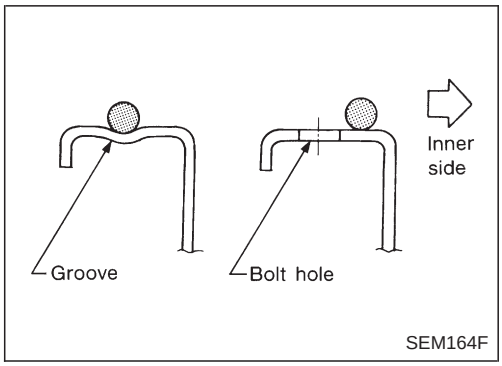
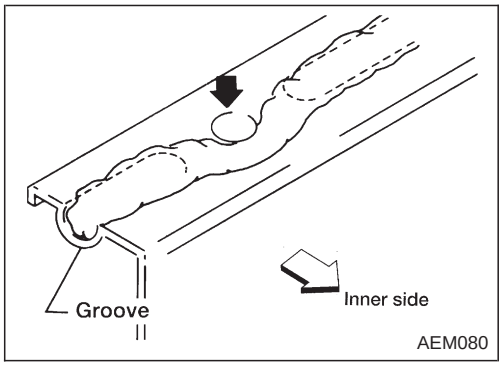
ENGINE LUBRICATION & COOLING SYSTEMS

SECTION **LC**

CONTENTS



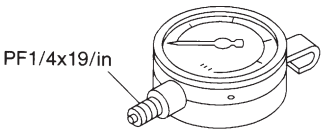
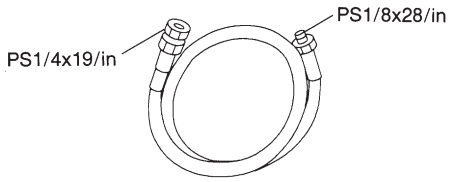
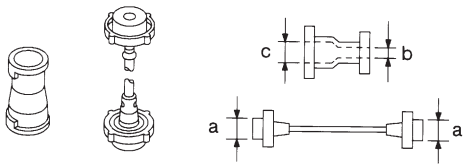
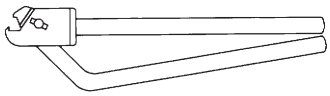
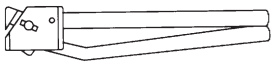
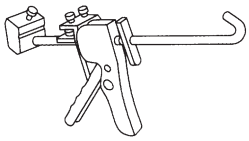
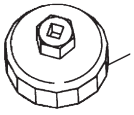
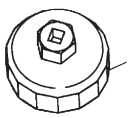


Liquid Gasket Application Procedure

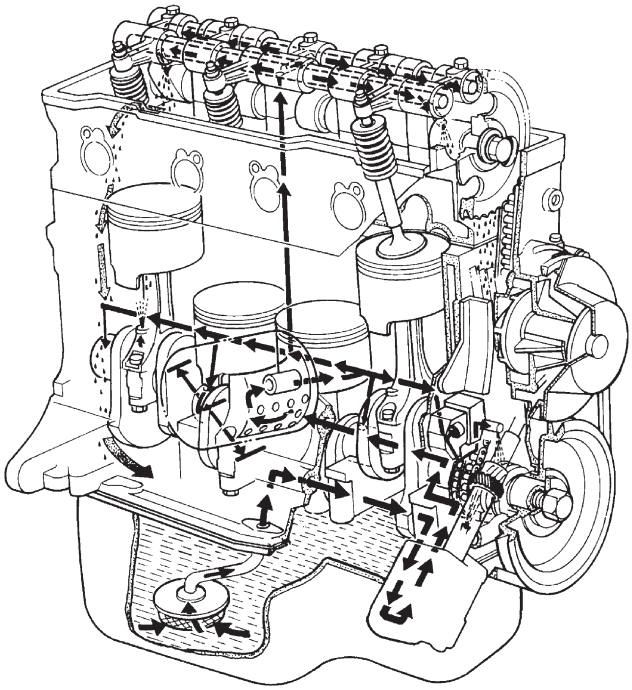
a. Use a scraper to remove all traces of old liquid gasket from mating surfaces and grooves. Also, completely clean any oil from these areas.
b. Apply a continuous bead of liquid gasket to mating surfaces. (Use Genuine Liquid Gasket or equivalent.)
   - For oil pan, be sure liquid gasket diameter is 3.5 to 4.5 mm (0.138 to 0.177 in) for gasoline engines.
   - For areas except oil pan, be sure liquid gasket diameter is 2.0 to 3.0 mm (0.079 to 0.118 in) for gasoline engines, and 2.5 to 3.5 mm (0.098 to 0.138 in) for diesel engines.
c. Apply liquid gasket around the inner side of bolt holes (unless otherwise specified).
d. Assembly should be done within 5 minutes after coating.
e. Wait at least 30 minutes before refilling engine oil and engine coolant.

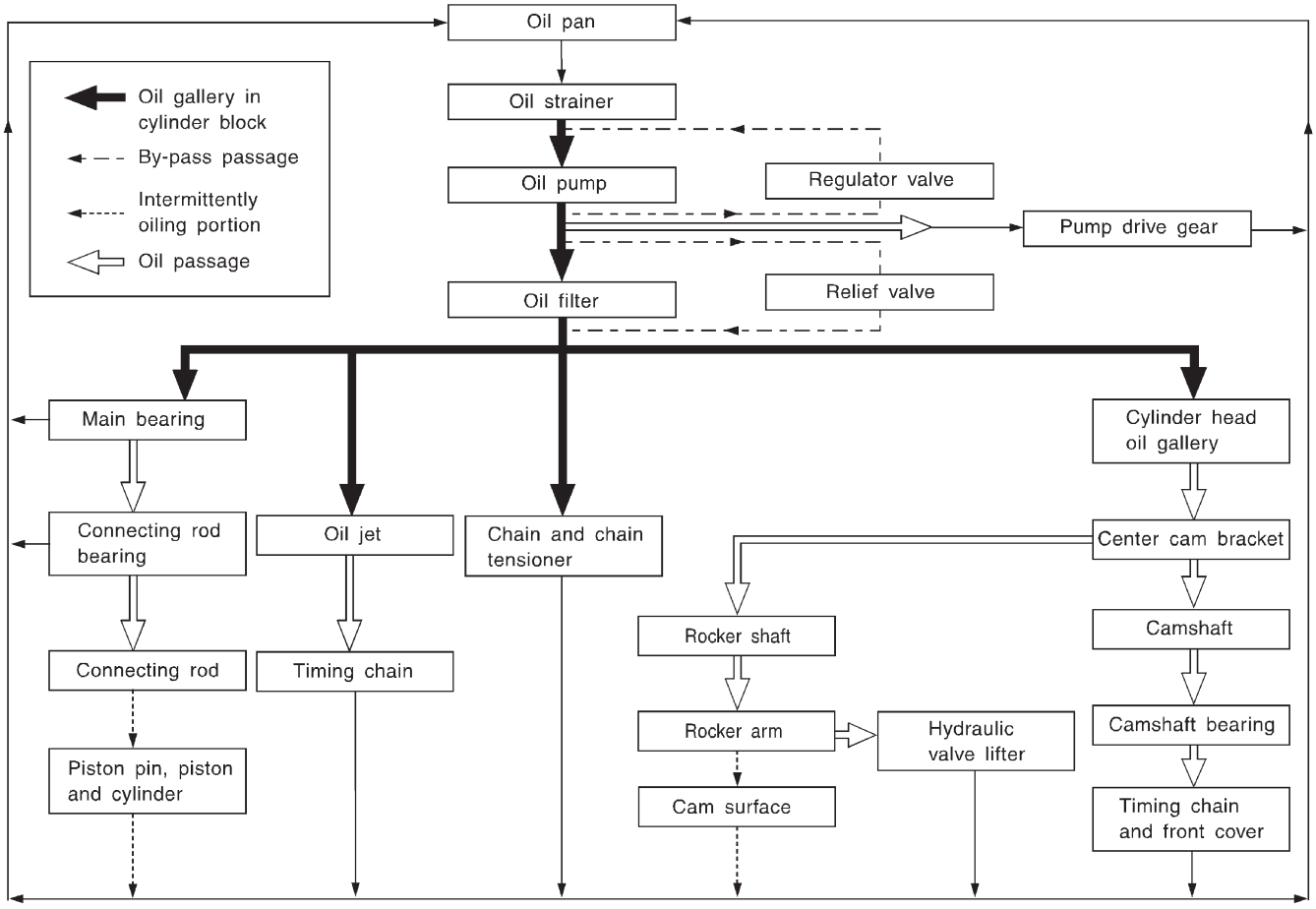
Special Service Tools

*: Special tool or commercial equivalent

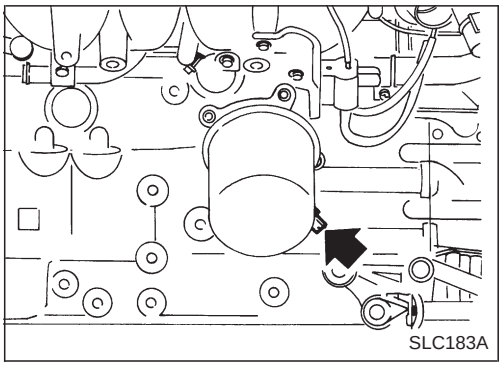
Tool number Tool name	Description		Engine application	
			KA	TD
ST25051001* Oil pressure gauge	 NT558	Measuring oil pressure **Maximum measuring range: 2,452 kPa (24.5 bar, 25 kg/cm^2, 356 psi)**	X	X
ST25052000* Hose	 NT559	Adapting oil pressure gauge to cylinder block	X	X
EG17650301 Radiator cap tester 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)	X	X
KV99103510 Radiator plate pliers A	 NT224	Installing radiator upper and lower tanks	X	X
KV99103520 Radiator plate pliers B	 NT225	Removing radiator upper and lower tanks	X	X
WS39930000 Tube presser	 NT052	Pressing the tube of liquid gasket	X	X
KV10105901 Oil filter cap wrench	 NT689	Removing oil filter	X	—
KV10106001 Oil filter wrench	 NT690	Replacing oil filter	—	X

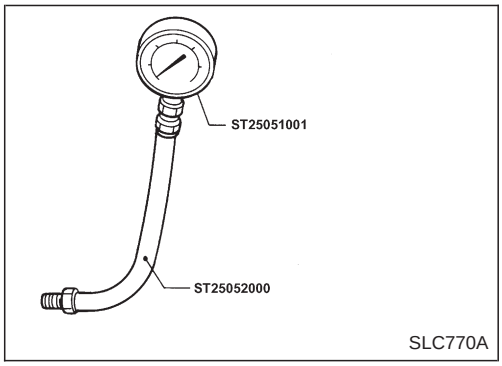
Lubrication Circuit





SLC150B


SLC183A



SLC770A

Oil Pressure Check

WARNING:

- **Be careful not to burn yourself, as the engine and oil may be hot.**
- **Put gearshift lever in Neutral N position.**

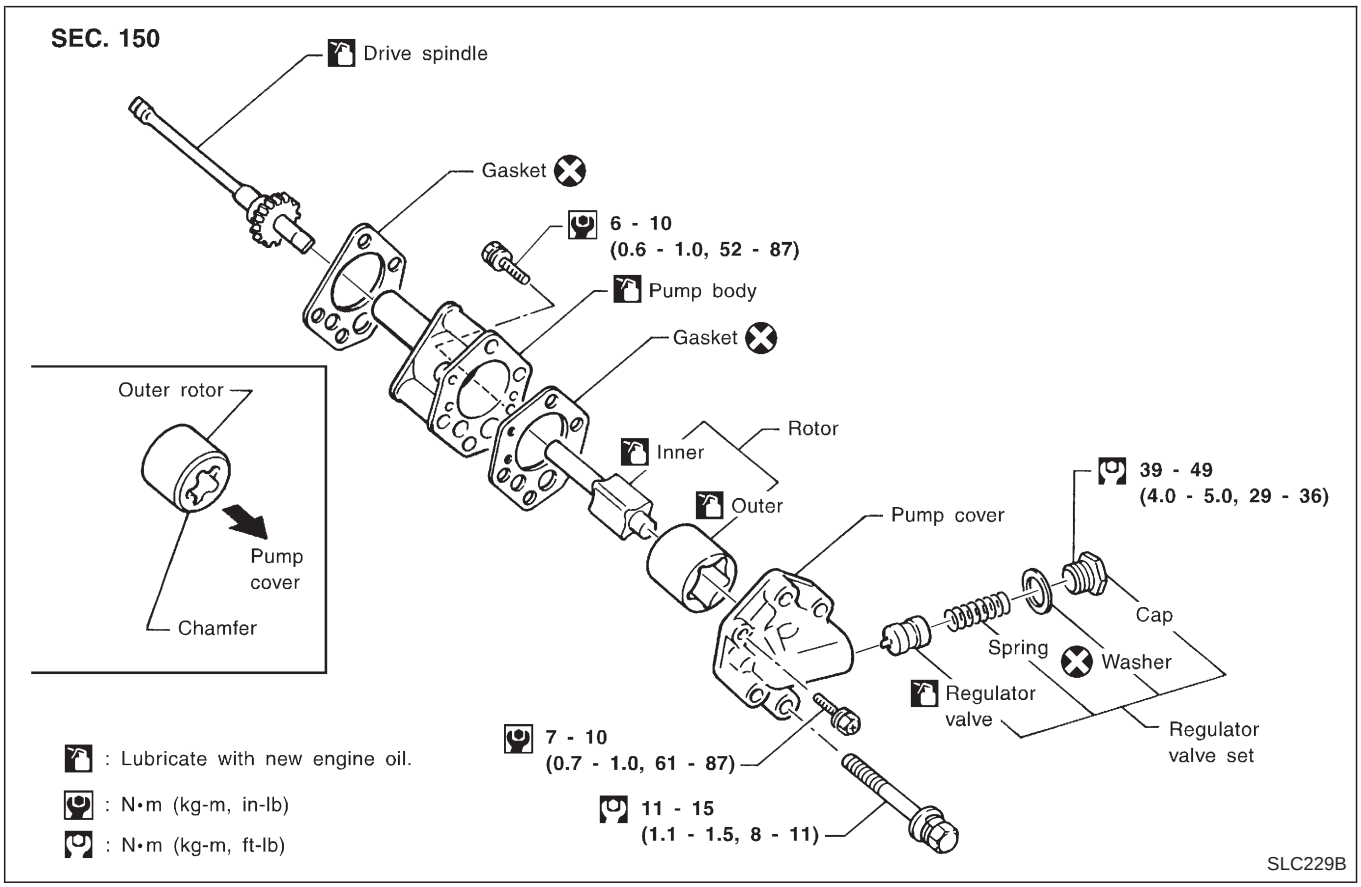
1. Check oil level.
2. Remove oil pressure switch.
3. Install pressure gauge.
4. Start engine and warm it up to normal operating temperature.
5. Check oil pressure with engine running under no-load.

