<SUPPLEMENT-I>

ENGINE LUBRICATION & COOLING SYSTEMS

SECTION LC

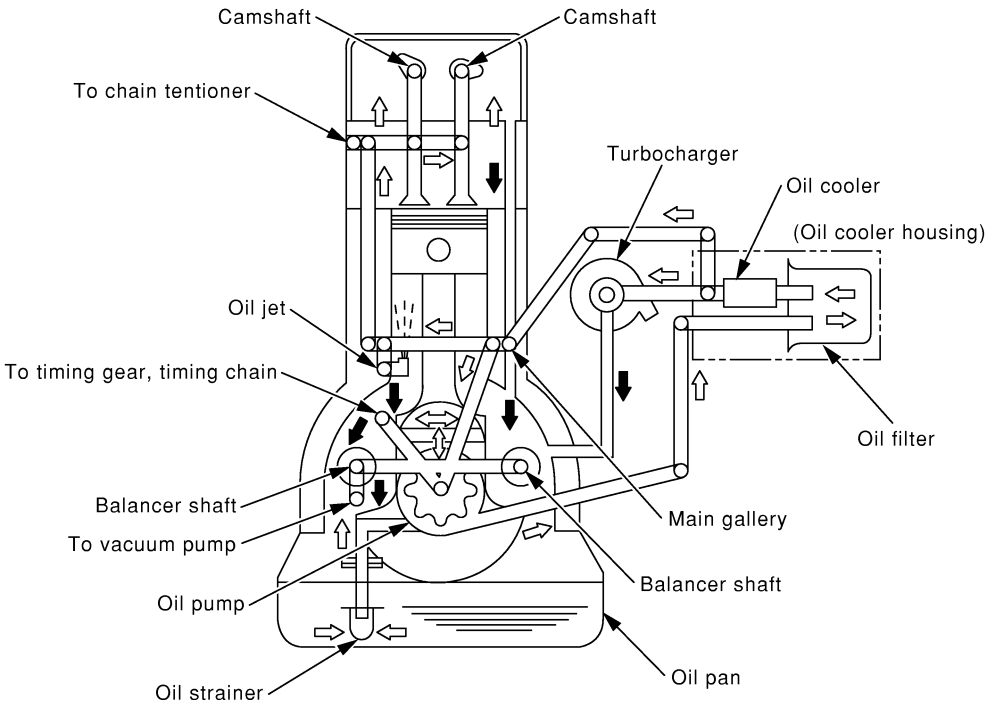
MODIFICATION NOTICE:

