

ENGINE LUBRICATION & COOLING SYSTEMS

SECTION **LC**

LC

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PREPARATION

SPECIAL SERVICE TOOLS

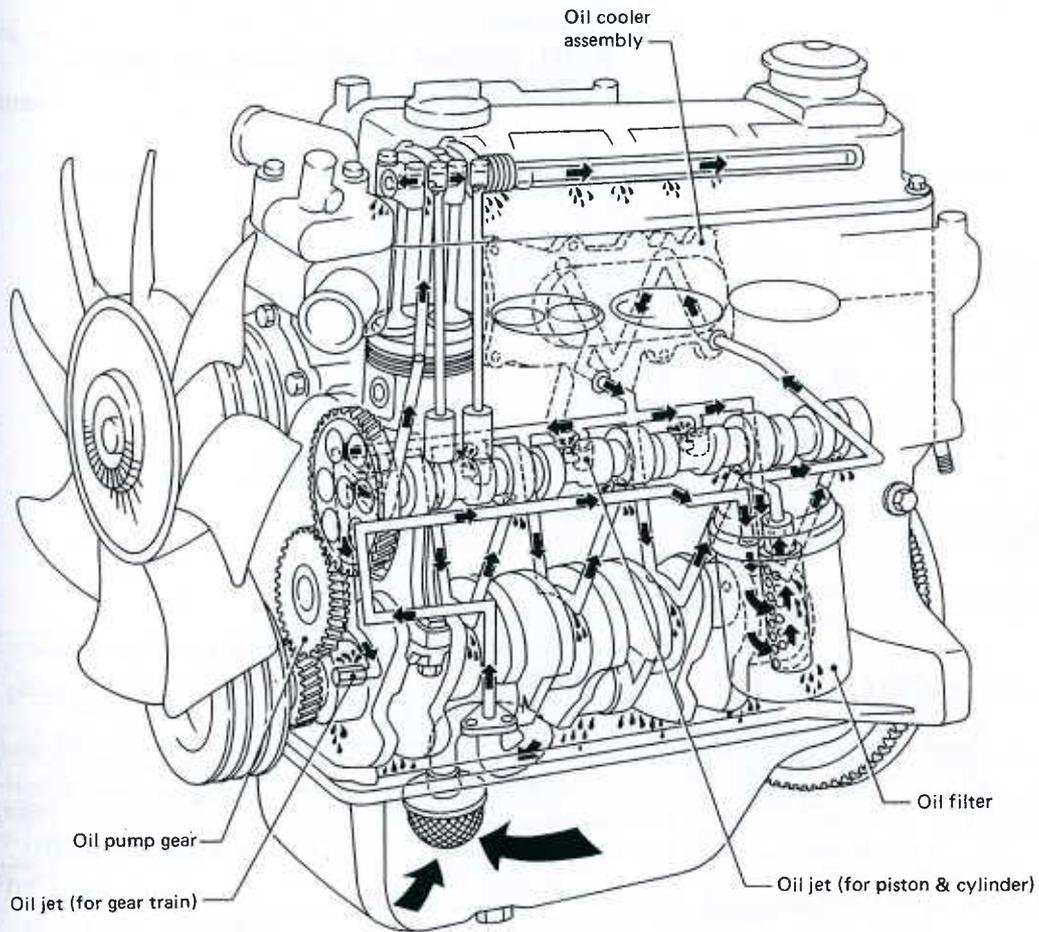
Tool number Tool name	Description
ST25051001 Oil pressure gauge	
ST25052000 Hose	 Adapting oil pressure gauge to cylinder block
EG17650301 Radiator cap tester adapter	 Adapting radiator cap tester to radiator filler neck

Note: 

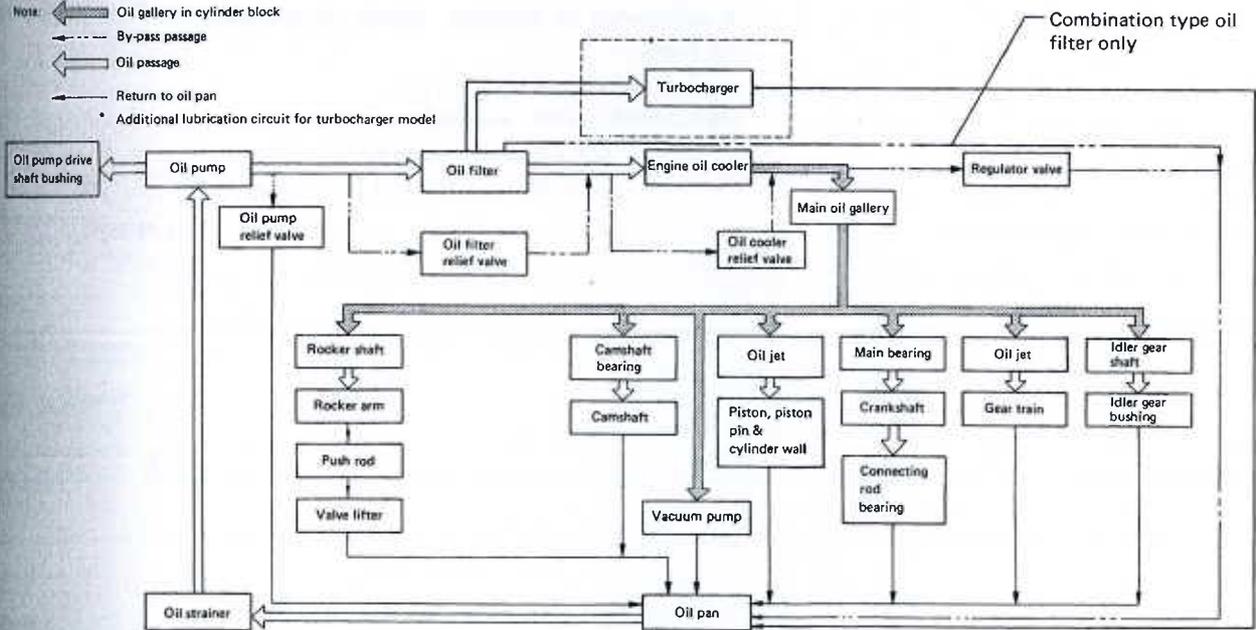
Oil pump di
shaft bushin

ENGINE LUBRICATION SYSTEM

Lubrication Circuit



- Note:
- ← Oil gallery in cylinder block
 - By-pass passage
 - ← Oil passage
 - ← Return to oil pan
 - Additional lubrication circuit for turbocharger model



