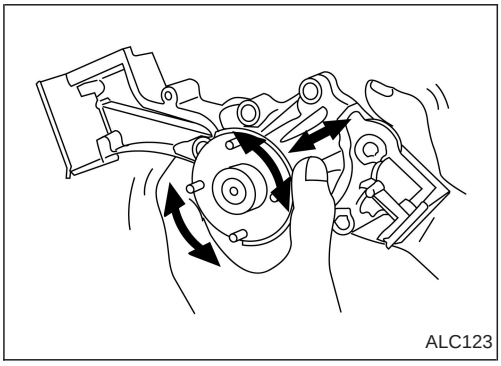




1. Drain engine coolant from drain plugs on both sides of cylinder block and radiator. Refer to “Changing Engine Coolant” in MA section.

Water Pump (Cont'd)

2. Remove radiator hoses (upper and lower) and fan shroud. Refer to LC-13, "Radiator".
3. Remove drive belts. Refer to "Checking Drive Belts" in MA section.
4. Remove water pump pulley.
5. Remove crankshaft pulley and front (upper and lower) belt cover. Refer to "TIMING BELT" in EM section.
6. Remove water pump.


ALC123

INSPECTION

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

INSTALLATION

1. Use a scraper to remove old gasket from water pump.
- **Also remove old gasket from mating surface of cylinder block.**
2. Install water pump with new gasket.
3. Install remaining parts in reverse order of removal.

CAUTION:

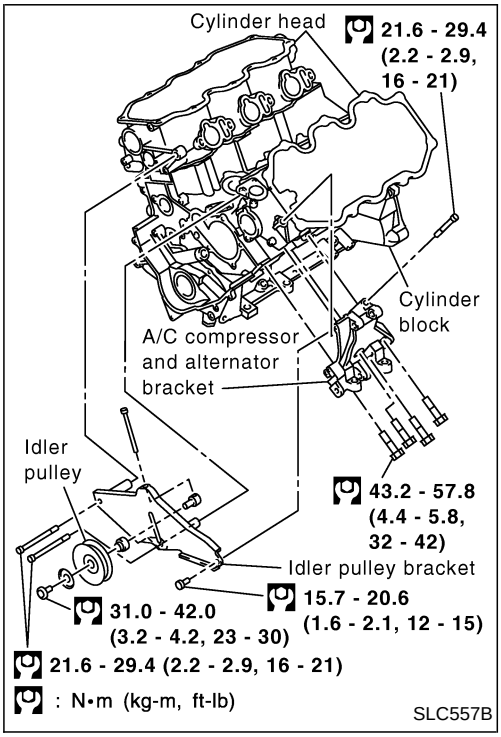
After installing the water pump, connect the hose and clamp securely, and then check for leaks using the radiator cap tester.

- **When installing drive belts, refer to "Checking Drive Belts" in MA section.**
- **When filling radiator with engine coolant, refer to "Changing Engine Coolant" in MA section.**

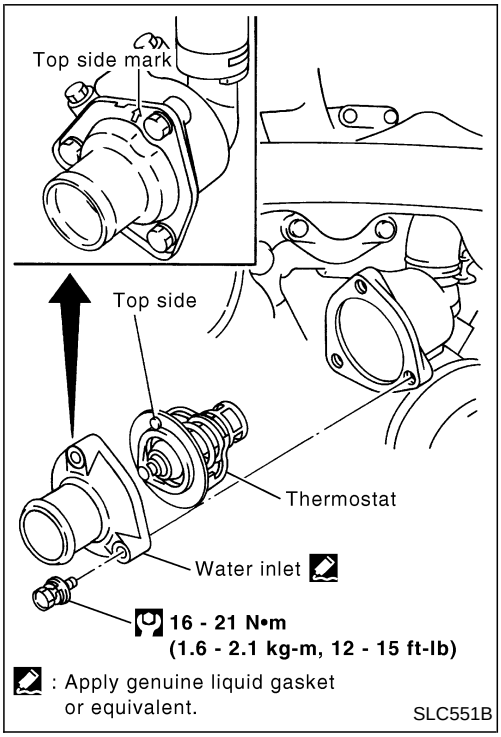
Thermostat

REMOVAL

1. Drain engine coolant from drain plug on radiator. Refer to “Changing Engine Coolant” in MA section.
2. Remove radiator hoses (upper and lower) and fan shroud.
3. Remove drive belts. Refer to “Checking Drive Belts” in MA section.