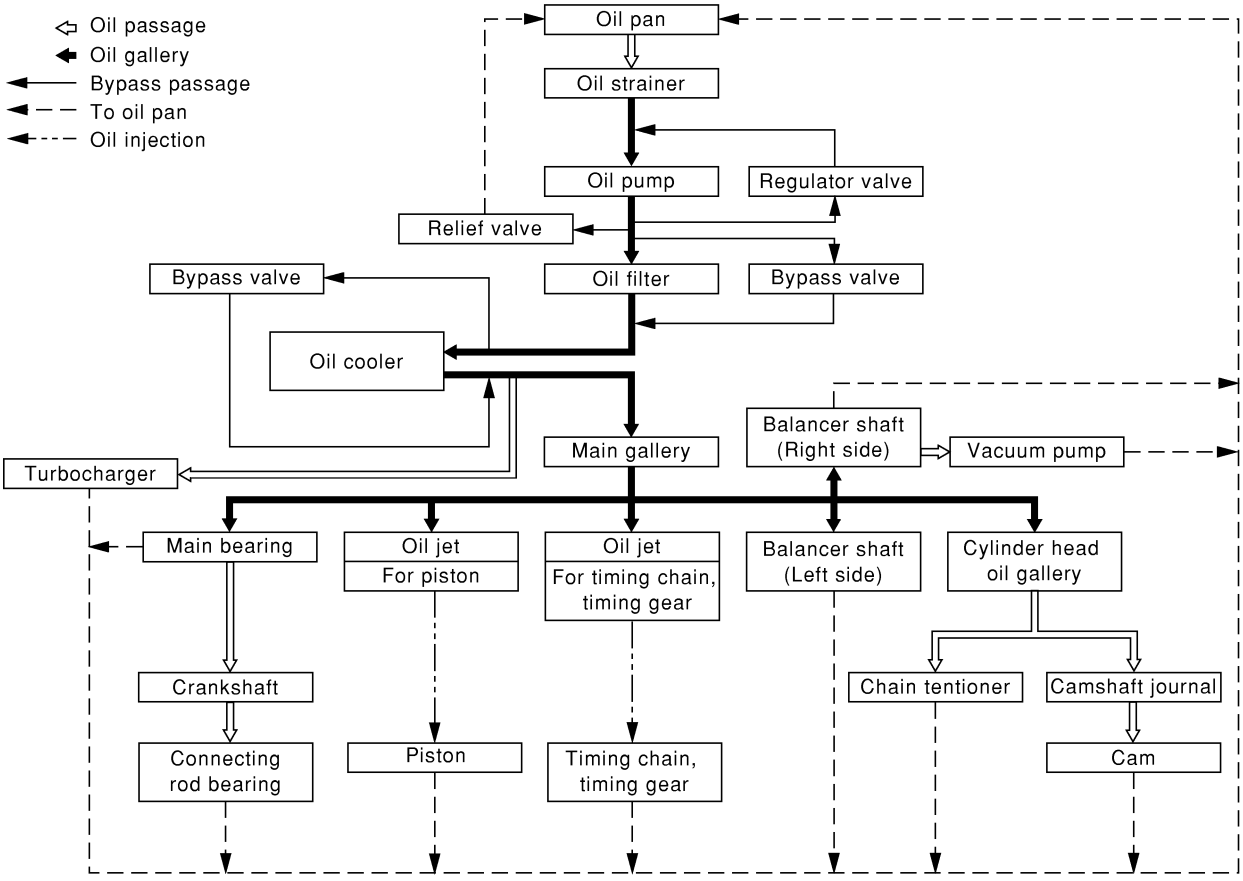
●The ZD30DDTi engine has been added.

CONTENTS

ZD

Lubricating Circuit





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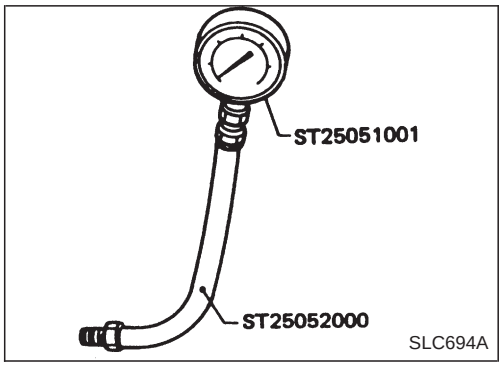
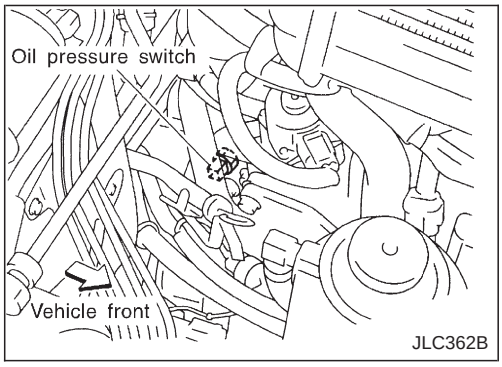




Oil Pressure Check

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.
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 147 (1.47, 1.5, 21)
2,000	More than 539 (5.39, 5.5, 78)
4,000	More than 736 (7.36, 7.5, 107)