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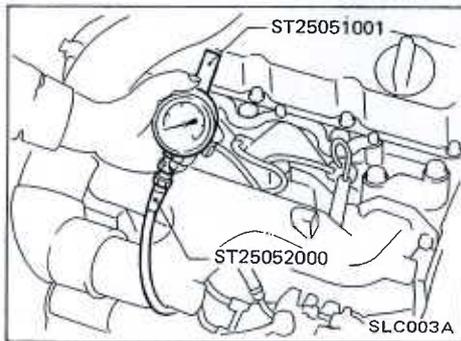
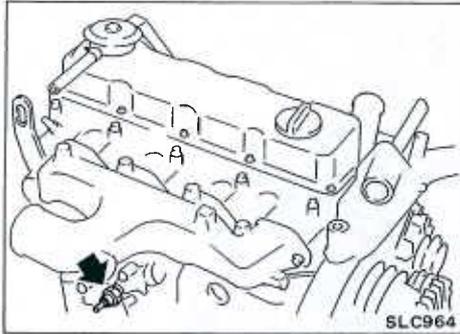
LC-3

ENGINE LUBRICATION SYSTEM

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. 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 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.

6. Install oil pressure switch.

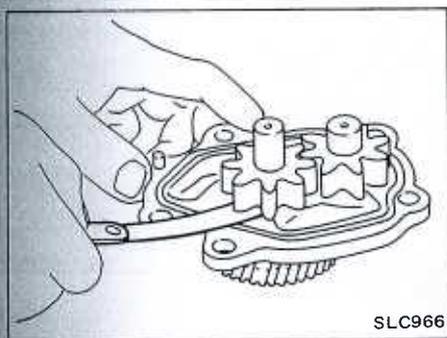
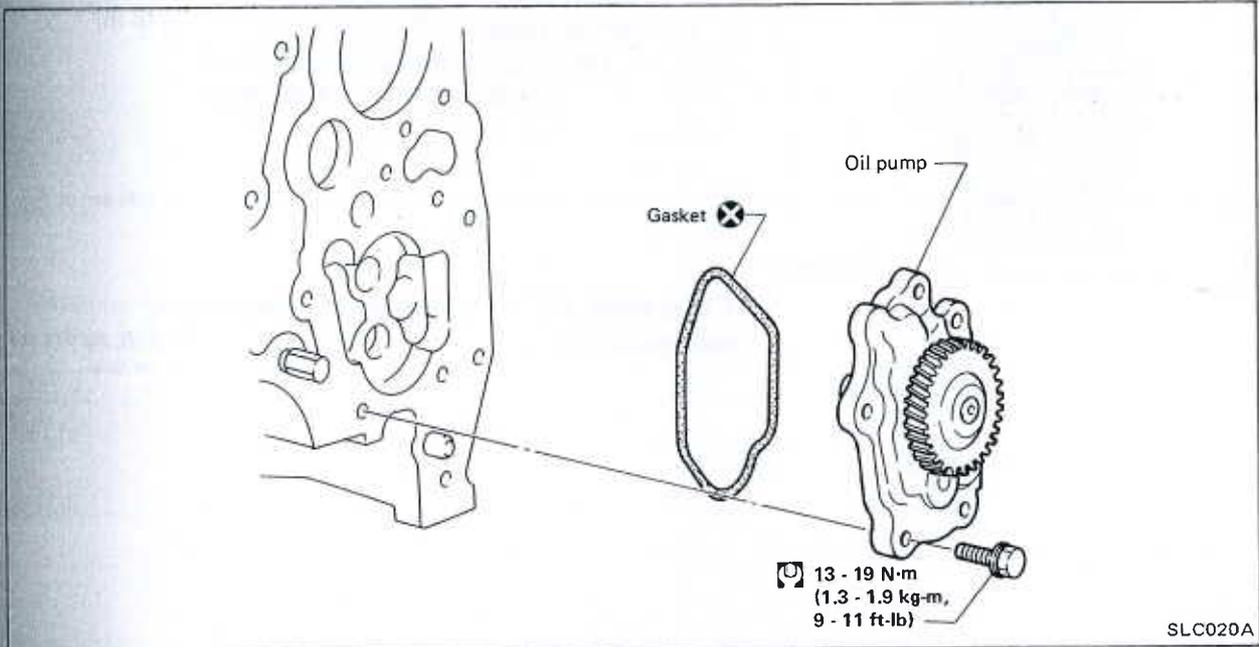
Use proper liquid sealant.

Oil pressure switch:

⊞ : 10 - 13 N·m (1.0 - 1.3 kg-m, 7 - 9 ft-lb)

ENGINE LUBRICATION SYSTEM

Oil Pump



OIL PUMP INSPECTION

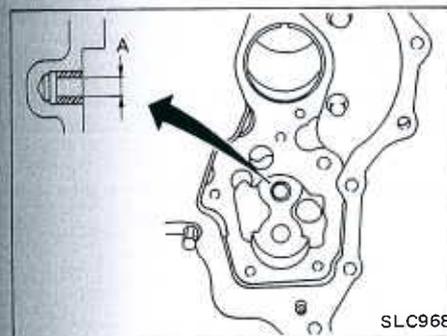
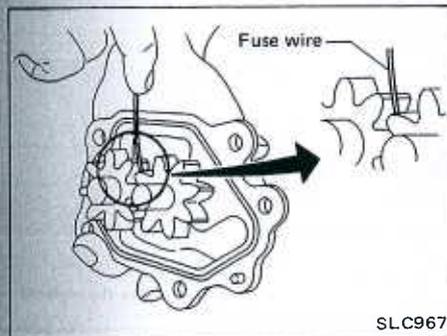
1. Inspect pump body, gears and drive shaft for wear and damage.
2. Using a feeler gauge and fuse wire, check the following clearances.