Engine speed rpm	Approximate discharge pressure kPa (bar, kg/cm^2, psi)
Idle speed	More than 78 (0.78, 0.8, 11)
3,000	412 - 481 (4.12 - 4.81, 4.2 - 4.9, 60 - 70)

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

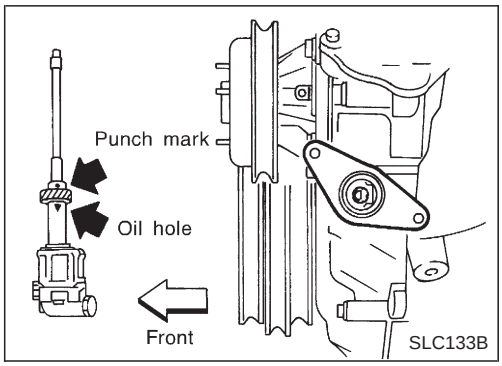
6. Install oil pressure switch with sealant.

Oil Pump

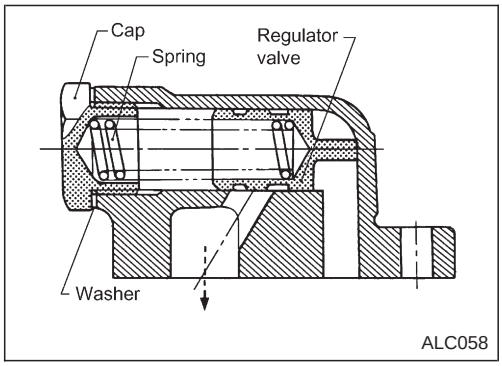


SLC229B

Oil Pump (Cont'd)



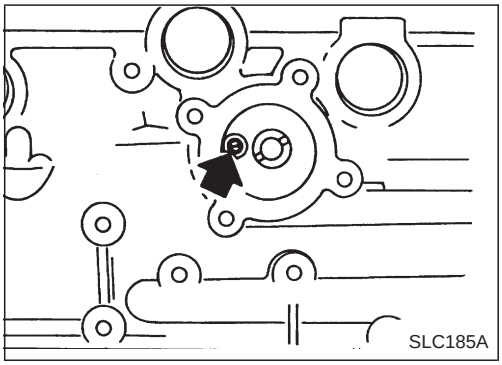
- **Always replace with new oil seal and gasket.**
- **When removing oil pump, turn crankshaft so that No. 1 piston is at TDC on its compression stroke.**
- **When installing oil pump, apply engine oil to gears, then align punchmark on drive spindle and oil hole on oil pump.**



REGULATOR VALVE INSPECTION

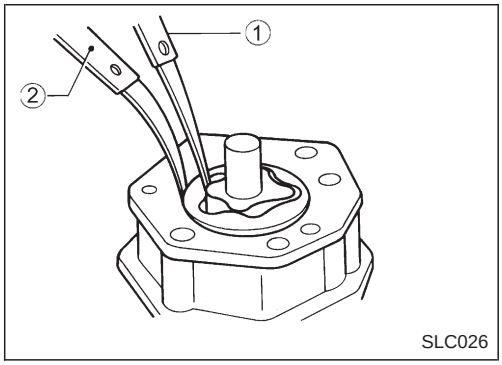
1. Visually inspect components for wear and damage.
2. Check oil pressure regulator valve sliding surface and valve spring.
3. Coat regulator valve with engine oil. Check that it falls smoothly into the valve hole by its own weight.

- **Replace regulator valve set or oil pump assembly, if damaged.**



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

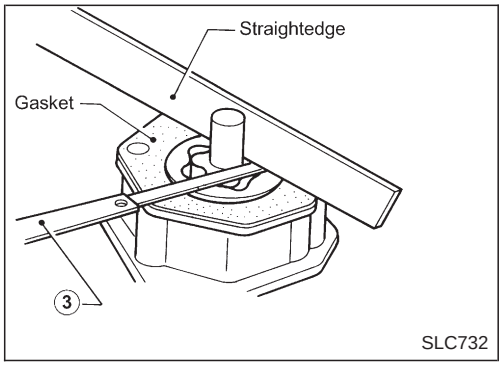
Using a feeler gauge, check the following clearance.

Standard clearance:

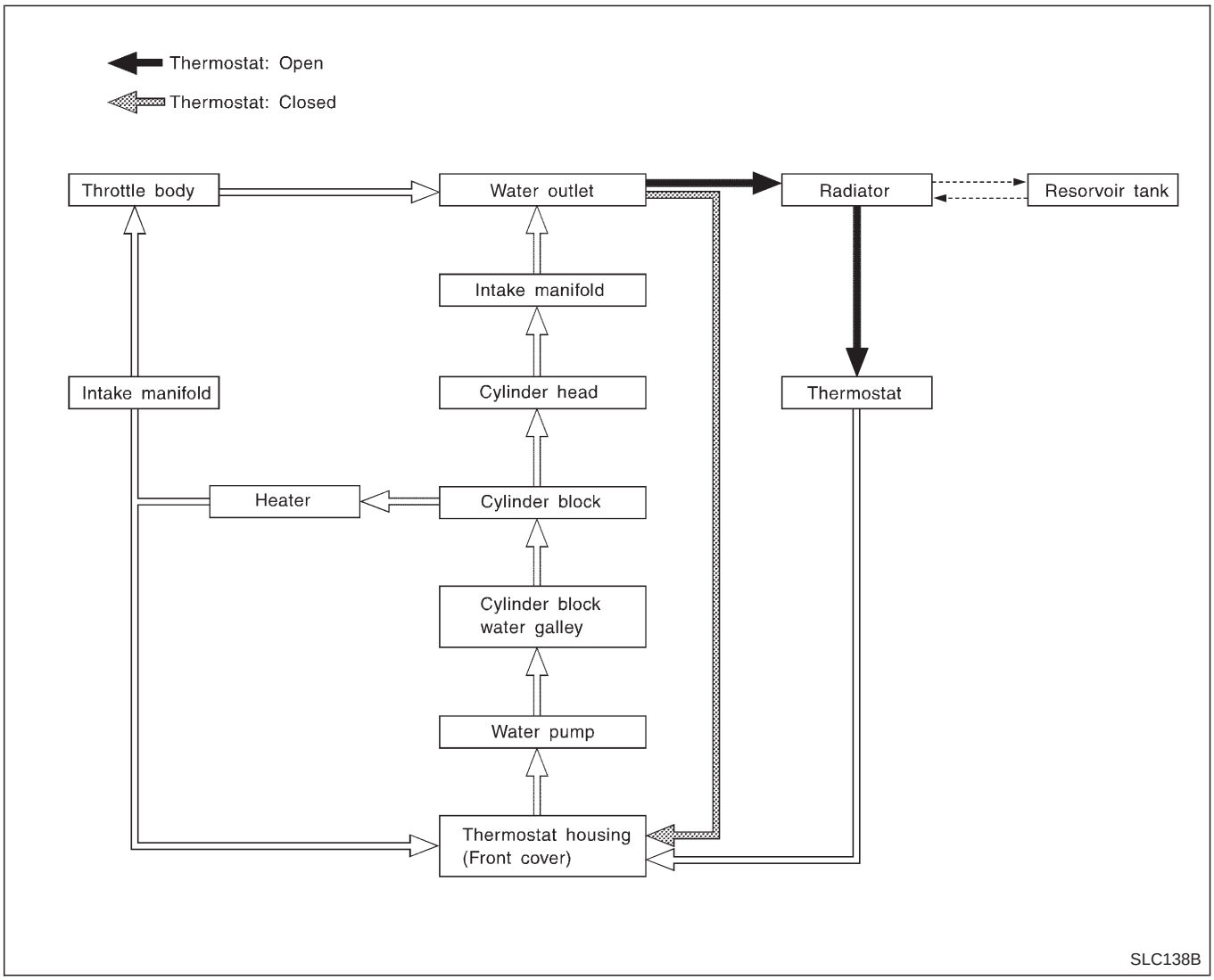
Unit: mm (in)

Rotor tip clearance ①	Less than 0.12 (0.0047)
Outer rotor to body radial clearance ②	0.15 - 0.21 (0.0059 - 0.0083)
Side clearance (with gasket) ③	0.04 - 0.08 (0.0016 - 0.0031)

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



Cooling Circuit



System Check

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.

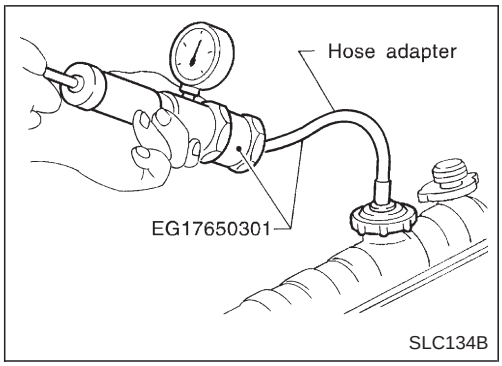
CHECKING COOLING SYSTEM HOSES

Check hoses for the following:

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

System Check (Cont'd)

CHECKING COOLING SYSTEM FOR LEAKS

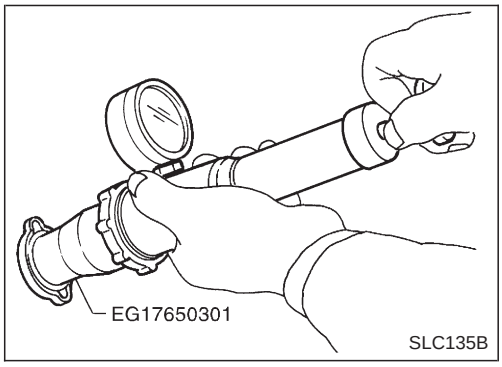


To check for leakage, apply pressure to the cooling system with a tester.

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

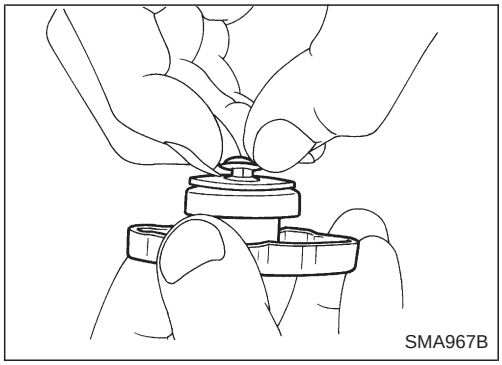
CAUTION:
Higher pressure than specified may cause radiator damage.

CHECKING RADIATOR CAP



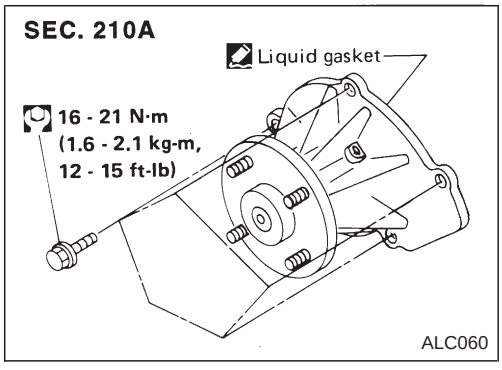
To check radiator cap, apply pressure to cap with a tester.

Radiator cap relief pressure:
Standard
78 - 98 kPa
(0.78 - 0.98 bar, 0.8 - 1.0 kg/cm^2, 11 - 14 psi)
Limit
59 - 98 kPa
(0.59 - 0.98 bar, 0.6 - 1.0 kg/cm^2, 9 - 14 psi)



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

Water Pump



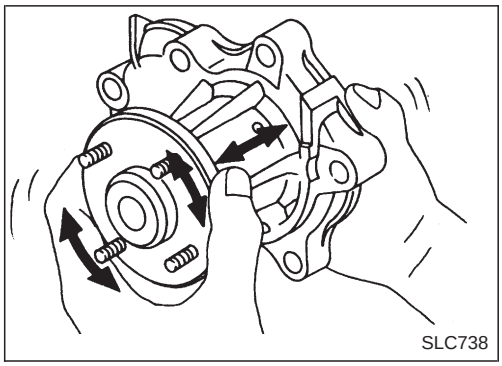
CAUTION:

- **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

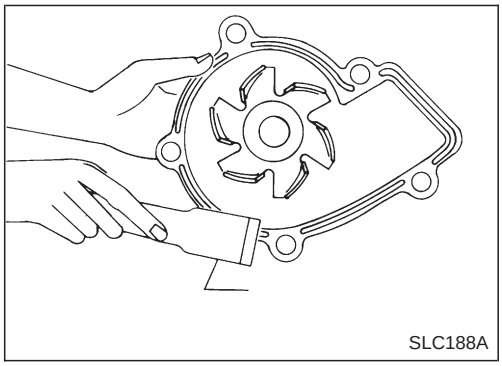
1. Drain coolant from radiator and cylinder block.
   Refer to MA section (''Changing Engine Coolant'', ''ENGINE MAINTENANCE'').
2. Remove power steering pump drive belt, generator drive belt and A/C compressor drive belt.
3. Remove fan coupling with fan.
4. Remove water pump.

Water Pump (Cont'd)


SLC738

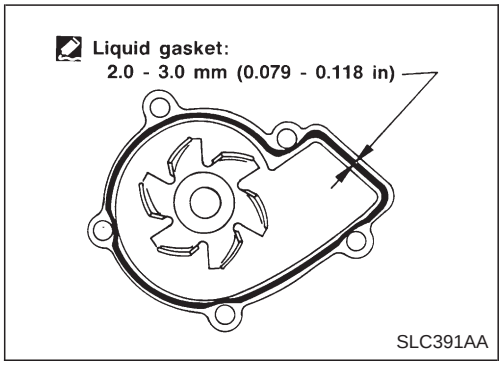
INSPECTION

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


SLC188A

INSTALLATION

1. Use a scraper to remove liquid gasket from water pump.
- **Also remove traces of liquid gasket from mating surface of cylinder block.**

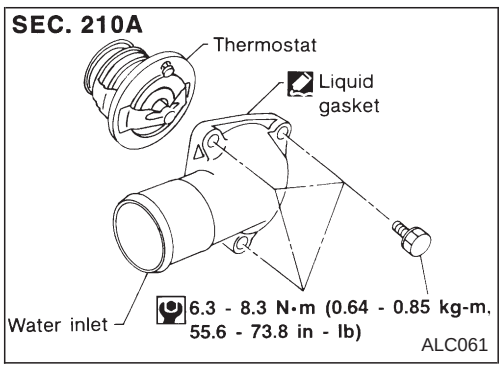


SLC391AA

2. Apply a continuous bead of liquid gasket to mating surface of water pump.
- **Use Genuine Liquid Gasket or equivalent.**

When filling radiator with coolant, refer to MA section (''Changing Engine Coolant'', ''ENGINE MAINTENANCE''). When installing drive belts, refer to MA section (''Checking Drive Belts'').