4. Remove idler pulley bracket.

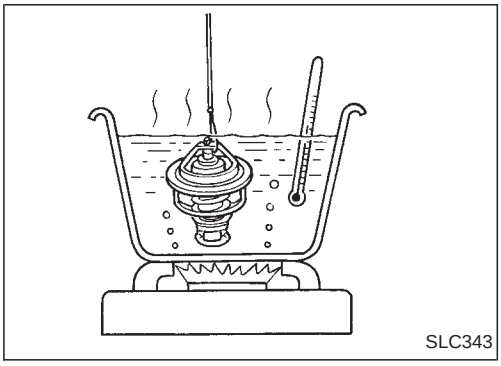


5. Remove water inlet and thermostat.

Thermostat (Cont'd)

INSPECTION

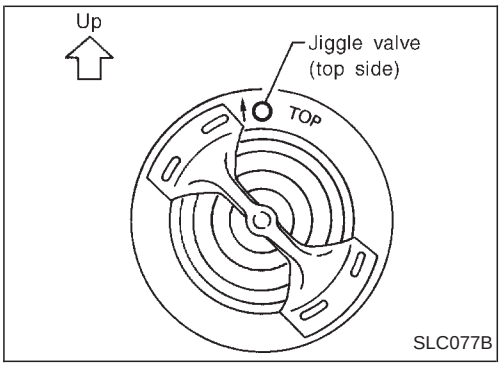
1. Check valve seating condition at ordinary temperatures. It should seat tightly.


SLC343

2. Check valve opening temperature and maximum valve lift.

		Standard
Valve opening temperature	°C (°F)	80 - 84 (176 - 183)
Maximum valve lift	mm/°C (in/°F)	More than 10/95 (0.39/203)

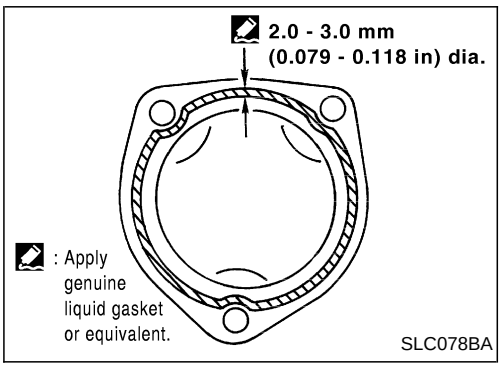
3. Then check if valve is closed at 5°C (9°F) below valve opening temperature.



SLC077B

INSTALLATION

1. Install thermostat with jiggle valve at upper side.



SLC078BA

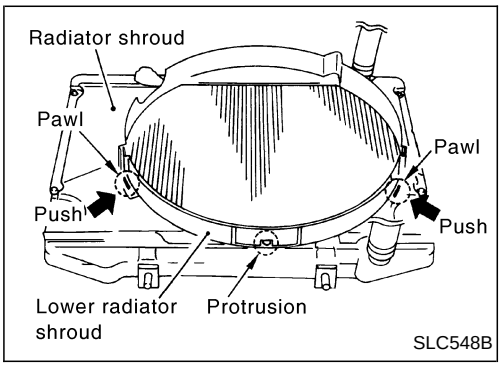
2. When installing water inlet apply liquid gasket as shown.
- **Use Genuine liquid gasket or equivalent.**
3. Install remaining parts in reverse order of removal.
- **After installation, run engine for a few minutes, and check for leaks.**
- **Be careful not to spill engine coolant over engine compartment. Use a rag to absorb engine coolant.**