Gear side clearance:

Less than 0.13 mm (0.0051 in)

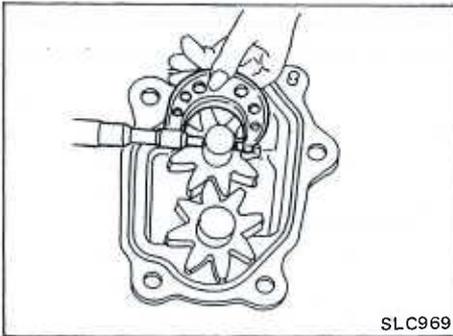
Gear backlash:

Less than 0.43 mm (0.0169 in)



3. Measure inside diameter "A" of bushing.
A: 13.012 - 13.098 mm (0.5123 - 0.5157 in)

ENGINE LUBRICATION SYSTEM

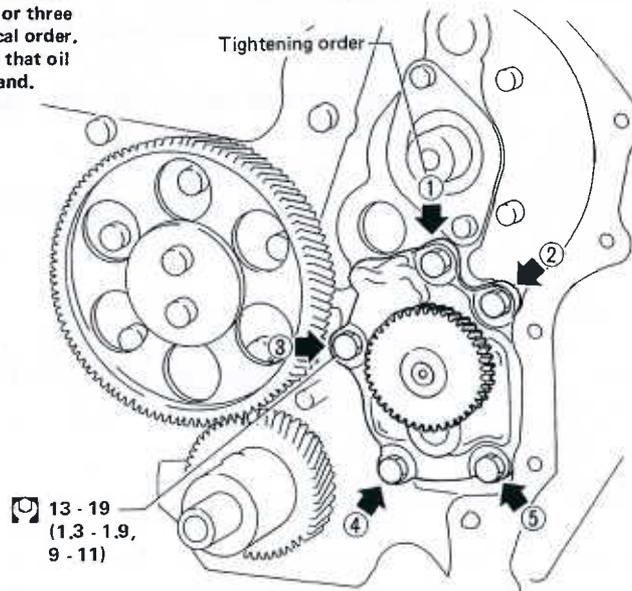


Oil Pump (Cont'd)

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.

- When installing oil pump, the bolt should be tightened in two or three stages according to numerical order.
- After installation, ascertain that oil pump turns smoothly by hand.



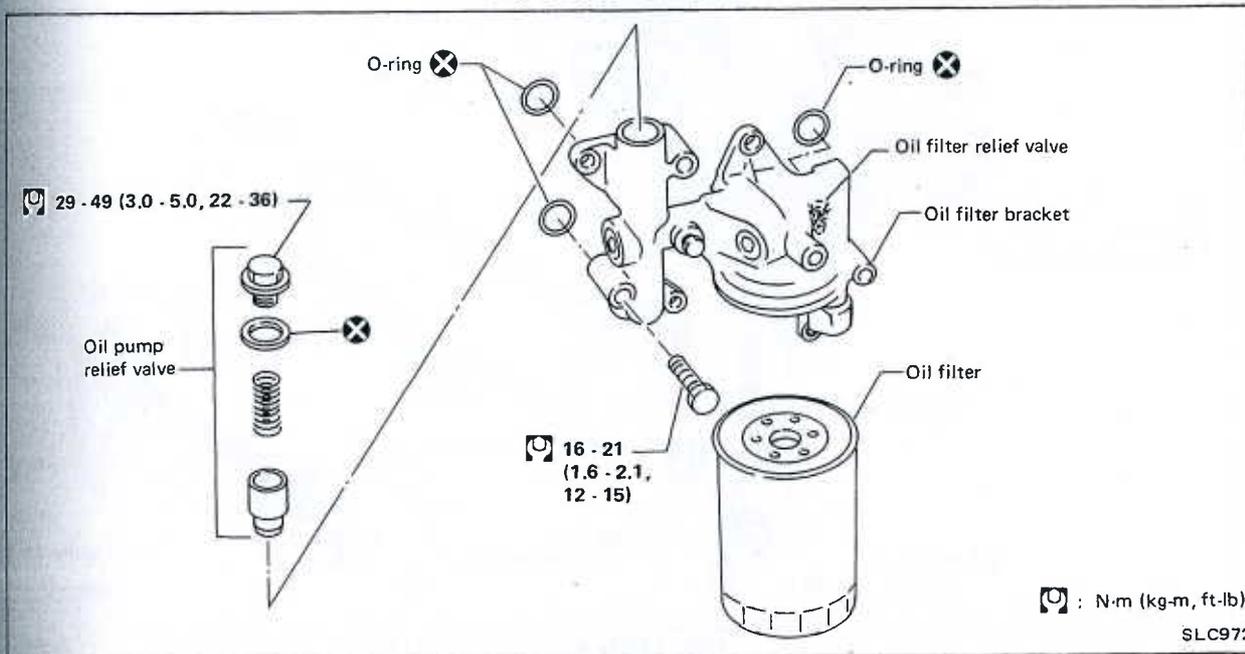
: N·m (kg·m, ft·lb)
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29 - 49 (3)

Oil pump
relief v

ENGINE LUBRICATION SYSTEM

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.