Thermostat

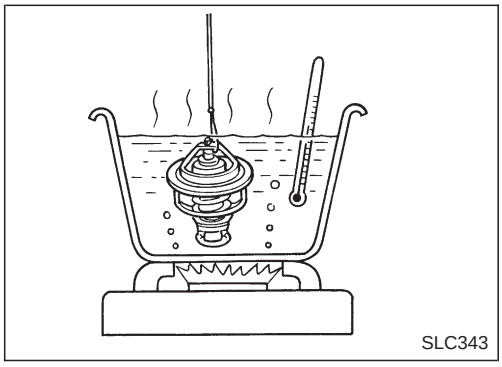


ALC061

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

REMOVAL

1. Drain coolant form engine. Refer to MA section (''Changing Engine Coolant'', ''ENGINE MAINTENANCE'').
2. Remove air cleaner and air duct assembly.
3. Remove water hose from water inlet housing.
4. Remove water inlet housing, then take out thermostat.


SLC343

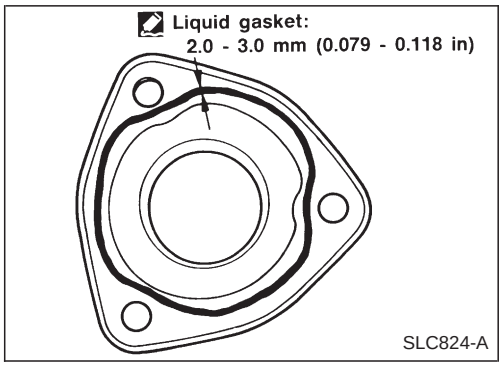
INSPECTION

1. Check valve seating condition at normal room temperatures. 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)

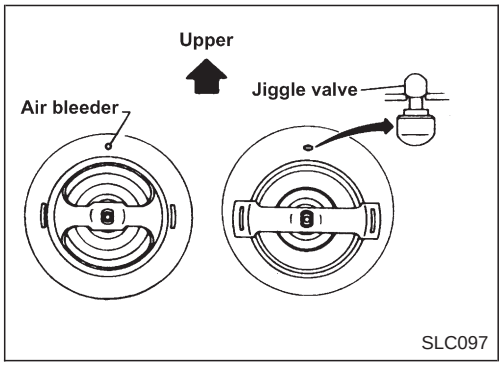
3. Then check if valve closes at 5°C (9°F) below valve opening temperature.

Thermostat (Cont'd)



INSTALLATION

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



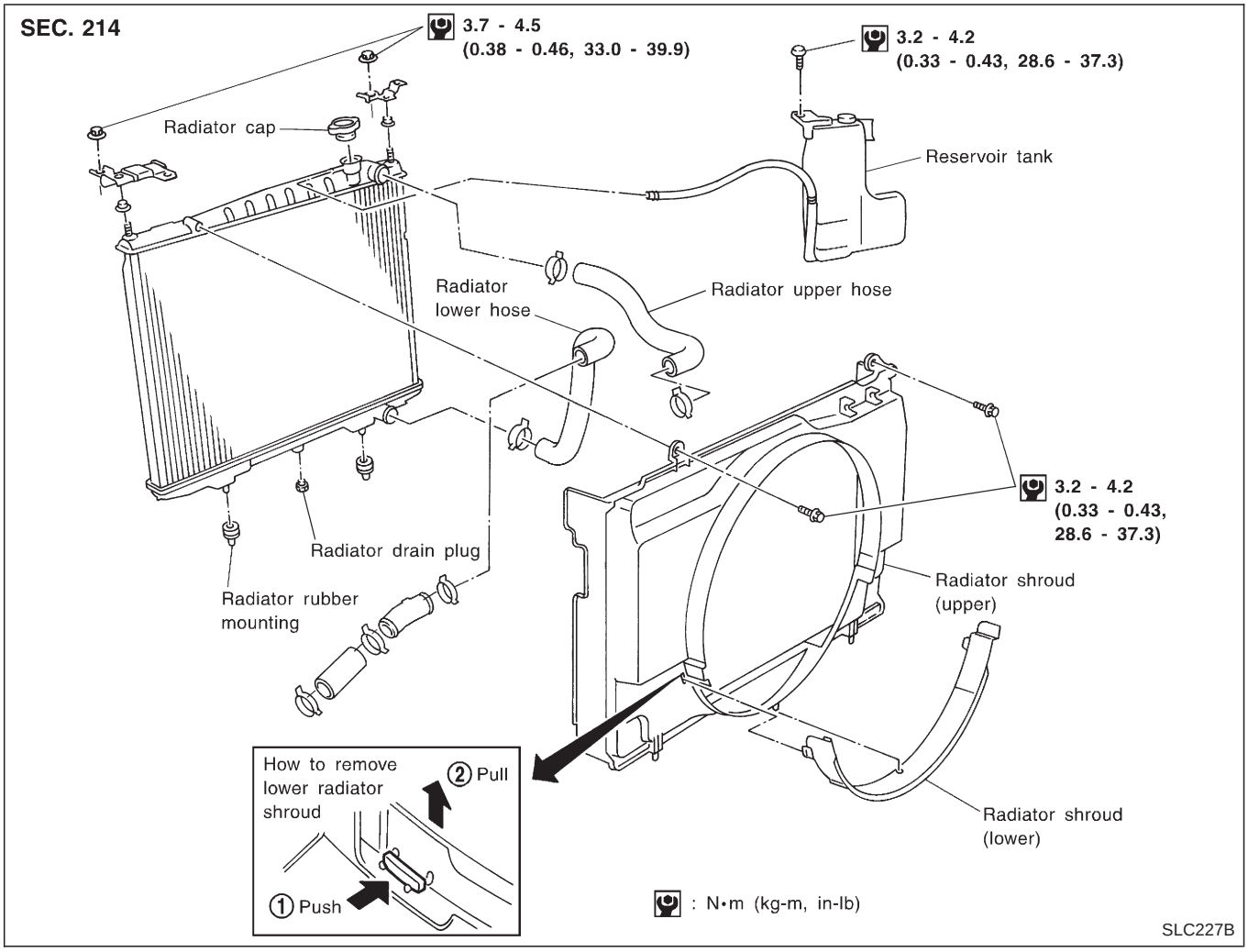
3. Install thermostat with jiggle valve or air bleeder at upper side.
4. Install water inlet housing.
5. Install water hose to water inlet housing.
6. Install air cleaner and air duct assembly.
7. Refill engine coolant. Refer to MA section (''Changing Engine Coolant'', ''ENGINE MAINTENANCE'').
- **After installation run engine for a few minutes, and check for leaks.**

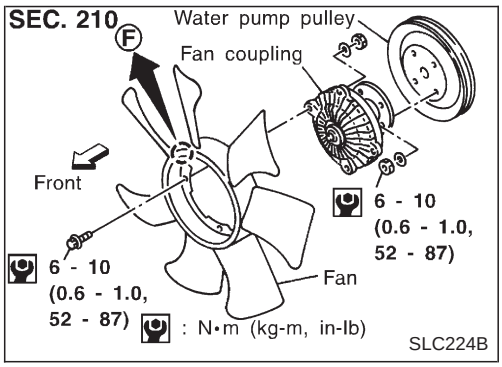
Radiator

REMOVAL AND INSTALLATION

1. Drain coolant from radiator. Refer to MA section (''Changing Engine Coolant'', ''ENGINE MAINTENANCE'').
2. Disconnect upper and lower radiator hoses.
3. Remove air cleaner and air duct assembly.
4. Remove lower radiator shroud.
5. Remove radiator shroud.
6. Disconnect coolant reservoir hose.
7. Remove radiator.
8. After replacing radiator, install all parts in reverse order of removal.
9. Refill engine coolant. Refer to MA section (''Changing Engine Coolant'', ''ENGINE MAINTENANCE'').
- **After installation, run engine for a few minutes, and check for leaks.**

Radiator (Cont'd)



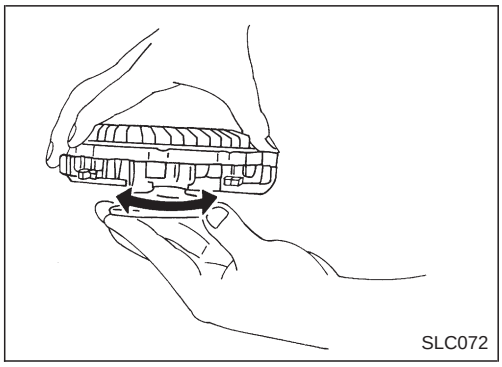


Cooling Fan (Crankshaft driven)

REMOVAL AND INSTALLATION

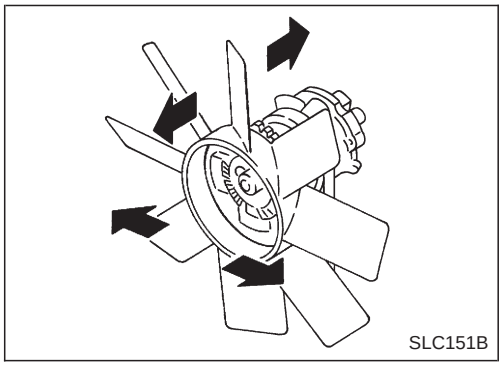
- Do not release the drive belt tension by removing the fan/ water pump pulley.
- Fan coupling cannot be disassembled and should be replaced as a unit. If front mark Ⓕ is present, install fan so that side marked Ⓕ faces the front.
- Install the drive belt only after the fan and fan coupling to water 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.

Cooling Fan (Crankshaft driven) (Cont'd)


SLC072

INSPECTION

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


SLC151B

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

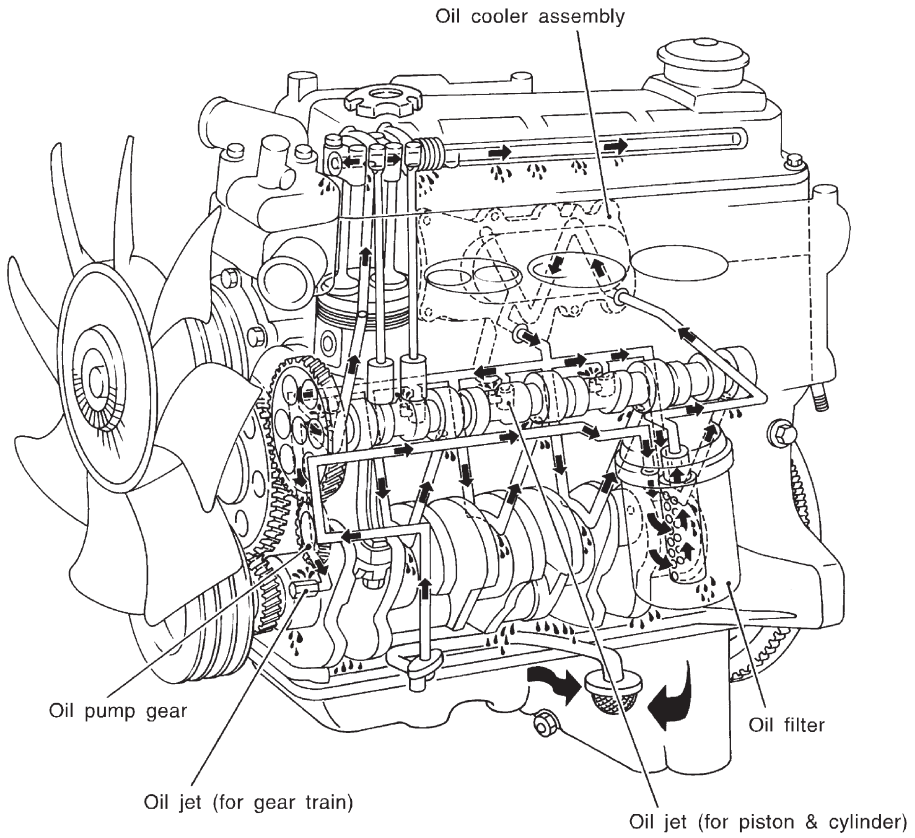
WARNING:

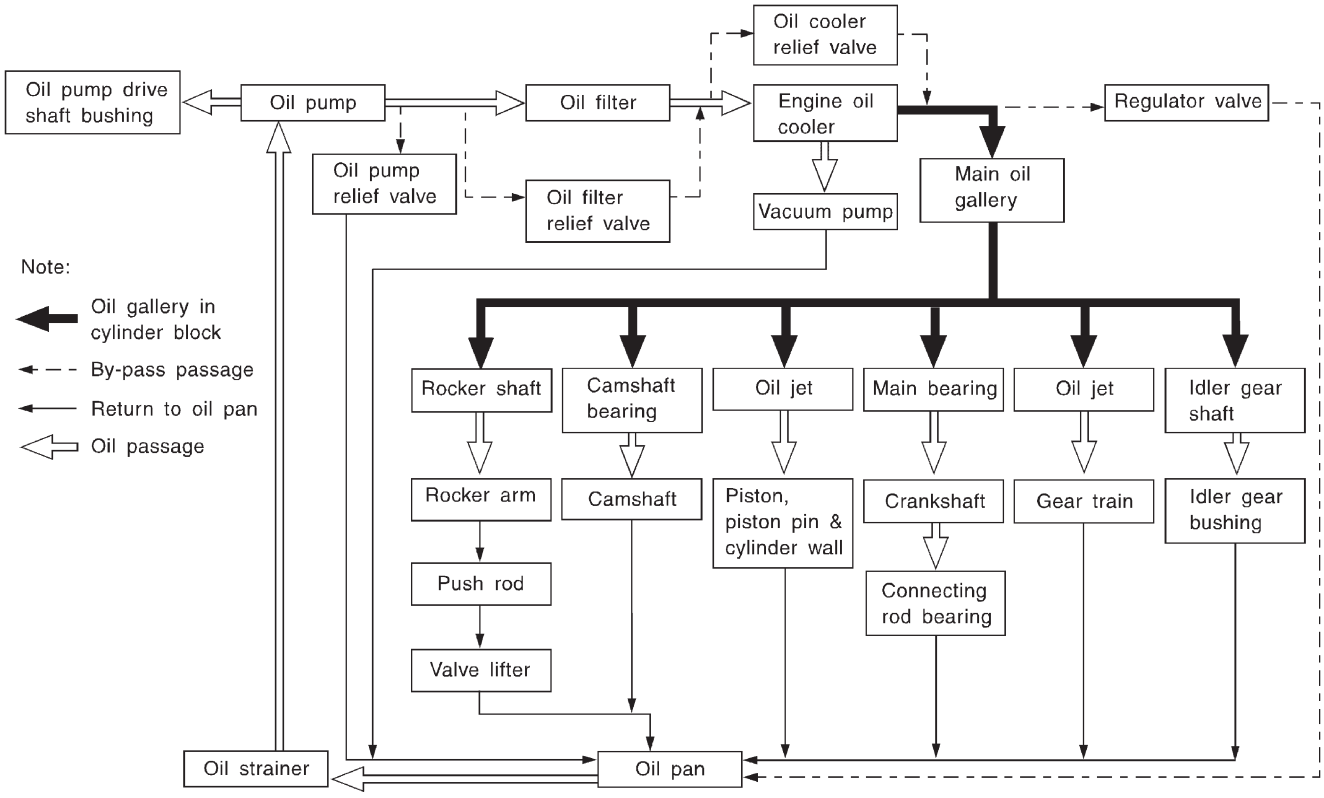
- **When the engine is running, keep hands and clothing away from moving parts such as drive belts and fan.**