Radiator

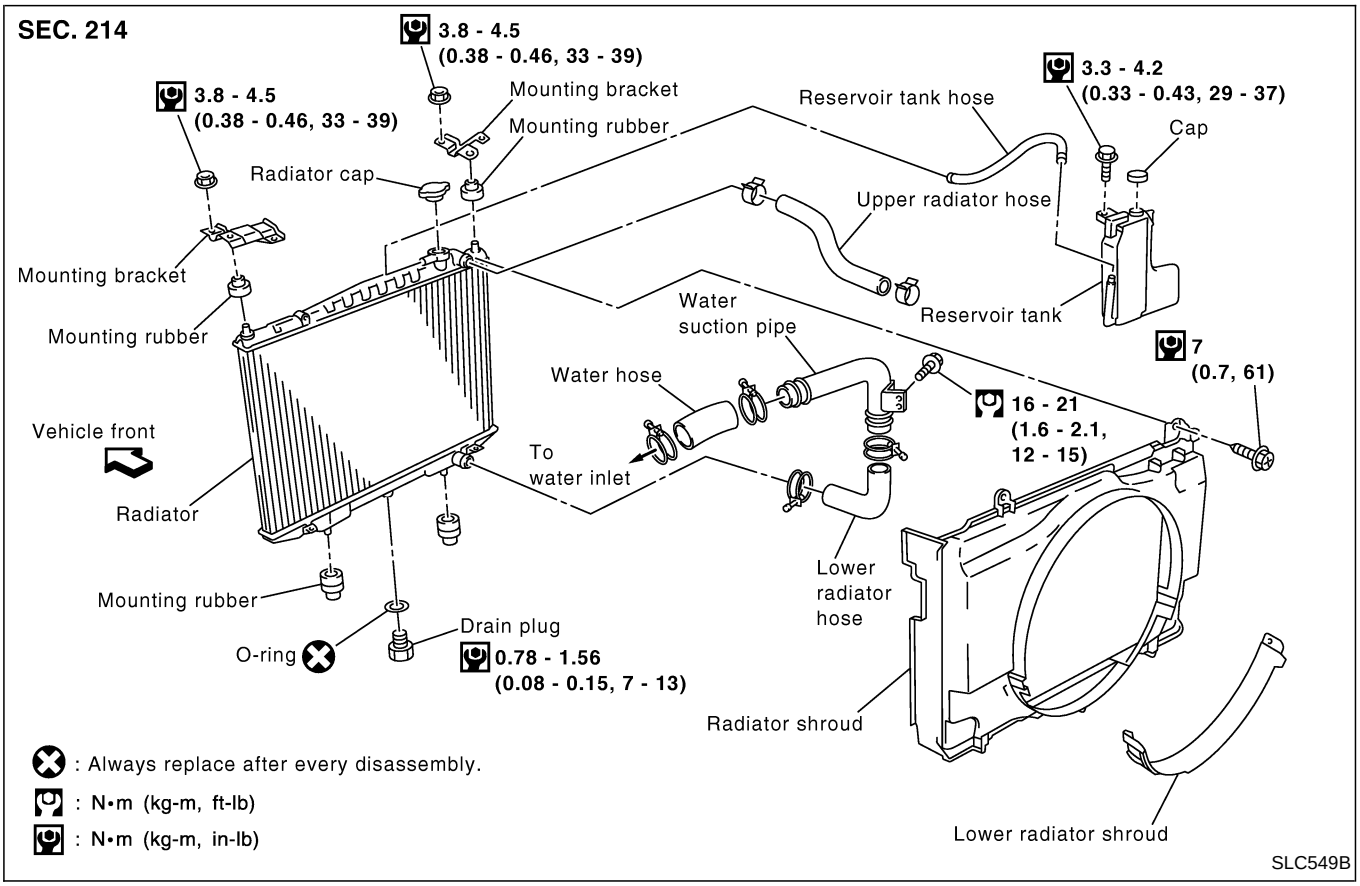
REMOVAL AND INSTALLATION

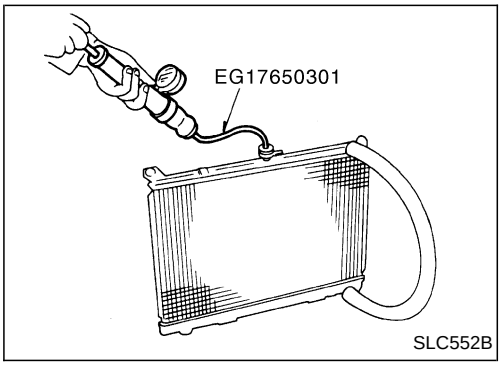
1. Remove undercover.
2. Drain engine coolant from radiator drain plug. Refer to "Changing Engine Coolant" in MA section.
3. Remove air duct (from mass air flow sensor to throttle body).
4. Disconnect radiator upper and lower hoses.