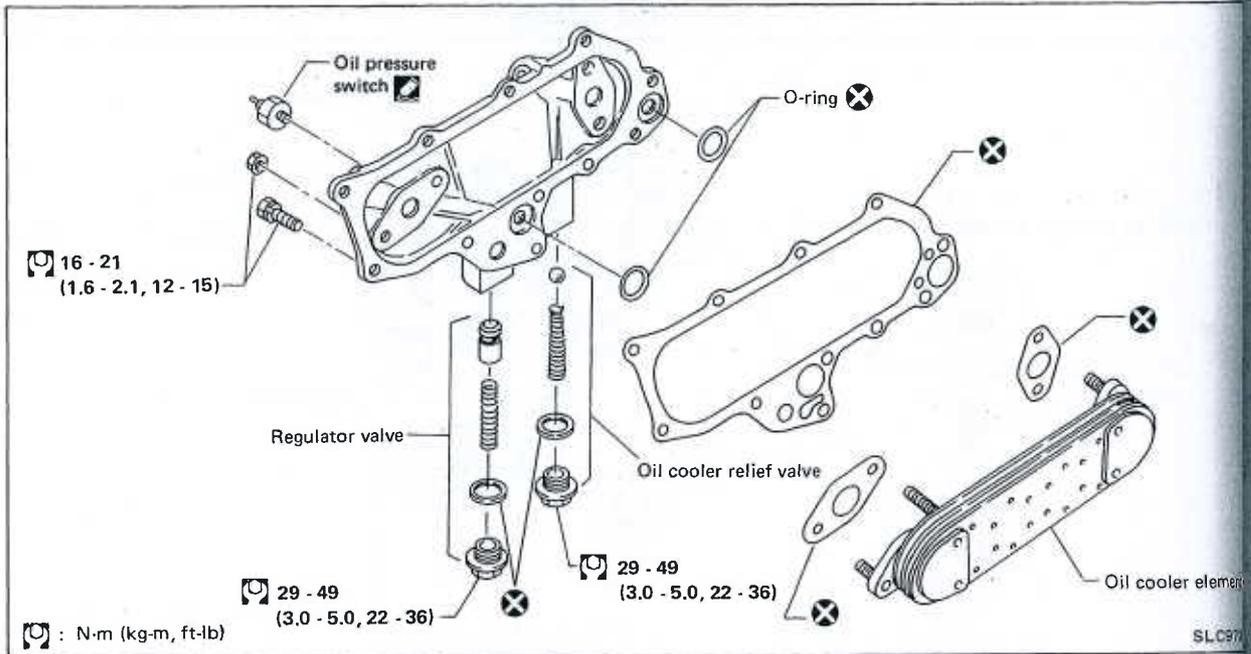
OIL FILTER RELIEF VALVE INSPECTION

Inspect oil filter short valve for movement, cracks and breaks by pushing the ball.

If damaged, replace oil filter bracket assembly.

ENGINE LUBRICATION SYSTEM

Oil Cooler



OIL COOLER RELIEF VALVE INSPECTION

Inspect oil cooler relief valve for movement, cracks and break 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.

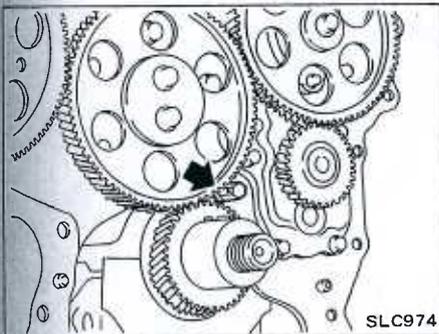
If damaged, replace regulator valve set.

ENGINE LUBRICATION SYSTEM

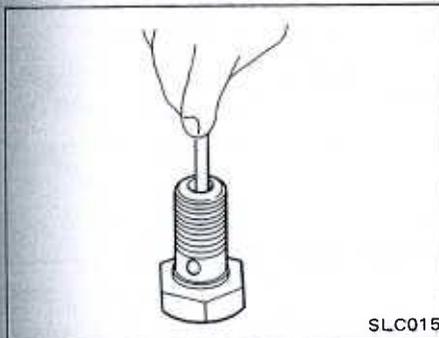
Oil Jet

INSPECTION (For gear train)

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

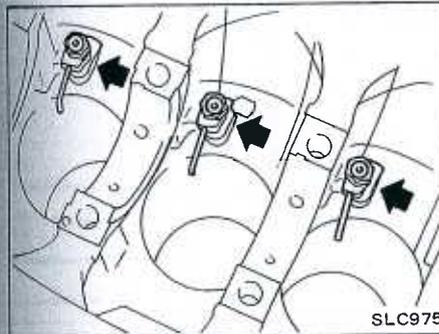


Oil jet has to be installed with oil hole facing crank gear and idler gear.



INSPECTION (For piston)

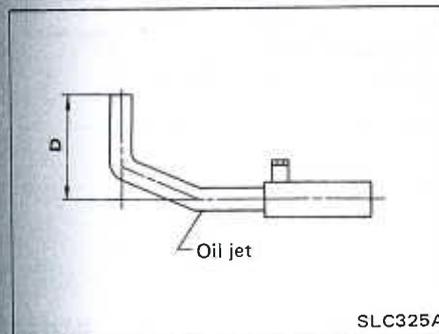
1. Blow through outlet of oil jet and make sure that air comes out of inlet.
2. Push cut-off valve of oil jet bolt with a clean resin or brass rod and make sure that cut-off valve moves smoothly with proper repulsion.



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

Oil jet bolt:

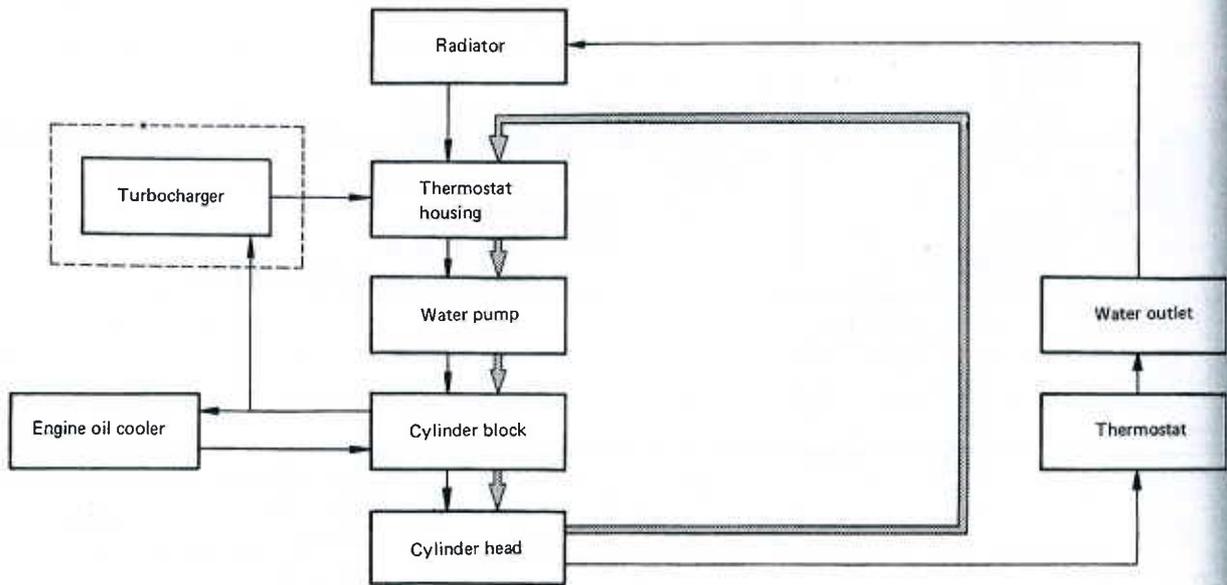
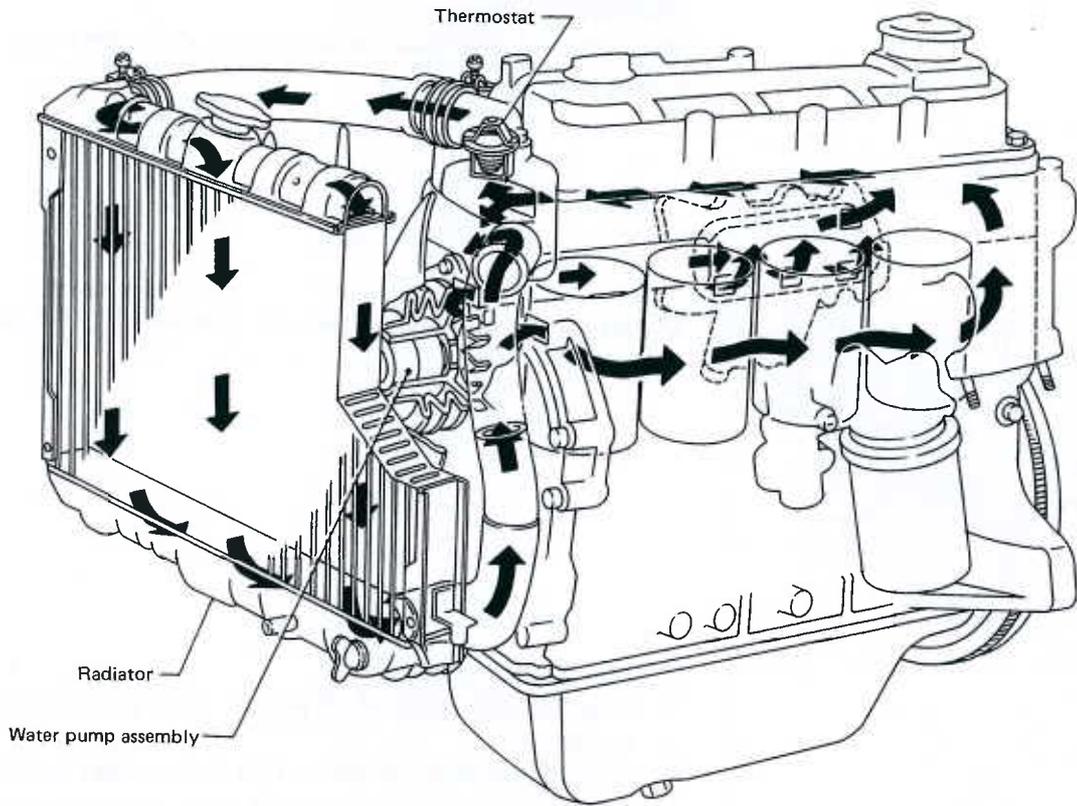
- ☞ : 29 - 39 N·m
(3.0 - 4.0 kg·m, 22 - 29 ft·lb)