Refilling engine coolant

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

Lubrication Circuit



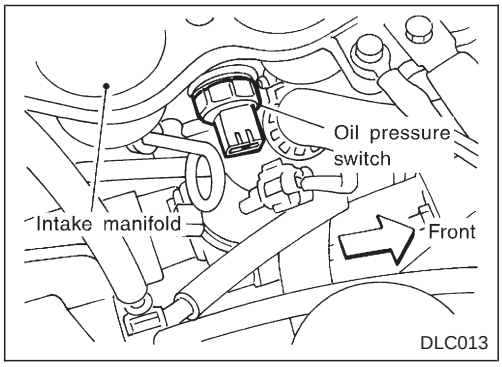


DLC014

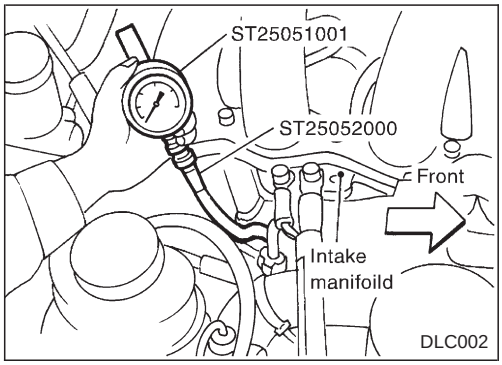
Oil Pressure Check (On-vehicle service)

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. Disconnect oil pressure switch harness connector.
3. Remove oil pressure switch.



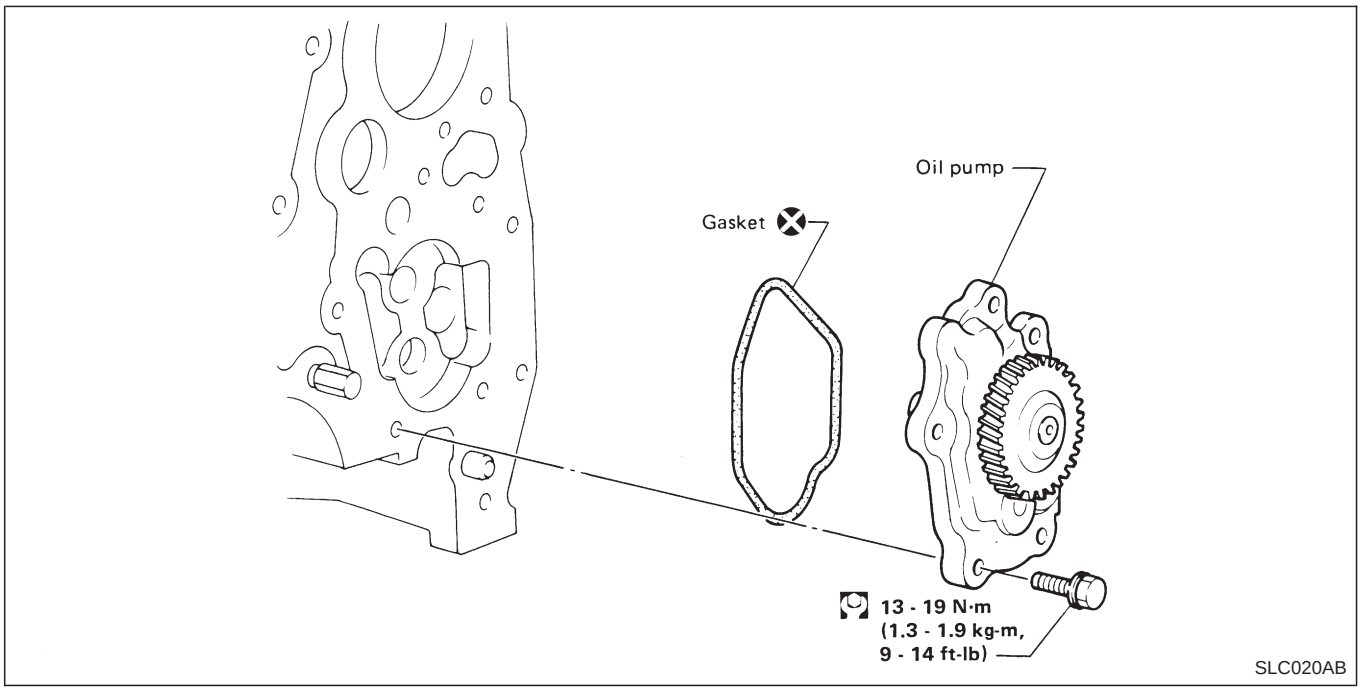
4. Install pressure gauge and hose.
5. Start engine and warm it up to normal operating temperature.
6. Check oil pressure with engine running under no-load.

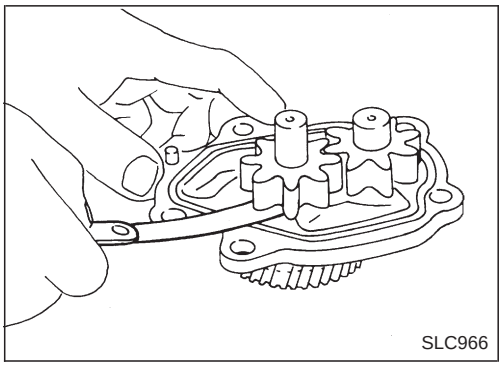
Engine speed rpm	Approximate discharge pressure kPa (bar, kg/cm^2, psi)
Idle speed	More than 78 (0.78, 0.8, 11)
3,000	294 - 392 (2.94 - 3.92, 3.0 - 4.0, 43 - 57)

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

7. Install oil pressure switch with sealant.
   Oil pressure switch:
   : 10 - 13 N·m (1.0 - 1.3 kg-m, 87 - 113 in-lb)

Oil Pump

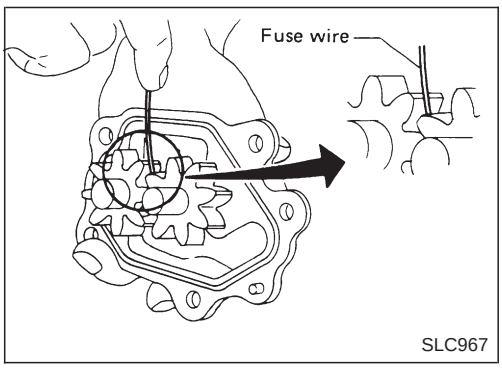




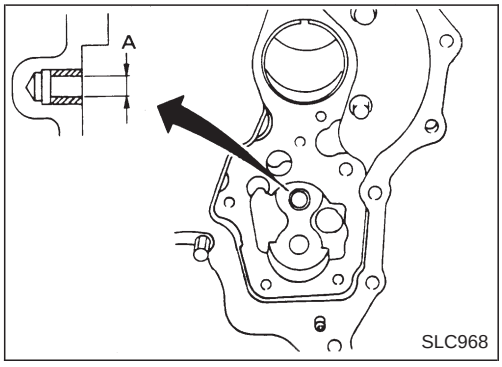
OIL PUMP INSPECTION

1. Inspect pump body, gears and drive shaft for wear and damage.
2. Using a feeler gauge and fuse wire, check the following clearances.

Gear side clearance:
Less than 0.13 mm (0.0051 in)

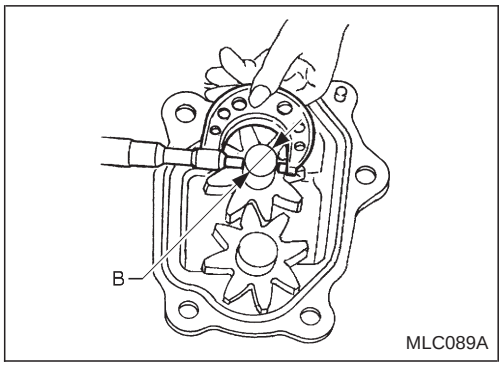


Gear backlash:
Less than 0.43 mm (0.0169 in)



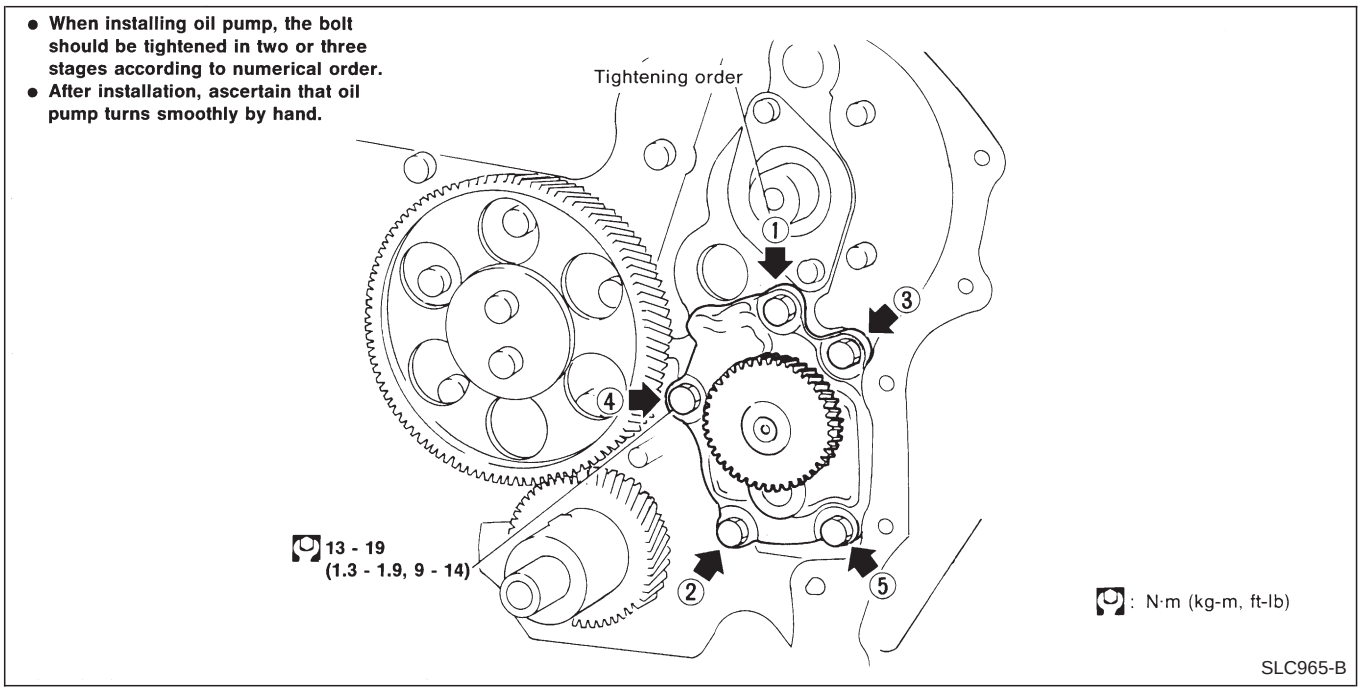
3. Measure inside diameter ‘‘A’’ of bushing.
A: 13.012 - 13.106 mm (0.5123 - 0.5160 in)

Oil Pump (Cont'd)



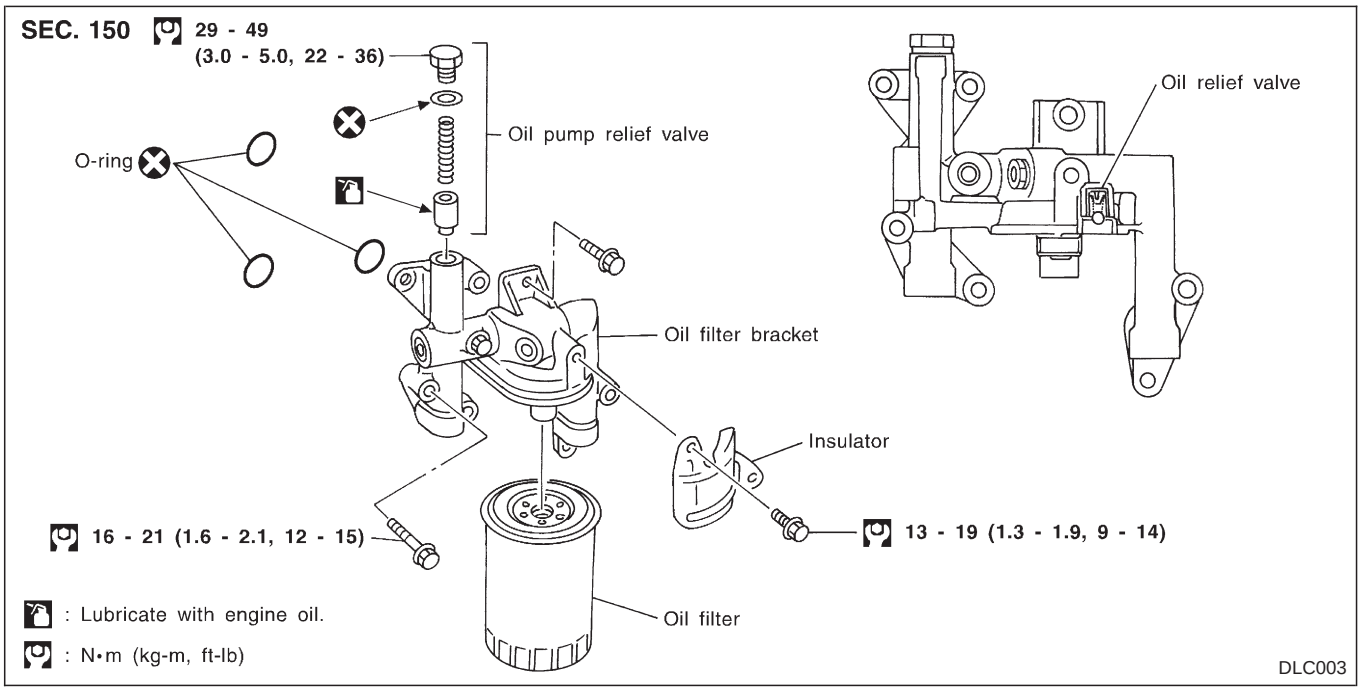
4. Measure outside diameter ''B'' of drive gear shaft.
   B: 12.974 - 12.992 mm (0.5108 - 0.5115 in)
5. Calculate oil pump bushing clearance.
   Oil pump bushing clearance: A − B
   Less than 0.15 mm (0.0059 in)

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



For installing timing gear case, refer to EM section (''TIMING GEAR CASE'', ''Assembly'', ''ENGINE OVERHAUL'').