Radiator (Cont'd)



5. Remove radiator lower shroud.
- When removing the shroud, pull it out backward while pushing both the right and left pawls.
6. Disconnect reservoir tank hose.
7. Remove radiator.
8. After repairing or replacing radiator, install all removed parts in the reverse order of removal.
- When installing the shroud, align the center notch with the protrusion on the radiator shroud to insert both the right and left pawls.
9. Refill the engine cooling system. Refer to "Changing Engine Coolant" in MA section.
- After installation, run the engine until it reaches operating temperature and check the system for leaks.





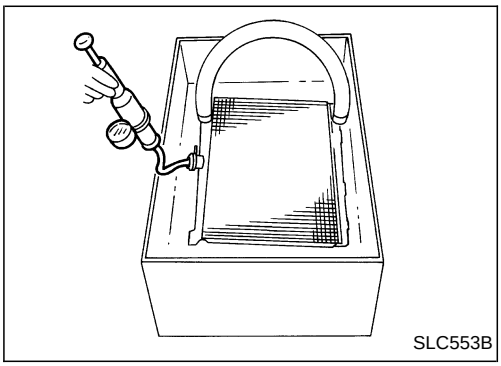
INSPECTION

1. Apply pressure with SST.
   Specified test pressure: 157 kPa (1.57 bar, 1.6 kg/cm^2, 23 psi)

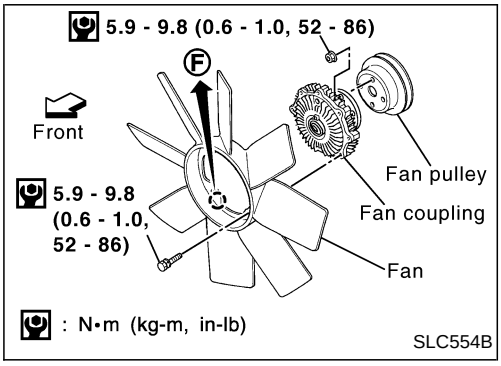
WARNING:

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

Radiator (Cont'd)


SLC553B

2. Check radiator for leaks in water tank by looking for bubbles.

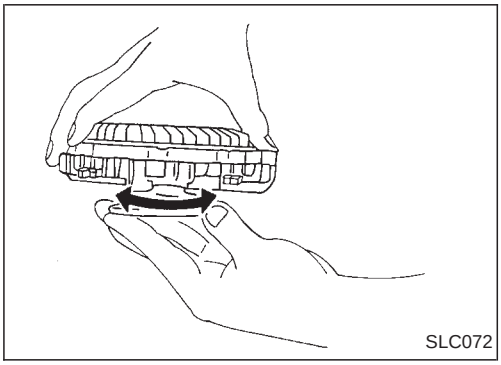


SLC554B

Cooling Fan (Crankshaft driven)

REMOVAL 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.

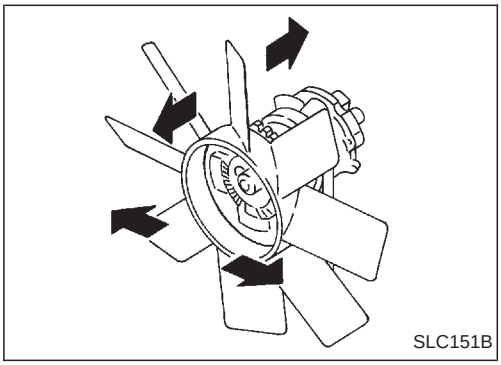

SLC072

INSPECTION

WARNING:

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

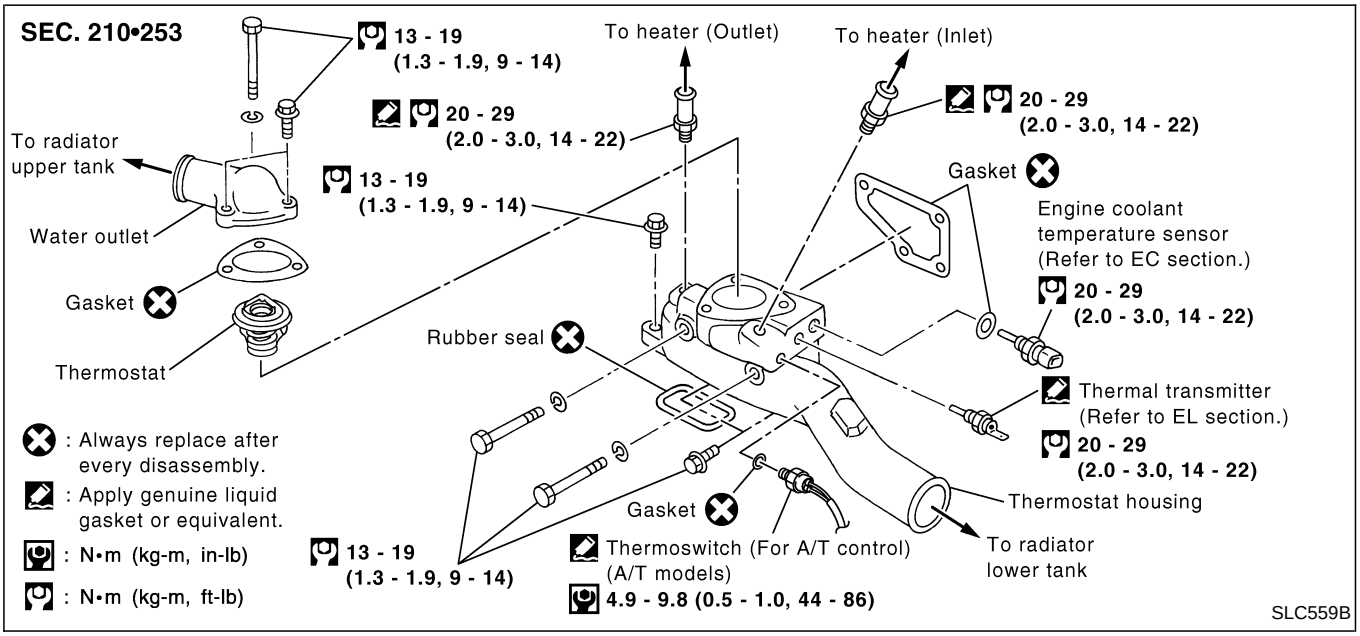
Check fan coupling for rough operation, wobbling, oil leakage or bent bimetal fins.