		TD23, TD25, TD27	TD27T
Dimension "D" mm (in)	Type I	12 (0.47)	-
	Type II	-	22 (0.87)

COOLING SYSTEM

Cooling Circuit



*: Additional cooling circuit for turbocharger model.

← Under cold conditions

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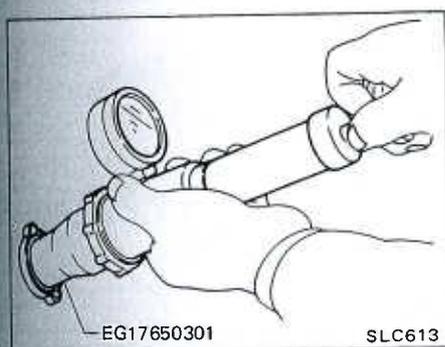
LC-10

COOLING SYSTEM

Cooling System Inspection

CHECKING HOSES

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



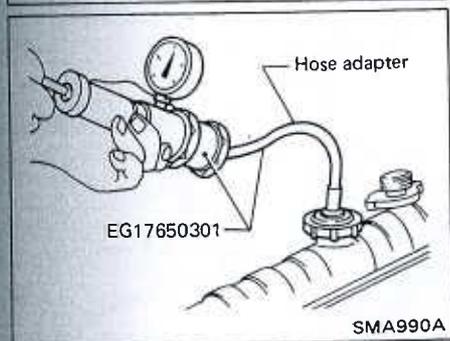
CHECKING RADIATOR CAP

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/cm², 11 - 14 psi)



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:

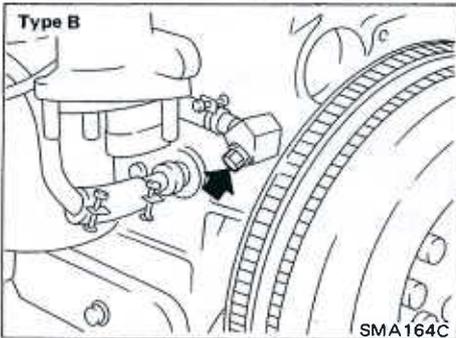
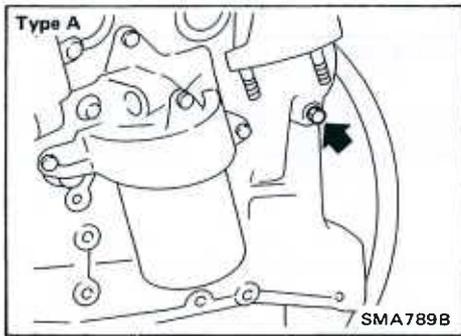
Higher than the specified pressure may cause radiator damage.