Oil Filter Bracket



OIL PUMP RELIEF VALVE INSPECTION

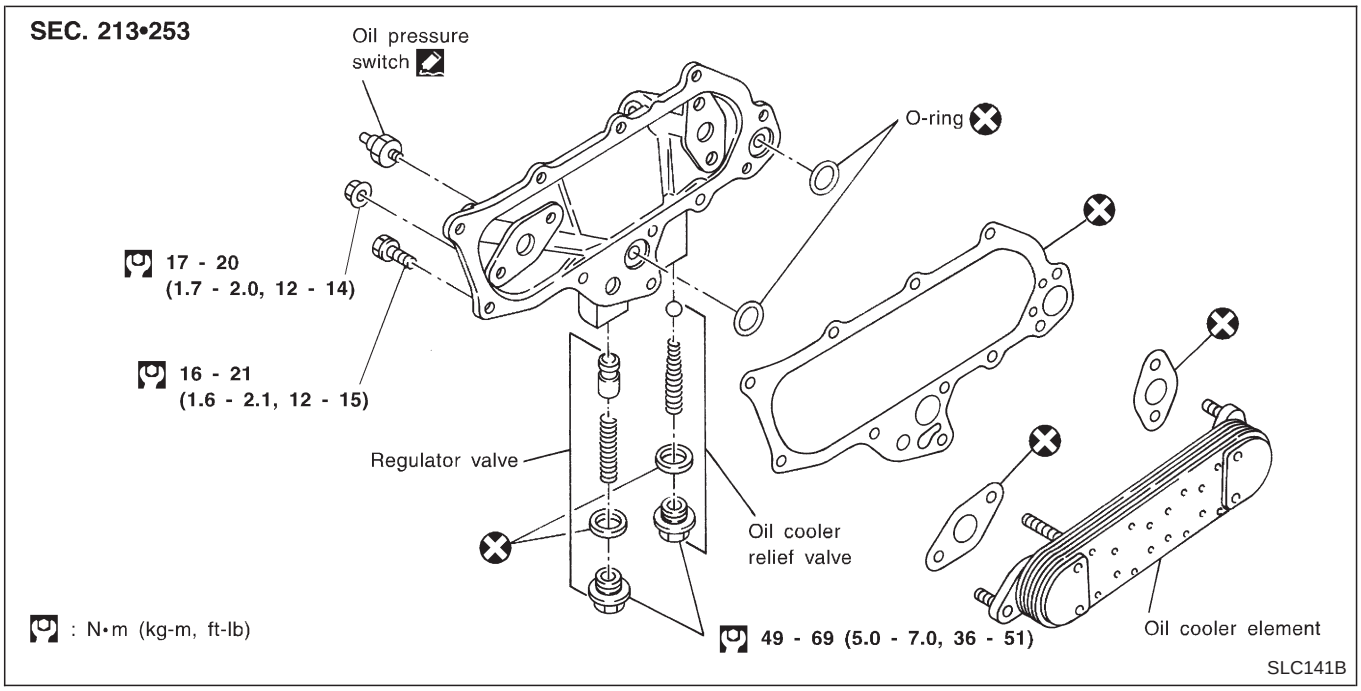
1. Visually inspect components for wear and damage.
2. Coat relief valve with engine oil and check that it falls smoothly into the valve hole by its own weight.

If damaged, replace oil pump relief valve set.

OIL FILTER RELIEF VALVE INSPECTION

Inspect oil filter relief valve for rough movement and damage by pushing the ball.
If damaged, replace oil filter bracket assembly.

Oil Cooler



OIL COOLER RELIEF VALVE INSPECTION

Inspect oil cooler relief valve for movement, cracks and breaks by pushing the ball.
If damaged, replace oil cooler relief valve set.

REGULATOR VALVE INSPECTION

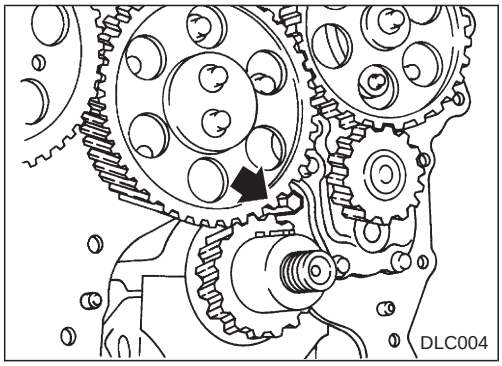
1. Visually inspect components for wear and damage.
2. Coat regulator valve with engine oil and check that it falls smoothly into the valve hole by its own weight.

If damaged, replace regulator valve set.

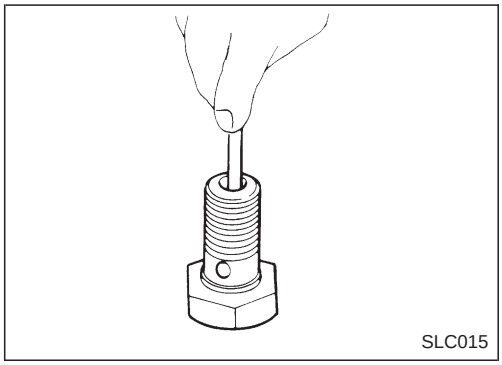
Oil Jet

INSPECTION (For gear train)

Make sure that the holes are not clogged. Clean them with a wire if necessary.

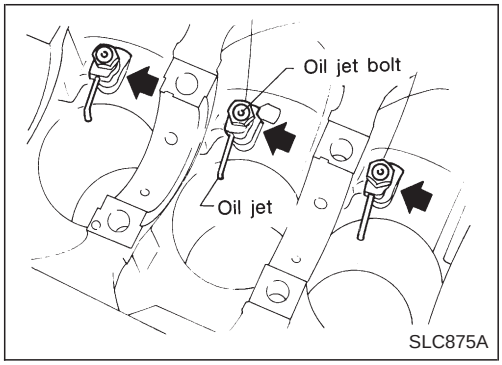


Oil jet has to be installed with oil hole facing crank gear and idler gear.



INSPECTION (For piston)

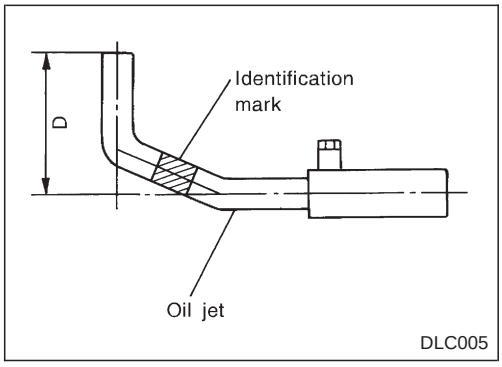
1. Push cut-off valve of oil jet bolt with a clean resin or brass rod and make sure that cut-off valve moves smoothly with proper repulsion.
2. Make sure that the oil jet passage is not clogged. Clean with a wire if necessary.



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

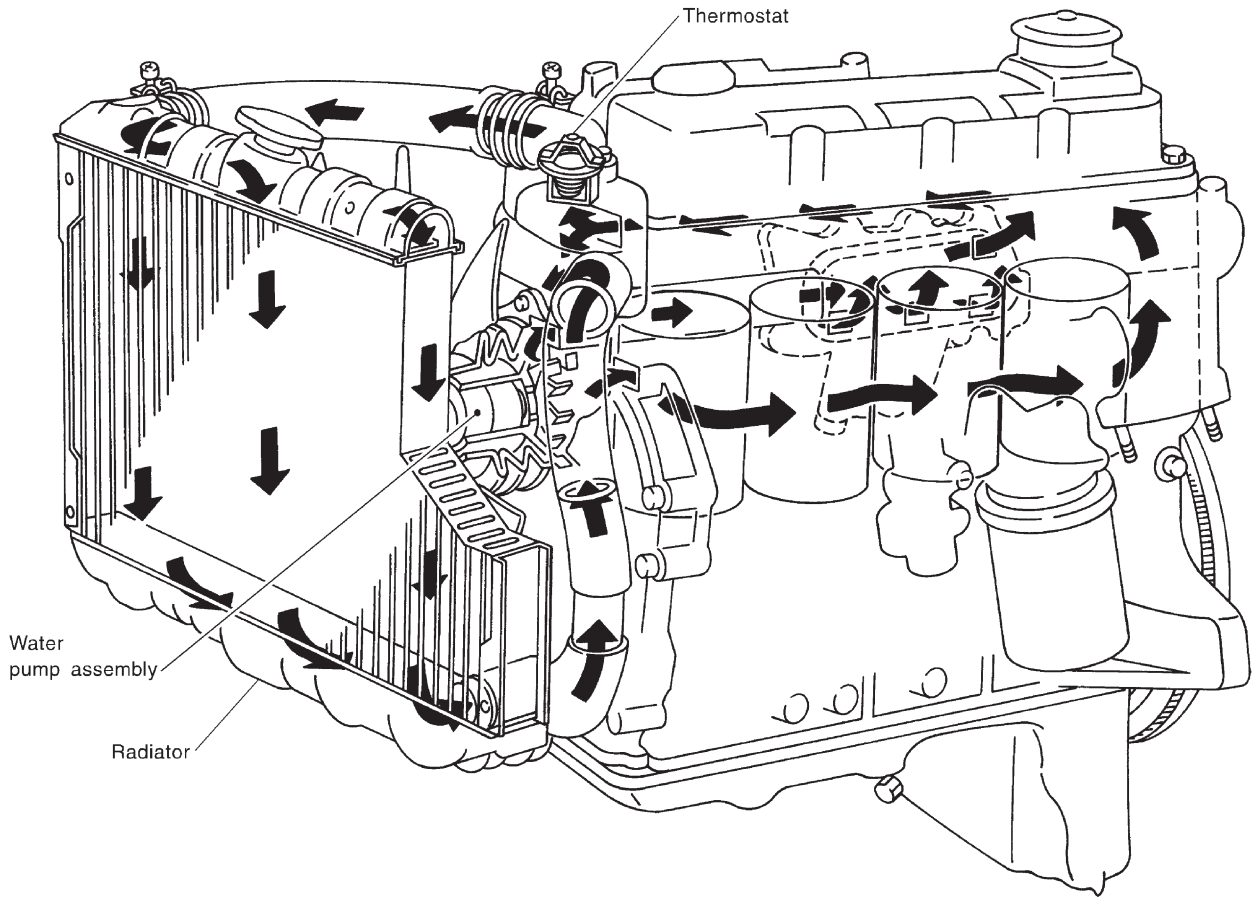
Oil jet bolt:

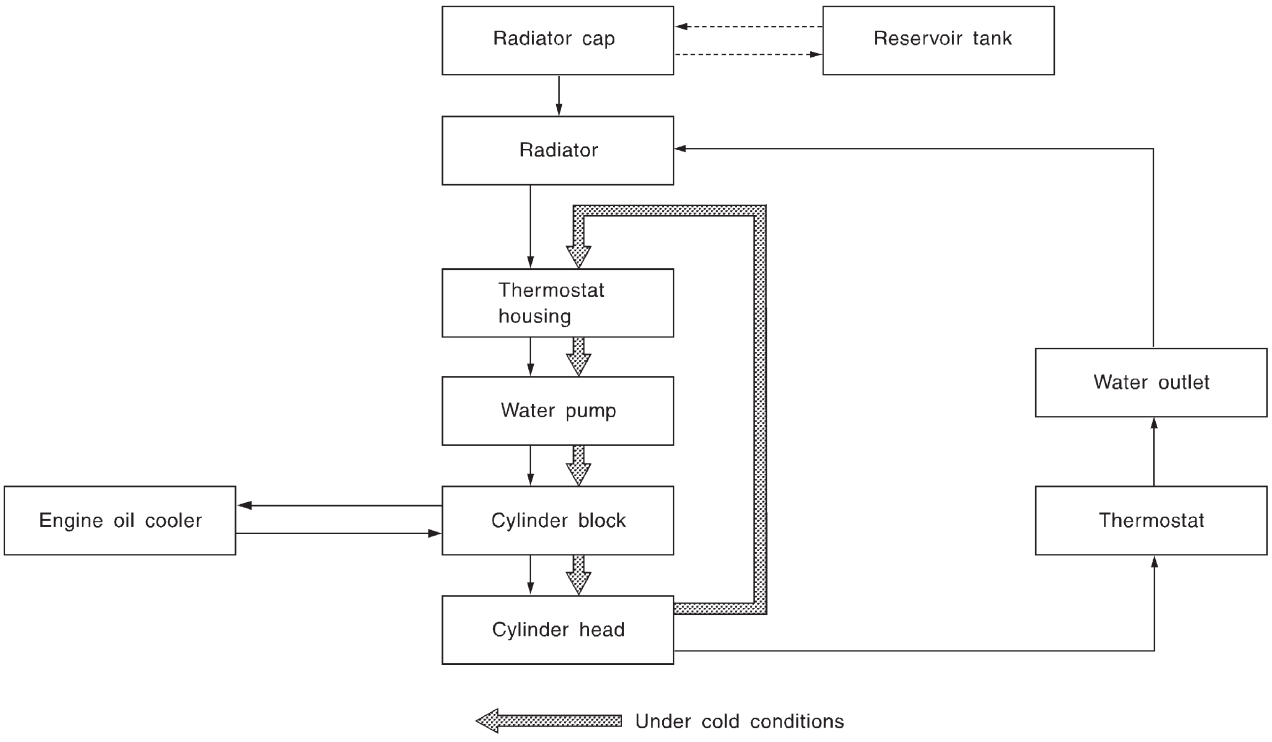
: 29 - 39 N·m (3.0 - 4.0 kg-m, 22 - 29 ft-lb)



		TD25
Dimension "D" mm (in)	Type I	—
	Type II	12 (0.47)
Identification color		—

Cooling Circuit





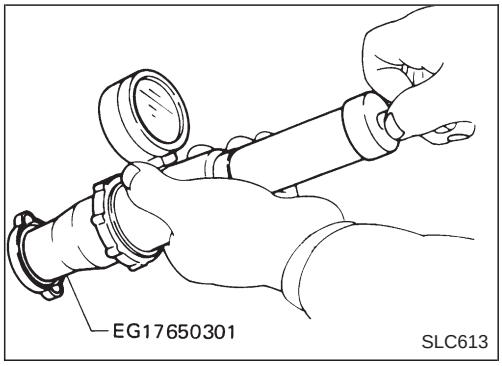
DLC006

Cooling System Inspection

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 HOSES

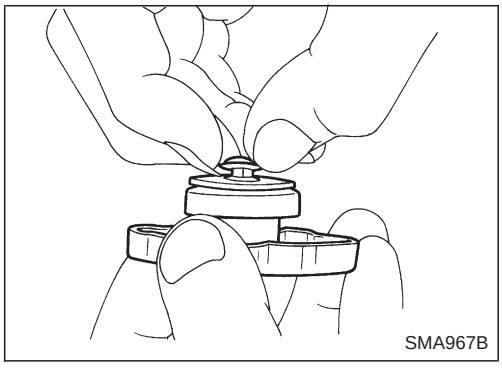
Check hoses for proper attachment, leaks, cracks, damage, loose connections, chafing and deterioration.