SLC151B

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

Technical Bulletin

Thermostat

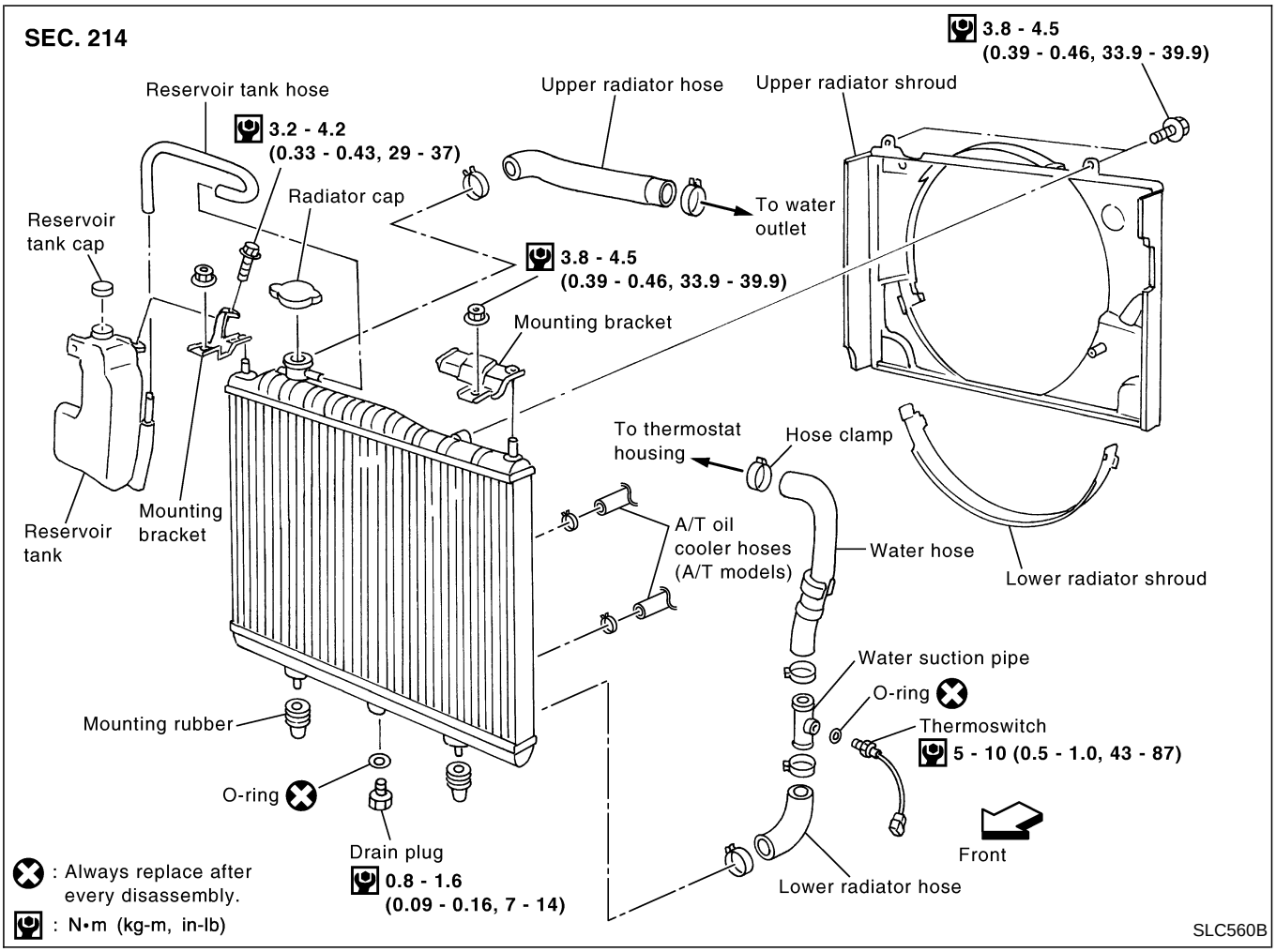


- **After installation, run engine for a few minutes, and check for leaks.**
- **Be careful not to spill coolant over engine compartment. Place a rag to absorb coolant.**

Radiator

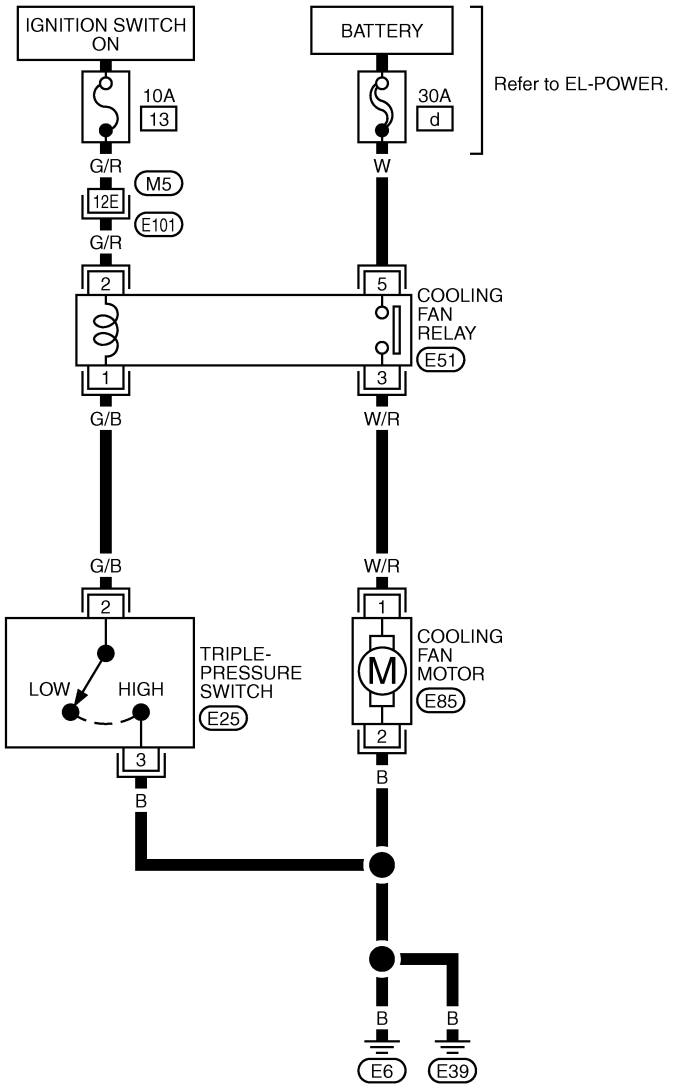
REMOVAL AND INSTALLATION

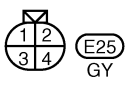
1. Remove under cover.
2. Drain coolant from radiator drain plug.
3. Disconnect radiator upper and lower hoses.
4. Disconnect A/T oil cooler hoses (A/T models).
5. Remove radiator lower shroud.
6. Disconnect reservoir tank hose.
7. Remove radiator.
8. After repairing or replacing radiator, install any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