outlet

ostat

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COOLING SYSTEM



Water Pump REMOVAL AND INSTALLATION

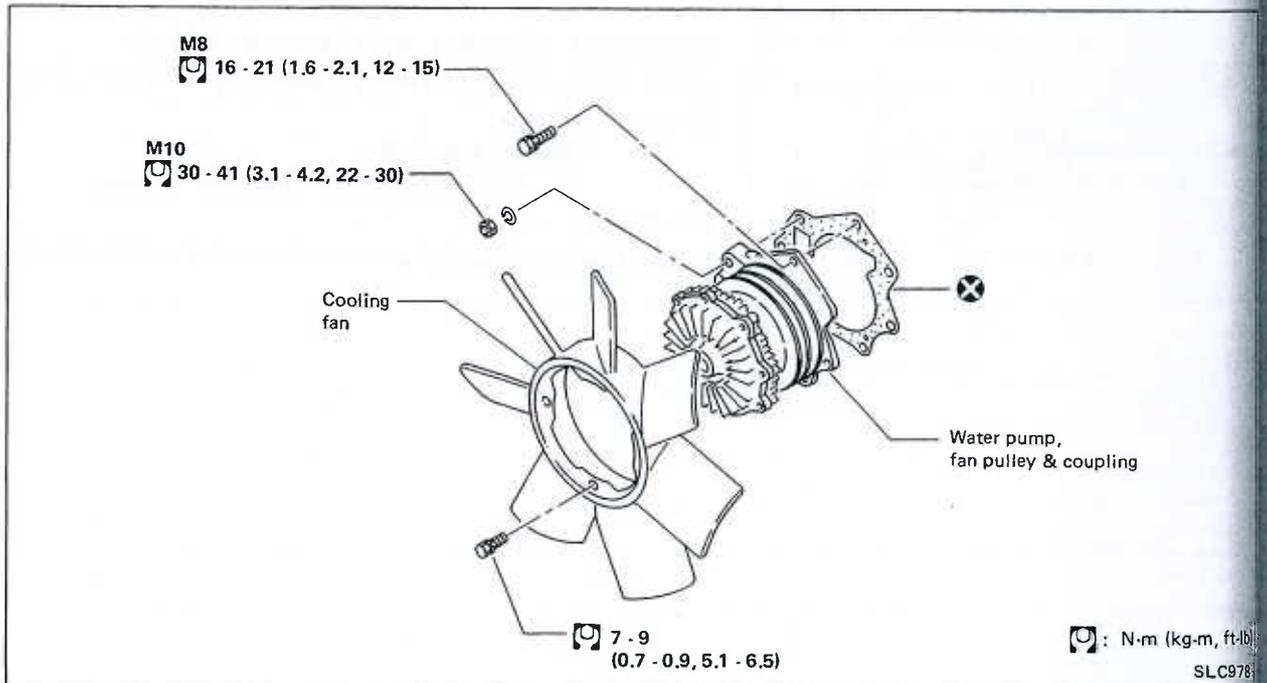
Drain coolant from drain plugs on cylinder block and radiator.

Cylinder block drain plug

(Use proper sealant):

⌘ : 20 - 29 N.m

(2.0 - 3.0 kg-m, 14 - 22 ft-lb)



CAUTION:

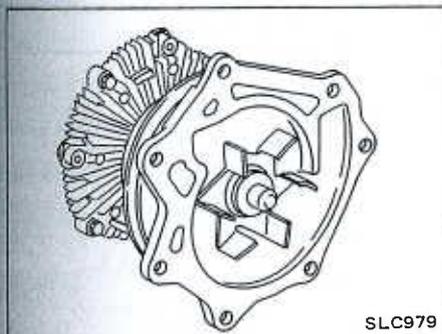
- When removing water pump assembly, be careful not to get coolant on drive belt.
- Water pump cannot be disassembled and should be replaced as a unit.
- Always replace with new gasket.
- After installing water pump, connect hose and clamp securely, then check for leaks using radiator cap tester.

COOLING SYSTEM

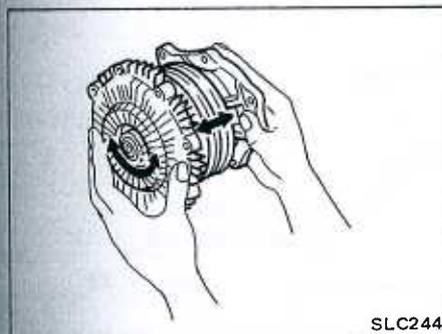
Water Pump (Cont'd)