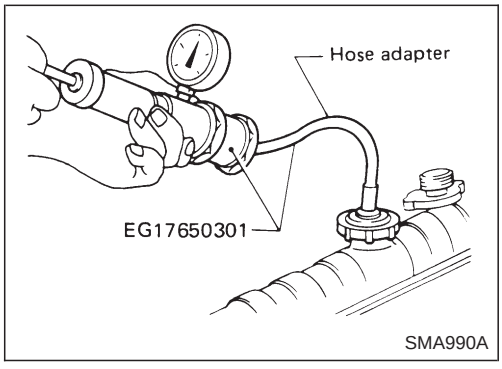
CHECKING RADIATOR CAP

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/cm^2, 11 - 14 psi)



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

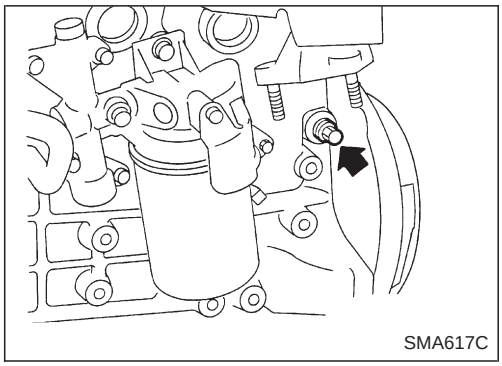


CHECKING COOLING SYSTEM FOR LEAKS

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

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

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

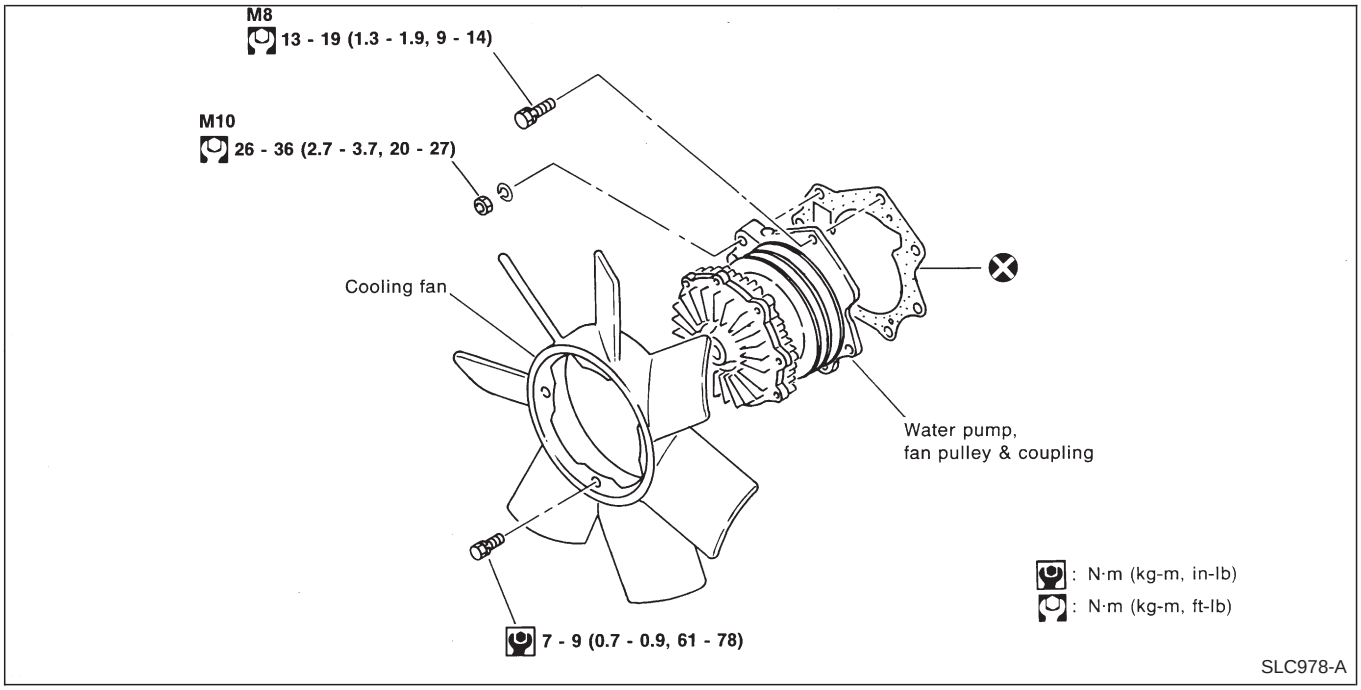

SMA617C

Water Pump and Cooling Fan (Camshaft driven)

REMOVAL AND INSTALLATION

Drain coolant from drain plugs on cylinder block and radiator.

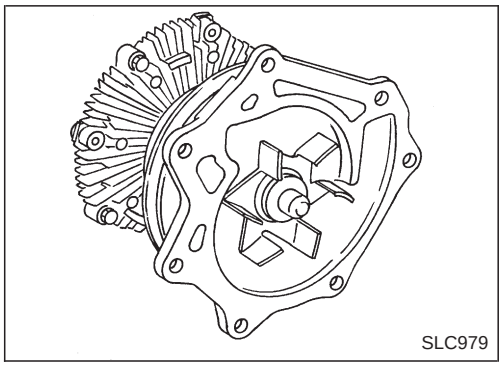
Cylinder block drain plug
(Use proper sealant):
: 20 - 29 N·m (2.0 - 3.0 kg-m, 14 - 22 ft-lb)



CAUTION:
- **When removing water pump assembly, be careful not to get coolant on drive belt.**
- **Water pump cannot be disassembled and should be replaced as a unit.**
- **Always replace with new gasket.**
- **After assembly, verify the fan does not wobble or flap while the engine is running.**
- **After installing water pump, connect hose and clamp securely, then check for leaks using radiator cap tester.**

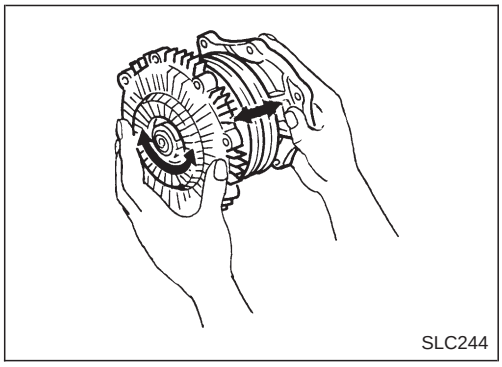
WARNING:
When the engine is running, keep hands and clothing away from moving parts such as drive belts and fan.

Water Pump and Cooling Fan (Camshaft driven) (Cont'd)

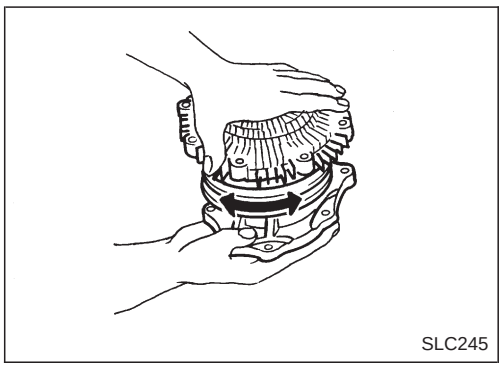

SLC979

INSPECTION

1. Check for badly rusted or corroded body assembly and vane.


SLC244

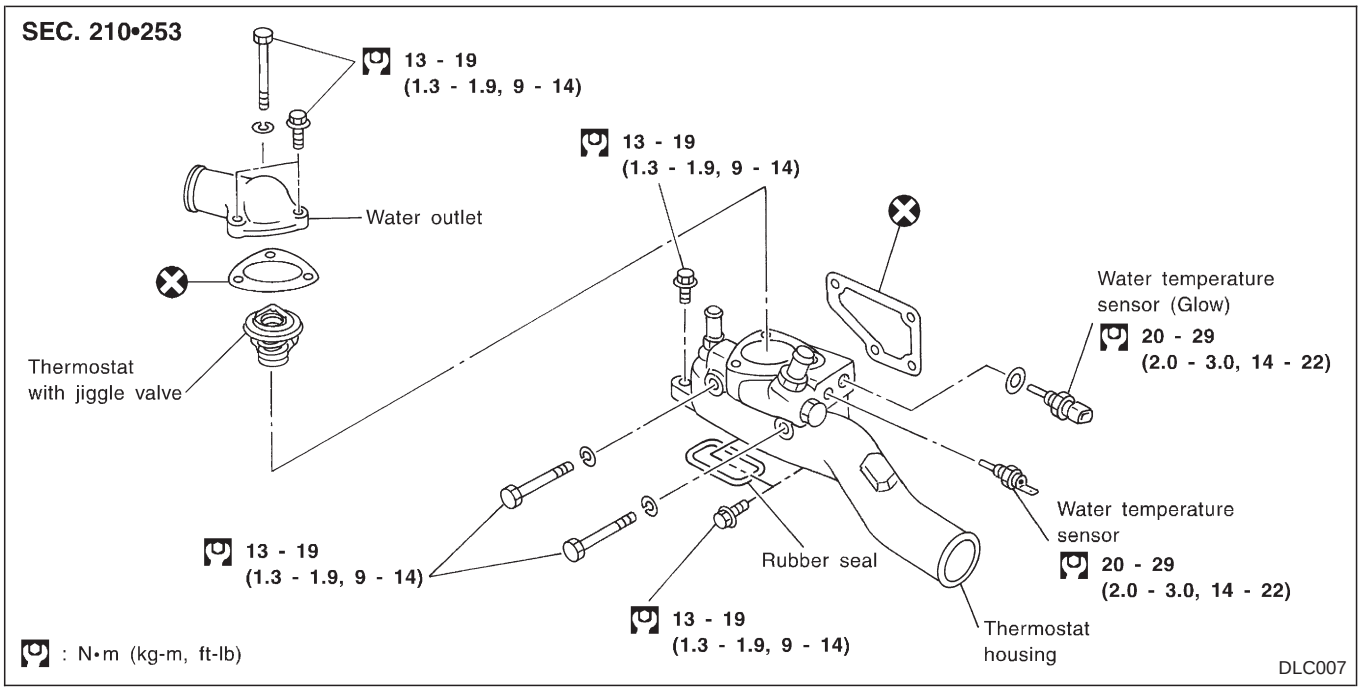
2. Check for rough operation due to excessive end play.


SLC245

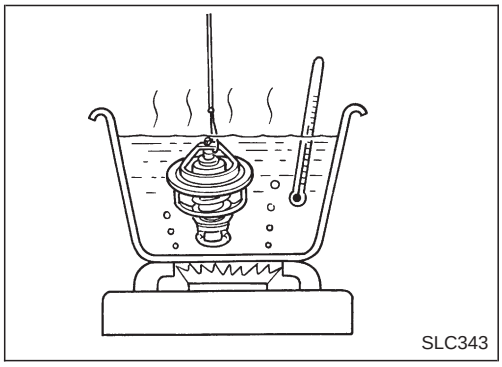
3. Check fan coupling for rough operation, wobbling, oil leakage or bent bimetal.

The water pump and fan coupling cannot be disassembled and should be replaced as a unit.

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.**



INSPECTION

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

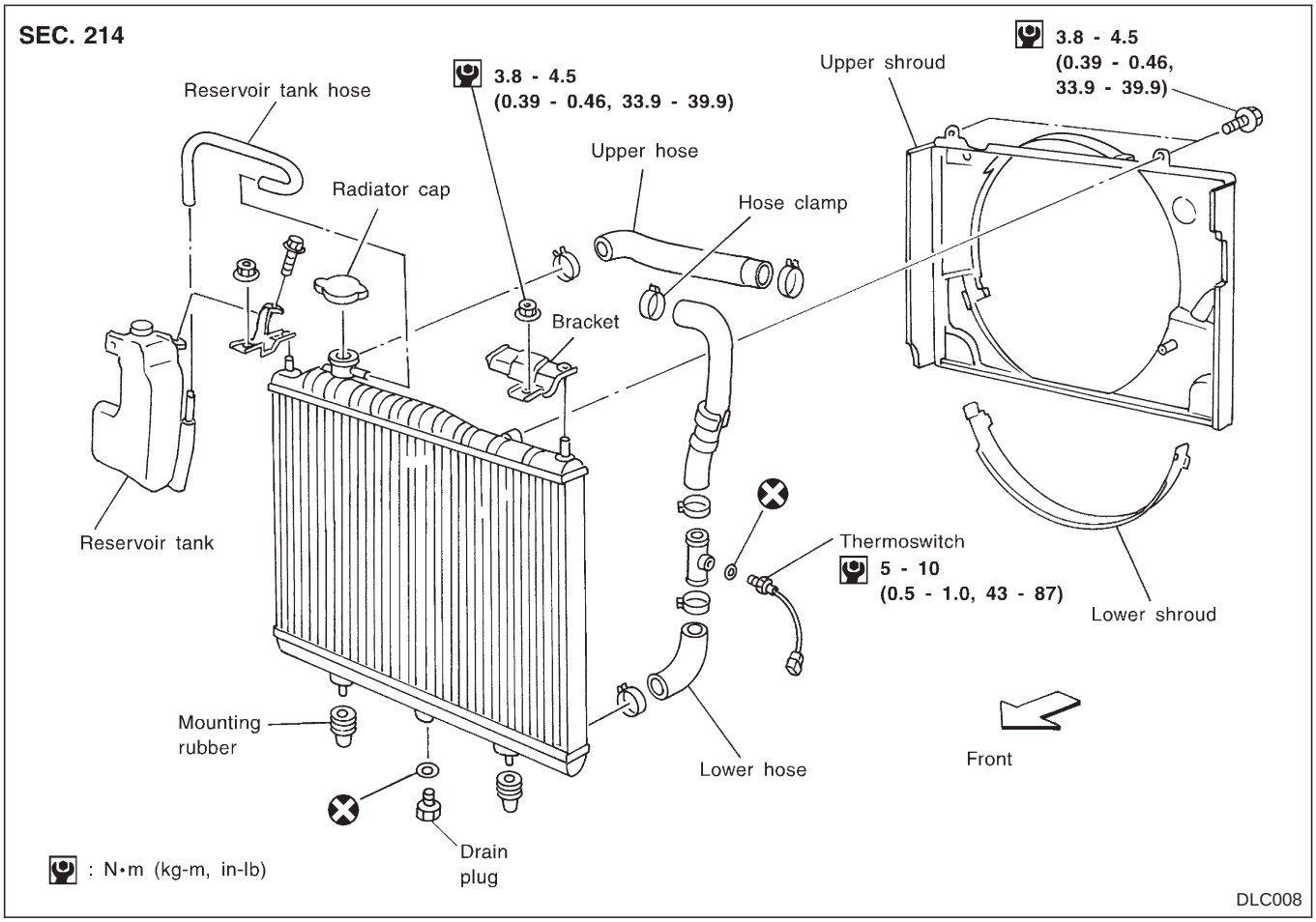
	Tropical type	Standard type
Valve opening temperature °C (°F)	76.5 (170)	82 (180)
Valve lift mm/°C (in/°F)	More than 8/90 (0.31/194)	More than 8/95 (0.31/203)

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

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.