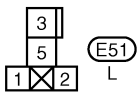


Wiring Diagram

LC-COOL/F-01







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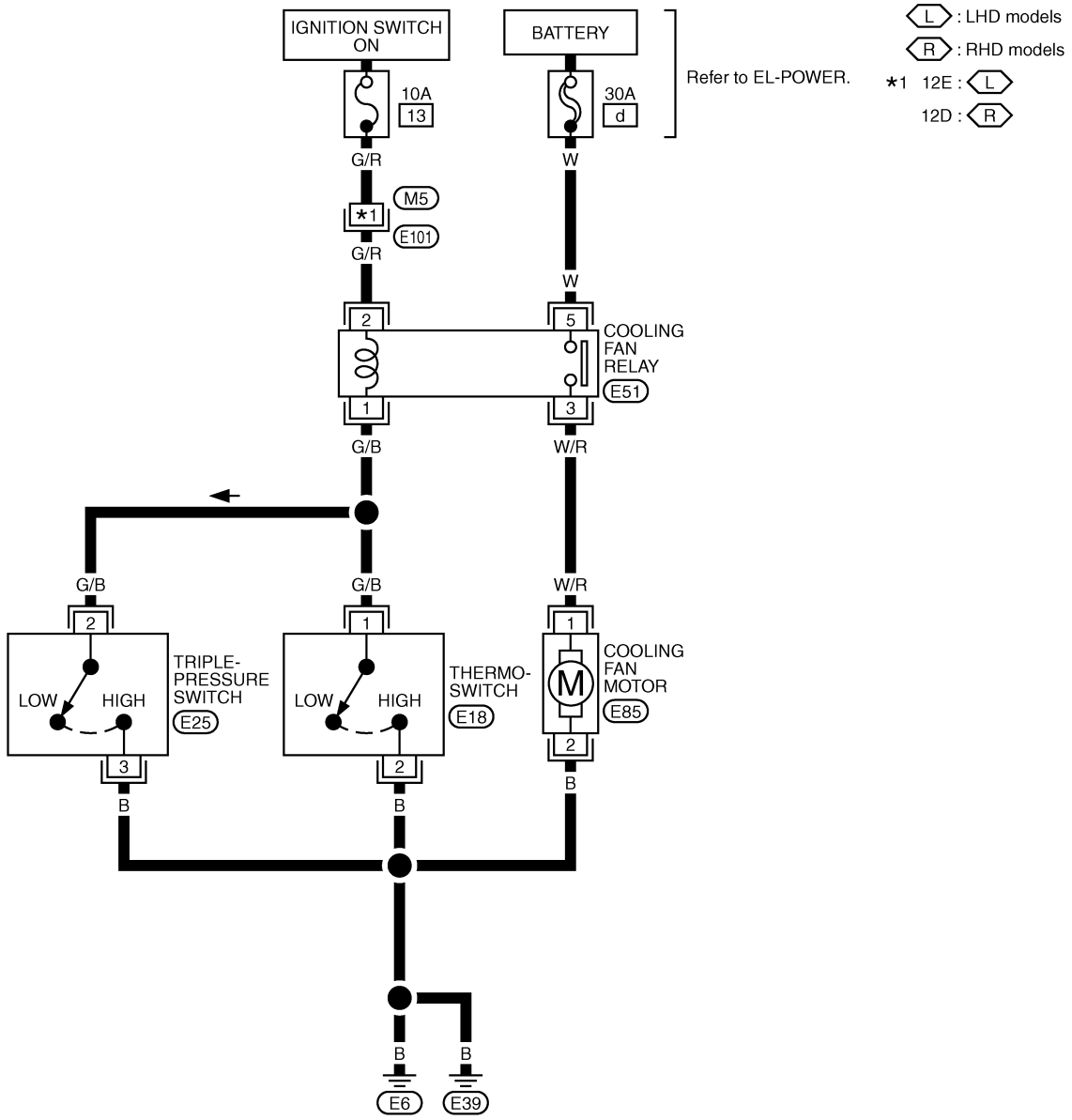
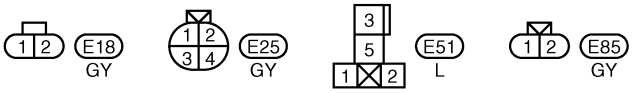
M5 , E101