INSPECTION

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

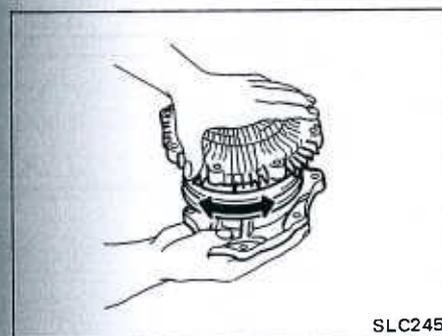


2. Check for rough operation due to excessive end play.



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

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



(kg-m, ft-lb)
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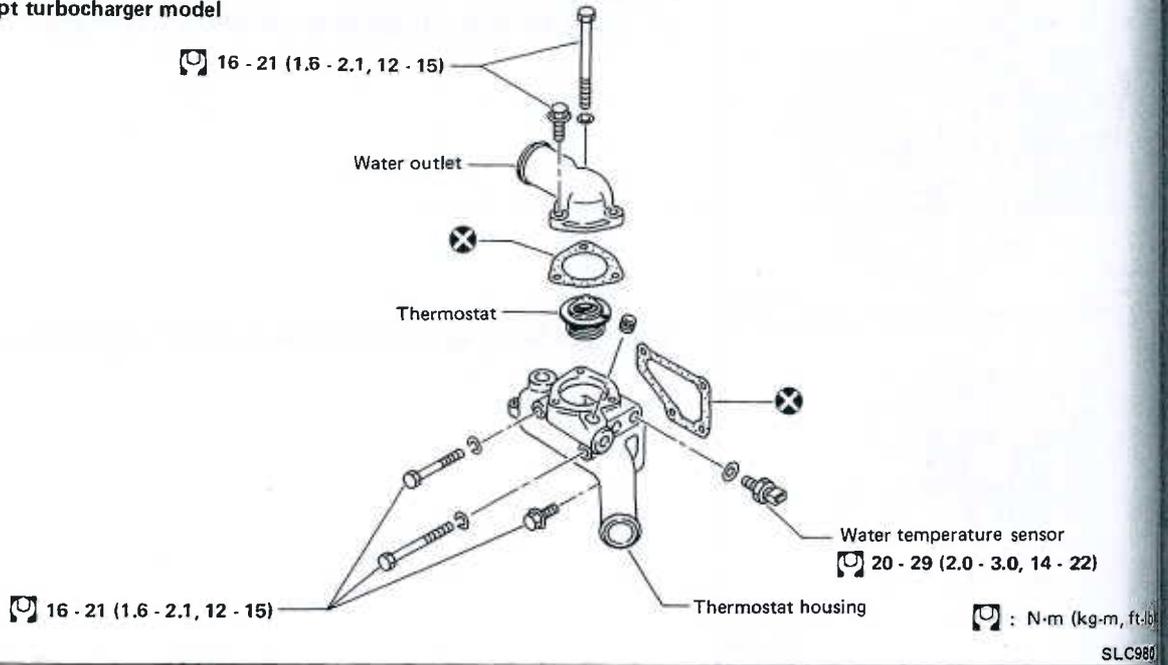
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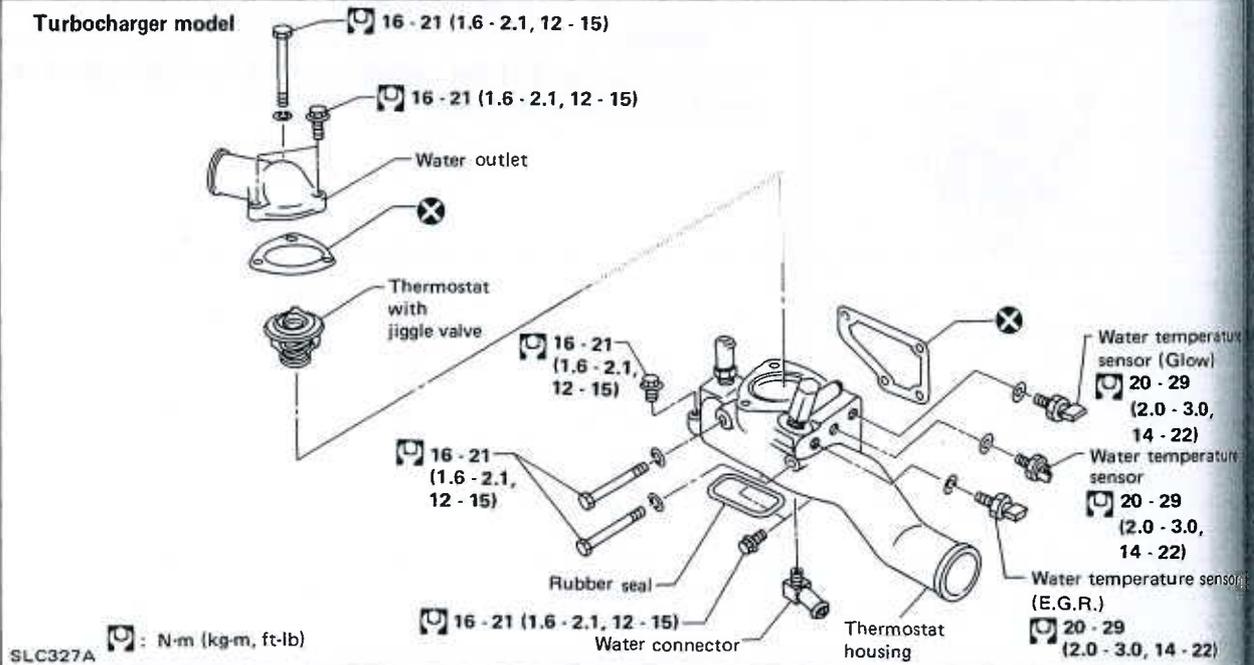
COOLING SYSTEM

Thermostat

Except turbocharger model



Turbocharger model



- 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.

COOLING SYSTEM

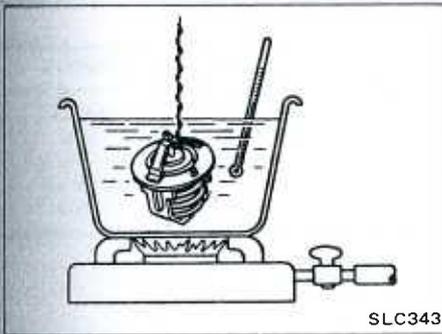
Thermostat (Cont'd)

INSPECTION

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

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

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

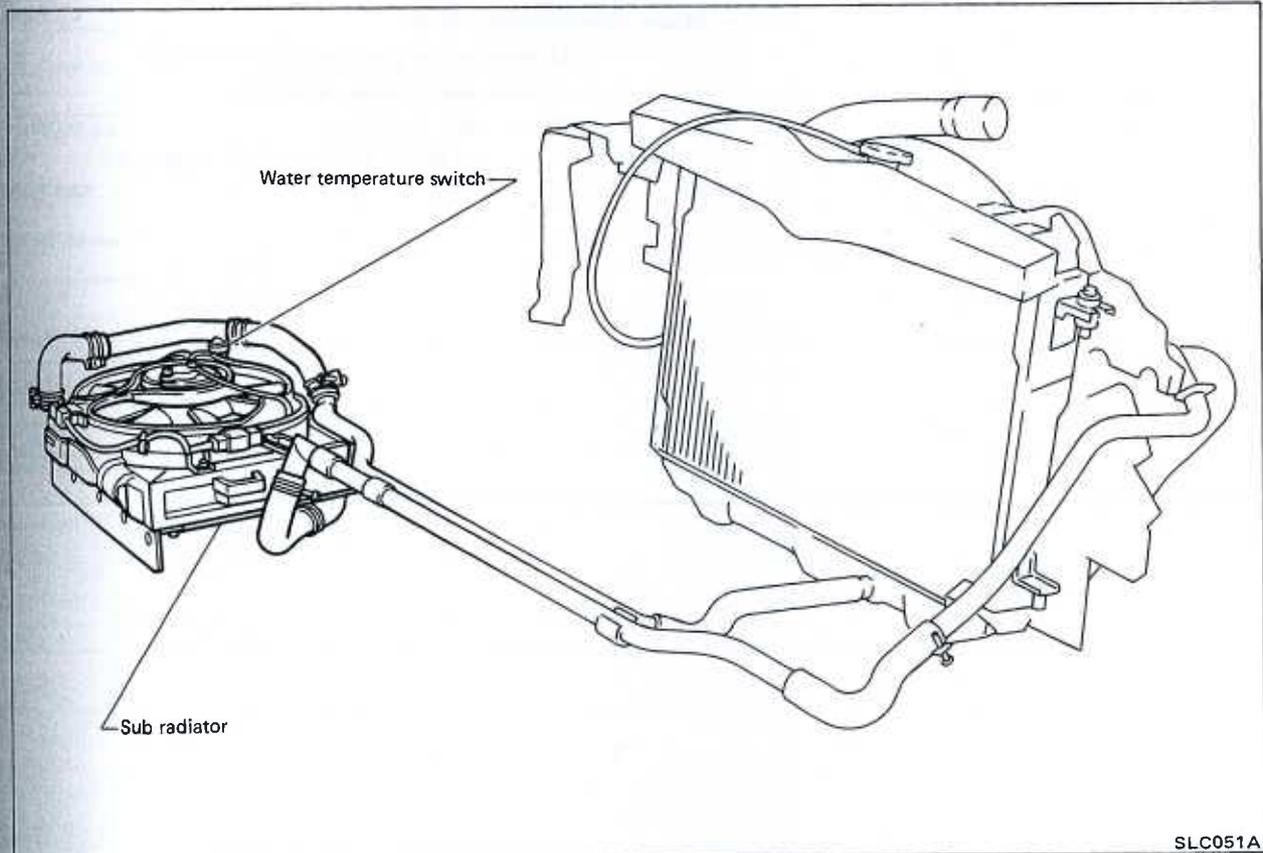


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Sub Radiator

APPLIED MODEL

- E24 series equipped with TD27 engine for Australia
- E24 series equipped with TD23 engine for tropical areas with air conditioner