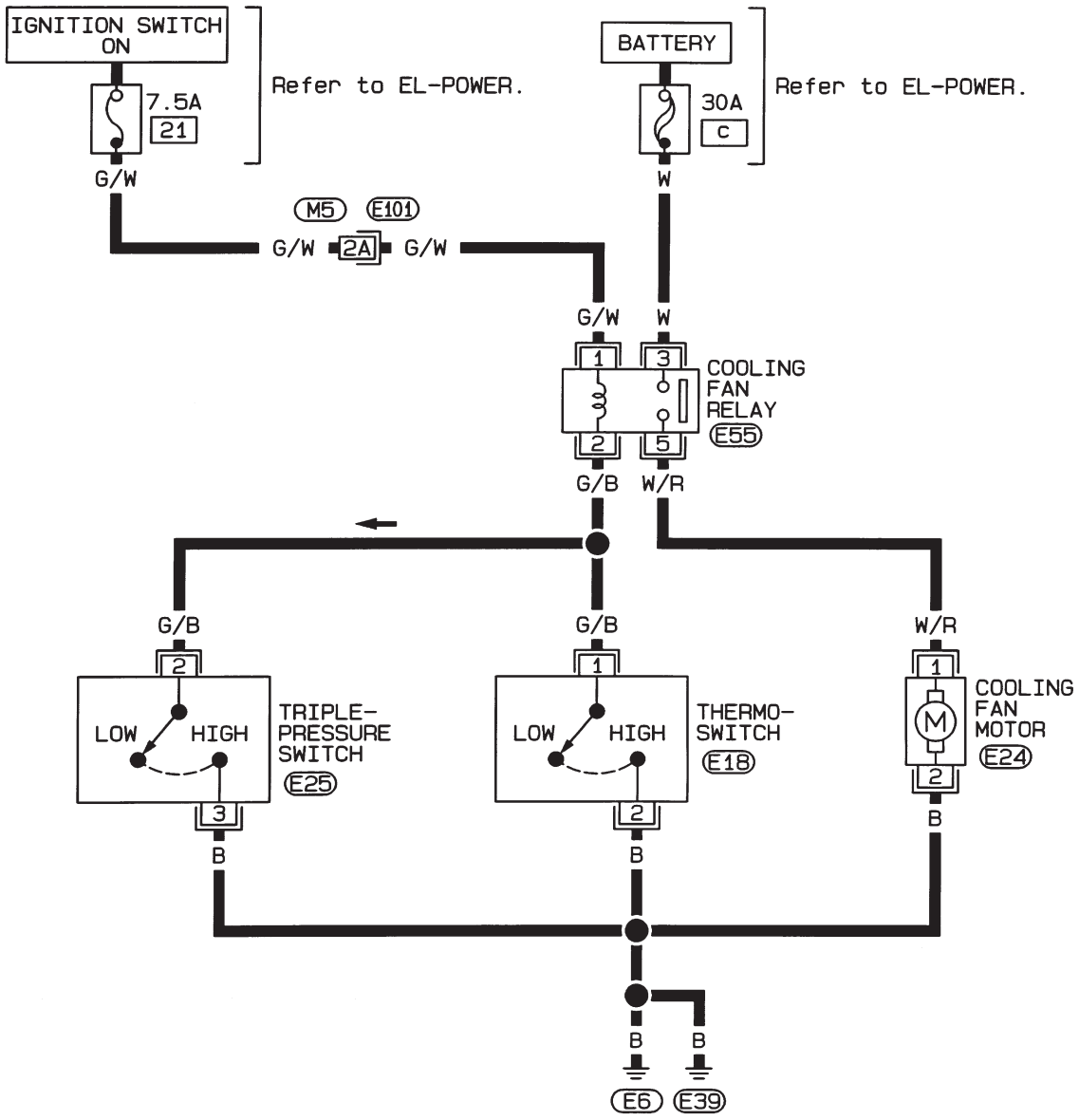


Refilling Engine Coolant

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

Wiring Diagram

LC-COOL/F-01



E18 GY, E24 GY

E25 B

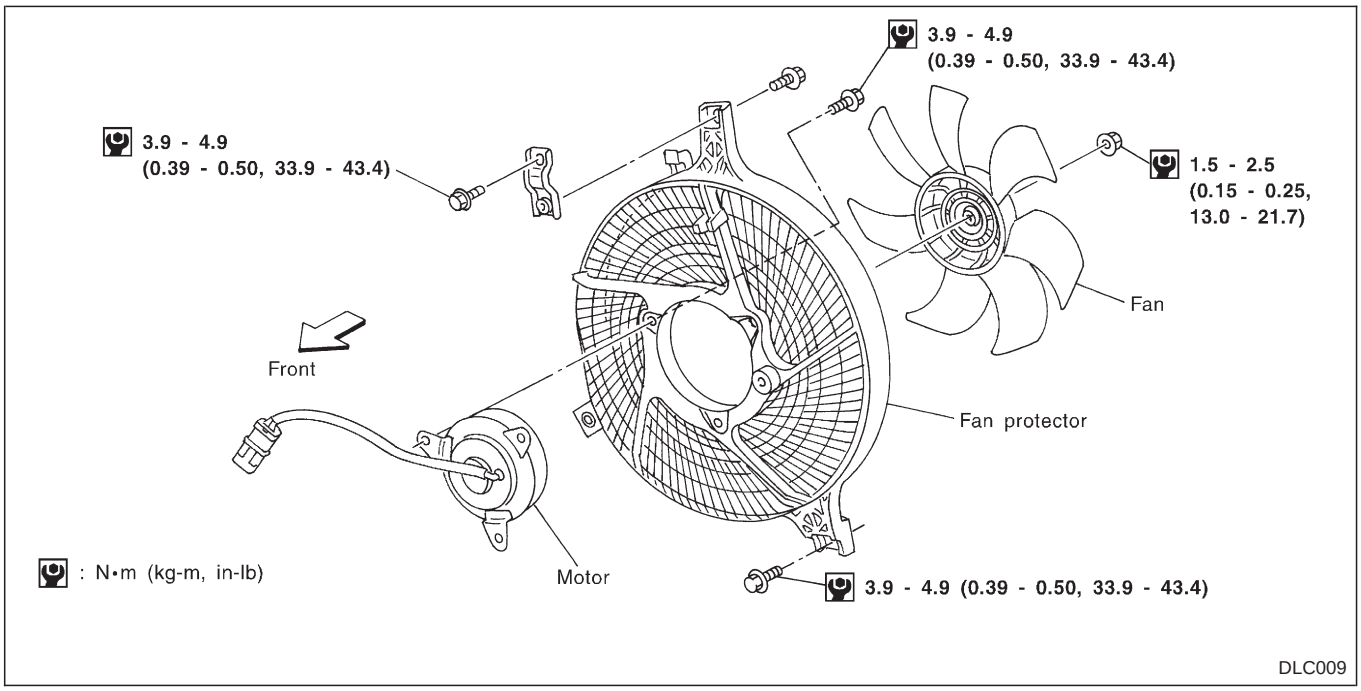
E55 L

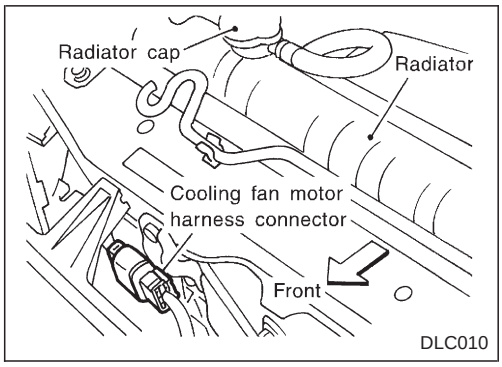
Refer to last page (Foldout page).

M5, E101

HLC005

Cooling Fan (Motor driven)

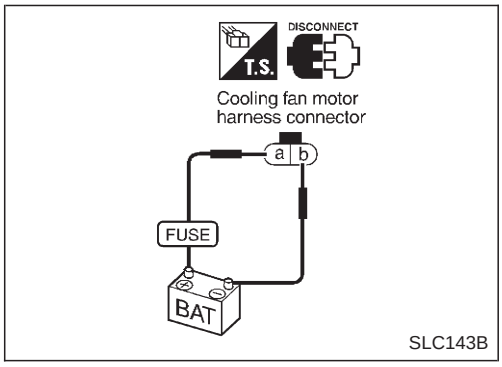




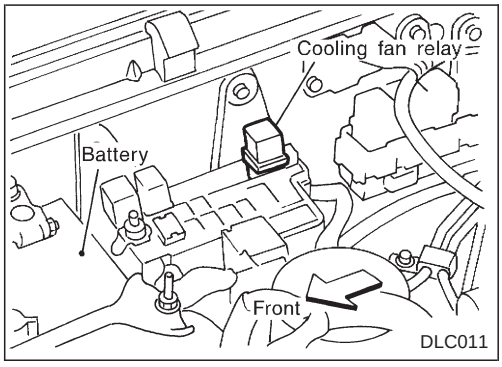
Electrical Components Inspection

COOLING FAN MOTOR

1. Disconnect cooling fan motor harness connector.

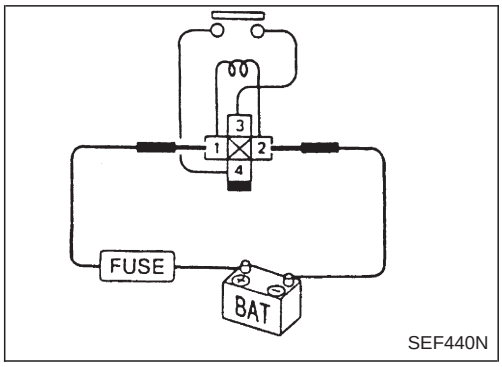


2. Supply cooling fan motor terminals with battery voltage and check operation.
   Cooling fan motor should operate.
   If NG, replace cooling fan motor.



COOLING FAN RELAY

Electrical Components Inspection (Cont'd)

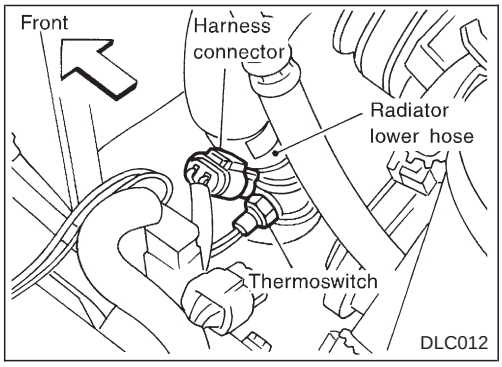


SEF440N

Check continuity between terminals ③ and ④.

Conditions	Continuity
12V direct current supply between terminals ① and ②	Yes
No current supply	No

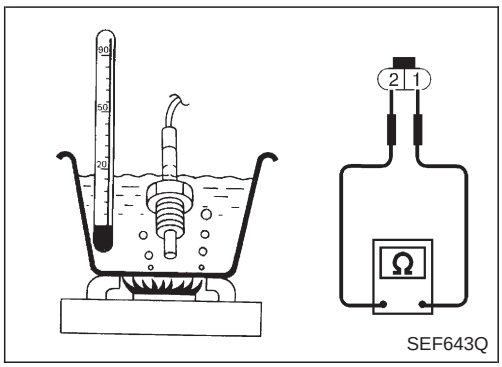
If NG, replace relay.