GLC012A

Wiring Diagram

LC-COOL/F-01





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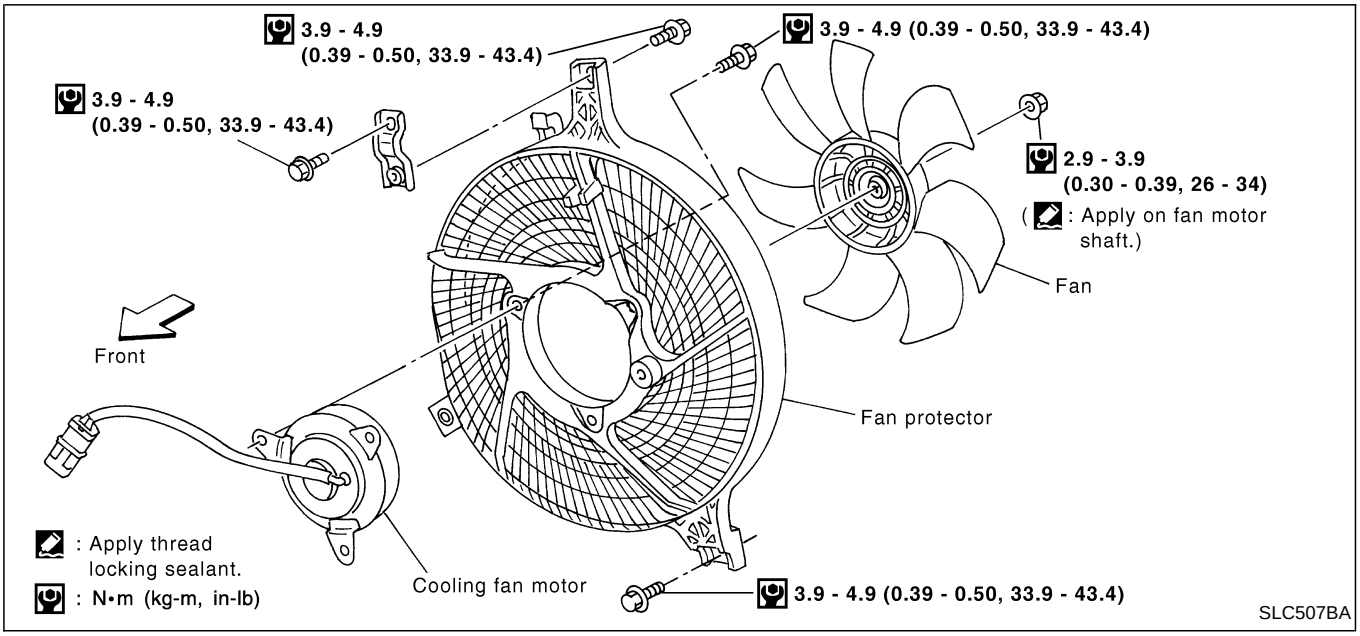
Cooling Fan (Motor driven)



Engine Lubrication System

OIL PRESSURE CHECK

Engine rpm	Approximate discharge pressure kPa (bar, kg/cm^2, psi)
Idle speed	More than 59 (0.59, 0.6, 9)
3,200	363 - 451 (3.63 - 4.51, 3.7 - 4.6, 53 - 65)

OIL PUMP

Unit: mm (in)

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

Engine Cooling System

THERMOSTAT

		Standard
Valve opening temperature	°C (°F)	80 - 84 (176 - 183)
Maximum valve lift	mm/°C (in/°F)	More than 10/95 (0.39/203)

RADIATOR

Unit: kPa (bar, kg/cm^2, psi)

Cap relief pressure	Standard	78.4 - 98 (0.78 - 0.98, 0.8 - 1.0, 11 - 14)
Leakage test pressure		157 (1.57, 1.6, 23)