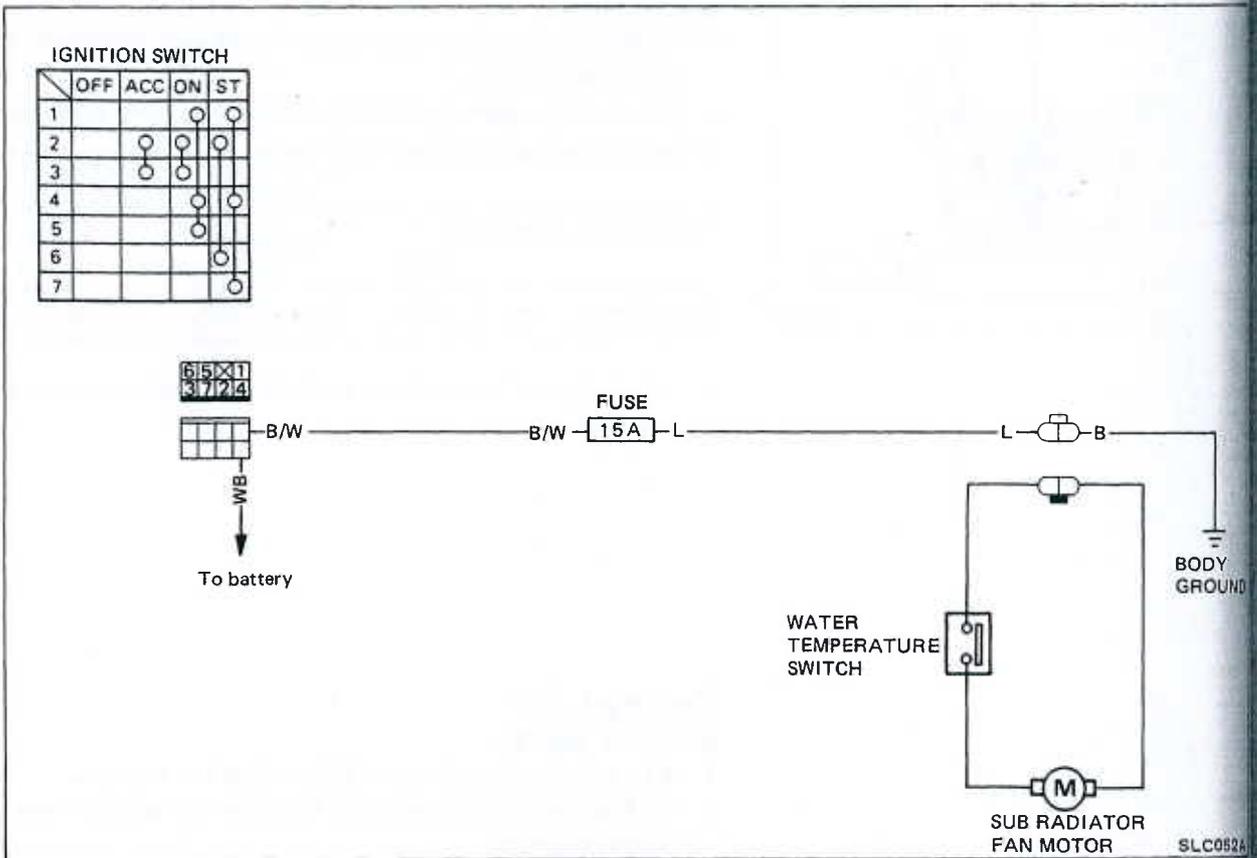


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COOLING SYSTEM

Sub Radiator (Cont'd)

Wiring for sub radiator fan motor



Water temperature switch

Operating temperature (OFF ↔ ON):

92 - 98°C (198 - 208°F)

 : 4.4 - 5.4 N·m
(0.45 - 0.55 kg·m, 3.3 - 4.0 ft·lb)

SERVICE DATA AND SPECIFICATIONS (S.D.S.)

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) 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 - 13.098 (0.5123 - 0.5157)
Drive gear shaft outside diameter	12.974 - 12.992 (0.5108 - 0.5115)

Tightening torque

Unit	N-m	kg-m	ft-lb
Oil pump fixing bolt	13 - 19	1.3 - 1.9	9 - 14
Oil cooler securing bolt	16 - 21	1.6 - 2.1	12 - 15
Oil filter bracket fixing bolt	16 - 21	1.6 - 2.1	12 - 15
Oil jet bolt (for piston)	29 - 39	3.0 - 4.0	22 - 29
Oil pump relief valve	29 - 49	3.0 - 5.0	22 - 36
Oil cooler short valve	29 - 49	3.0 - 5.0	22 - 36
Regulator valve	29 - 49	3.0 - 5.0	22 - 36

Engine Cooling System

Thermostat

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

*: TD27T engine with a jiggle valve (Frigid type) only

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	98 (0.98, 1.0, 14)

Tightening torque

Unit	N-m	kg-m	ft-lb
Water pump M8	16 - 21	1.6 - 2.1	12 - 15
M10	30 - 41	3.1 - 4.2	22 - 30
Thermostat housing bolt	16 - 21	1.6 - 2.1	12 - 15
Water outlet bolt	16 - 21	1.6 - 2.1	12 - 15
Fan securing bolt	7 - 9	0.7 - 0.9	5.1 - 6.5
Cylinder block drain plug	20 - 29	2.0 - 3.0	14 - 22
Water temperature sensor	20 - 29	2.0 - 3.0	14 - 22

BODY GROUND

SLC052A



CON

PREPA
INJEC
INJEC
INJEC
INJEC
INJEC
BLEED
FUEL
FUEL
SOLEM
POTEN
CRANI