DLC012

THERMOSWITCH

1. Disconnect thermoswitch harness connector.



SEF643Q

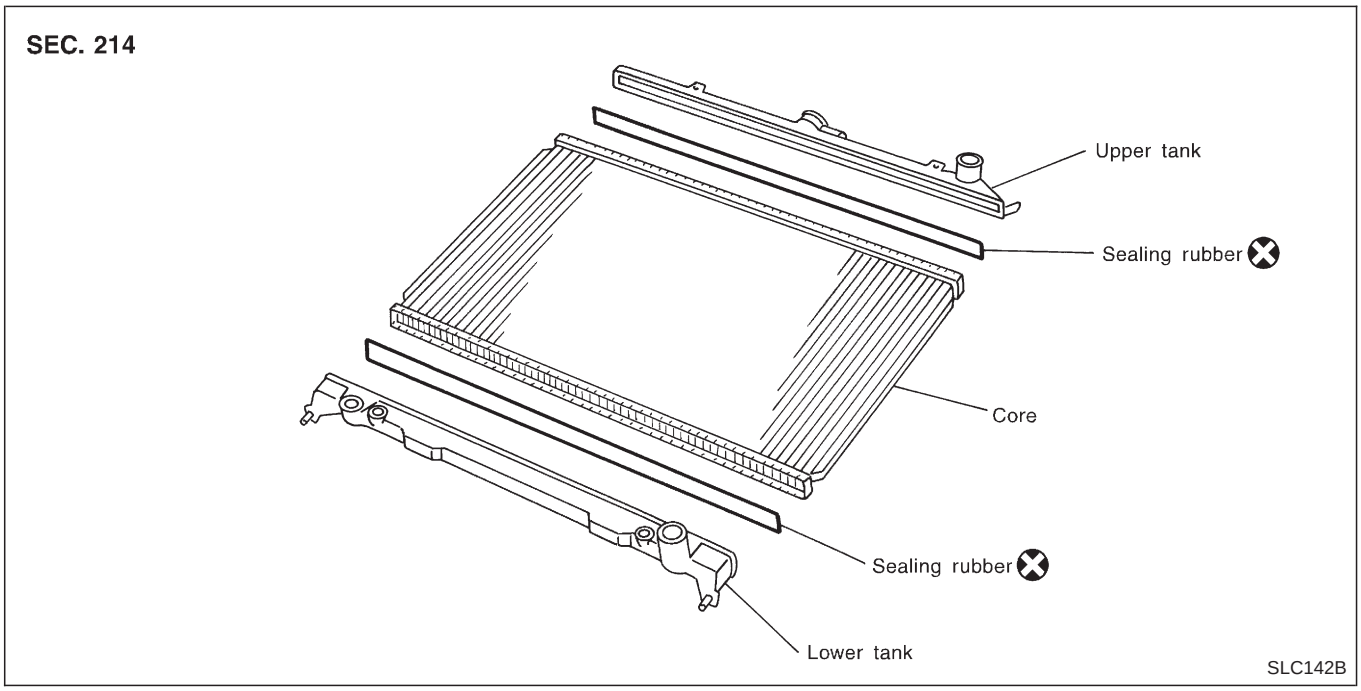
2. Check operation as shown in the figure.

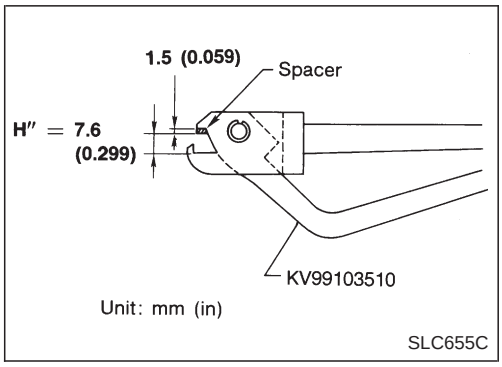
Coolant temperature °C (°F)	Operation	Continuity
Increased to 92 - 98 (198 - 208)	OFF → ON	ON: Exists.
Decreased to 87 - 93 (189 - 199)	ON → OFF	OFF: Does not exist.

TRIPLE-PRESSURE SWITCH

For inspection of this switch, refer to HA section (''TRIPLE-PRESSURE SWITCH'', ''Electrical Components Inspection'').

Radiator (Aluminum type)

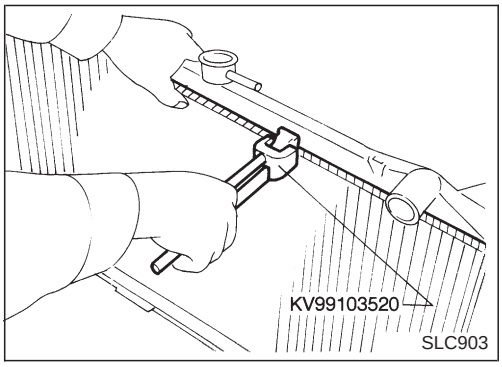




PREPARATION

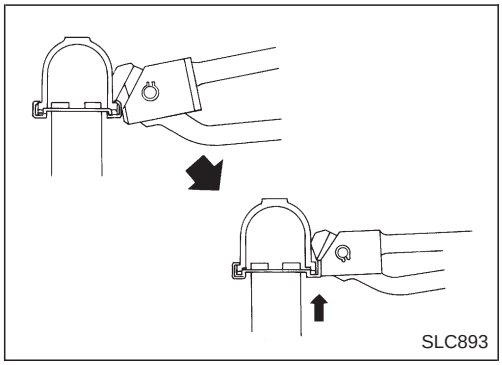
1. Attach the spacer to the tip of the radiator plate pliers A. Spacer specification: 1.5 mm (0.059 in) thick x 18 mm (0.71 in) wide x 8.5 mm (0.335 in) long.
2. Make sure that when radiator plate pliers A are closed dimension H″ is approx. 7.6 mm (0.299 in).
3. Adjust dimension H″ with the spacer, if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

- **If the radiator core rims cannot be crimped as specified, further modification of the radiator plate pliers A is required. Refer to the Technical Bulletin LC 91-001.**



DISASSEMBLY

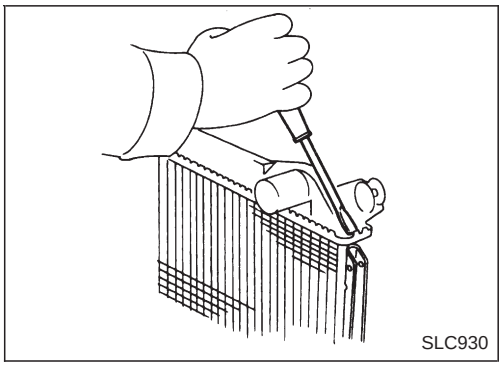
1. Remove tank with Tool.



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

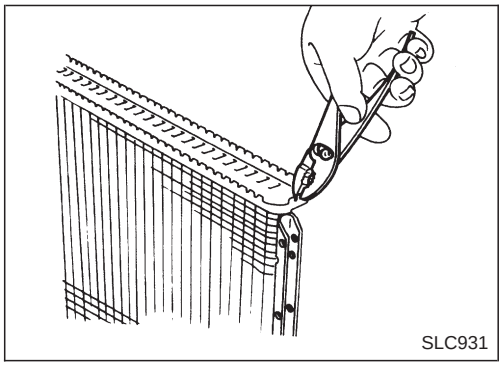
Do not bend excessively.

Radiator (Aluminum type) (Cont'd)

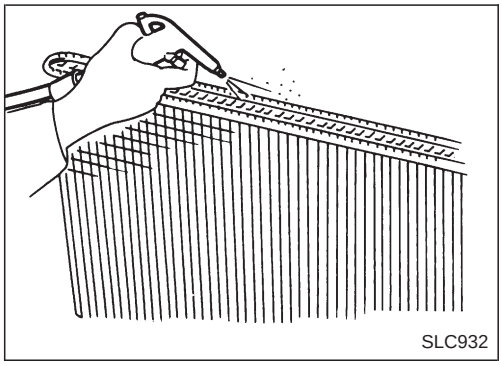


- In areas where Tool cannot be used, use a screwdriver to bend the edge up.

Be careful not to damage tank.

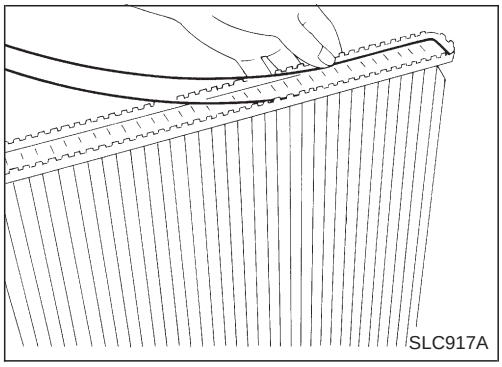


2. Make sure the edge stands straight up.



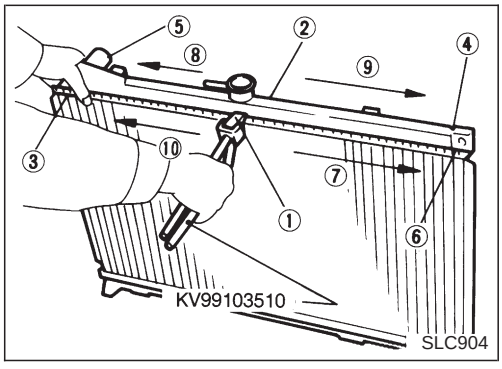
ASSEMBLY

1. Clean contact portion of tank.



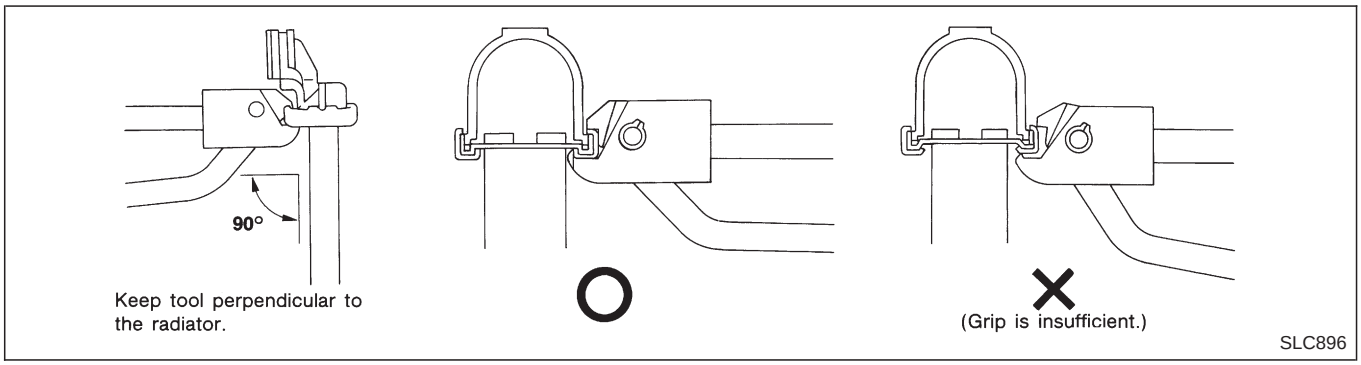
2. Install sealing rubber.

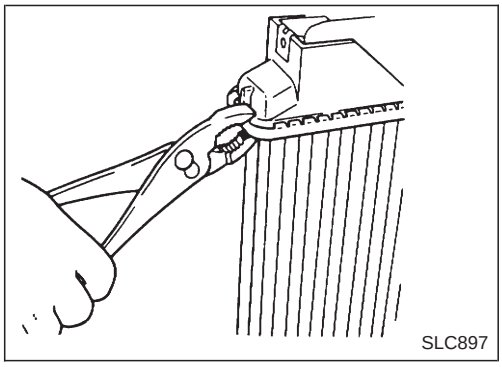
Push it in with fingers.
Be careful not to twist sealing rubber.



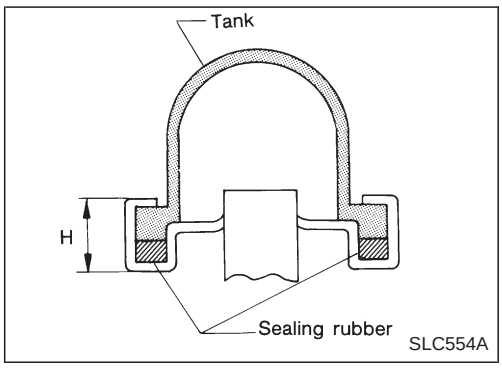
3. Caulk tank in specified sequence with Tool.

Radiator (Aluminum type) (Cont'd)



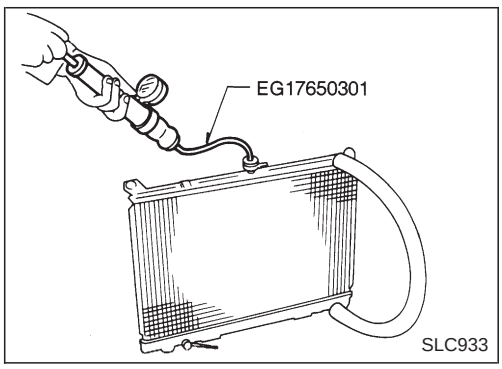


- Use pliers in the locations where Tool cannot be used.



4. Make sure that the rim is completely crimped down.
   Standard height "H":
   8.0 - 8.4 mm (0.315 - 0.331 in)
5. Confirm that there is no leakage.

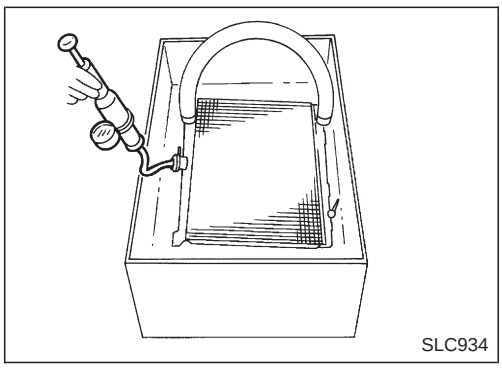
Refer to Inspection.



INSPECTION

1. Apply pressure with Tool.
   Specified pressure value:
   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.



2. Check for leakage.

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		

Engine Lubrication System (KA)

Oil pressure check

Engine speed rpm	Approximate discharge pressure kPa (bar, kg/cm^2, psi)
Idle speed	More than 78 (0.78, 0.8, 11)
3,000	412 - 481 (4.12 - 4.81, 4.2 - 4.9, 60 - 70)

Oil pump inspection

Unit: mm (in)

Rotor tip clearance	Less than 0.12 (0.0047)
Outer rotor to body radial clearance	0.15 - 0.21 (0.0059 - 0.0083)
Side clearance (with gasket)	0.04 - 0.08 (0.0016 - 0.0031)

Engine Cooling System (KA)

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 (bar, kg/cm^2, psi)

Cap relief pressure	Standard	78 - 98 (0.78 - 0.98, 0.8 - 1.0, 11 - 14)
	Limit	59 - 98 (0.59 - 0.98, 0.6 - 1.0, 9 - 14)
Leakage test pressure		157 (1.57, 1.6, 23)

Engine Lubrication System (TD)

Oil pressure check

Engine speed rpm	Approximate discharge pressure kPa (bar, kg/cm^2, psi)
Idle speed	More than 78 (0.78, 0.8, 11)
3,000	294 - 392 (2.94 - 3.92, 3.0 - 4.0, 43 - 57)

Oil pump inspection

Unit: mm (in)

Gear side clearance	Less than 0.13 (0.0051)
Gear backlash	Less than 0.43 (0.0169)
Oil pump bushing clearance	Less than 0.15 (0.0059)
Oil pump bushing inside diameter	13.012 - 13.106 (0.5123 - 0.5160)
Drive gear shaft outside diameter	12.974 - 12.992 (0.5108 - 0.5115)

Engine Cooling System (TD)

Radiator

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

Thermostat

	Tropical type	Standard type
Valve opening temperature °C (°F)	76.5 (170)	82 (180)
Valve lift mm/°C (in/°F)	More than 8/90 (0.31/194)	More than 8/95 (0.31/203)