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

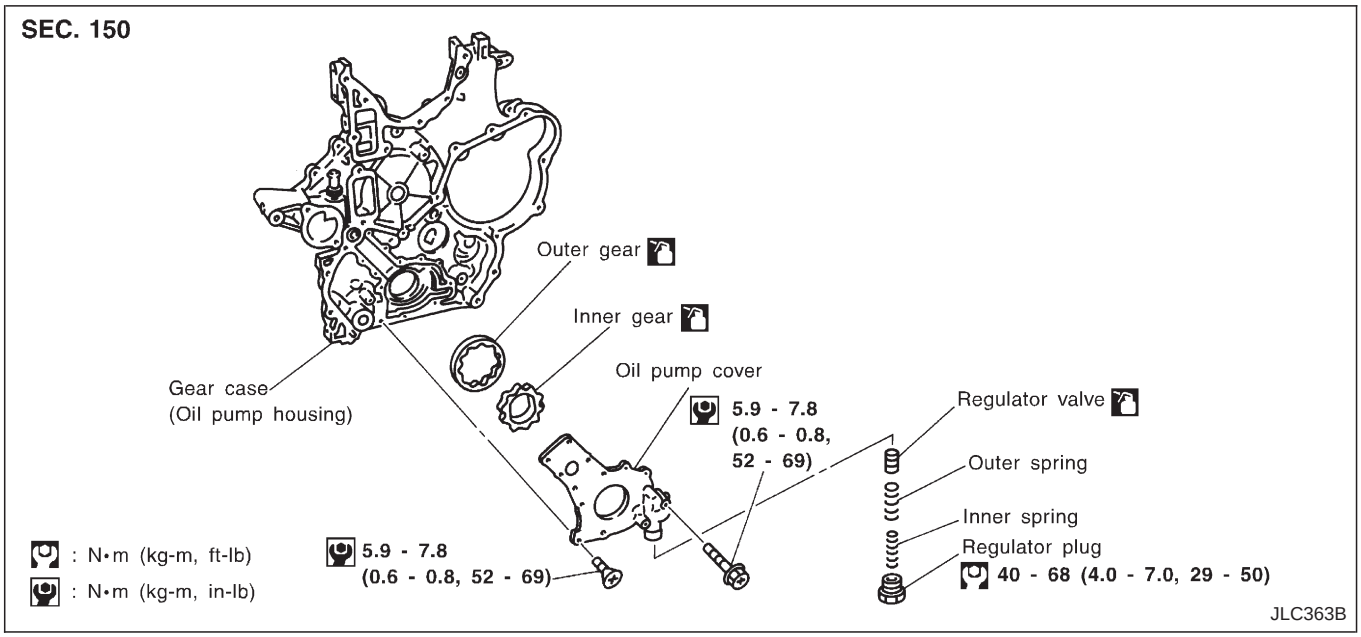
6. Install oil pressure switch with sealant.
   Oil pressure switch:
   : 13 - 17 N·m (1.25 - 1.75 kg-m, 9 - 12 ft-lb)

Oil Pump

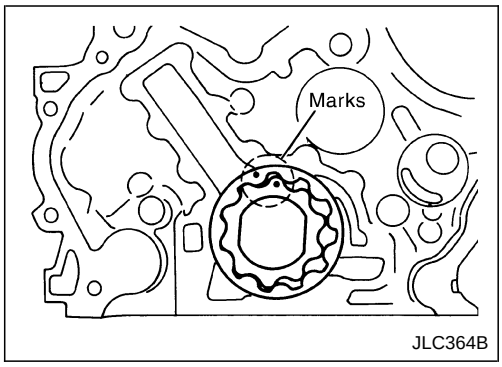
REMOVAL AND INSTALLATION

Refer to “TIMING GEAR” in EM section.

DISASSEMBLY AND ASSEMBLY



- **When installing oil pump, apply new engine oil to gears.**



- **When installing the inner and outer gear, face mating mark toward the oil pump cover as shown (left).**

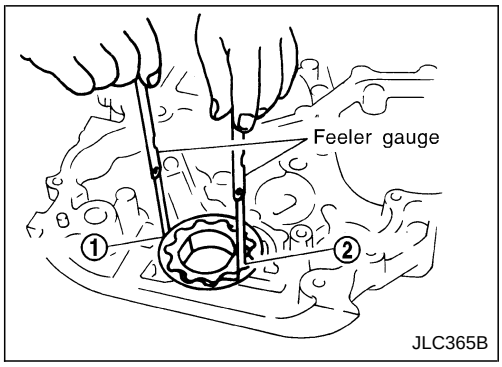
Oil Pump (Cont'd)

OIL PUMP INSPECTION

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

Unit: mm (in)

Body to outer gear radial clearance ①	0.114 - 0.200 (0.0045 - 0.0079)
Inner gear to outer gear tip clearance ②	Less than 0.180 (0.0071)
Body to inner gear axial clearance ③	0.05 - 0.09 (0.0020 - 0.0035)
Body to outer gear axial clearance ④	0.050 - 0.105 (0.0020 - 0.0041)
Inner gear to brazed portion of housing clearance ⑤	0.045 - 0.091 (0.0018 - 0.0036)
Regulator valve to oil pump cover clearance ⑥	0.040 - 0.097 (0.0016 - 0.0038)



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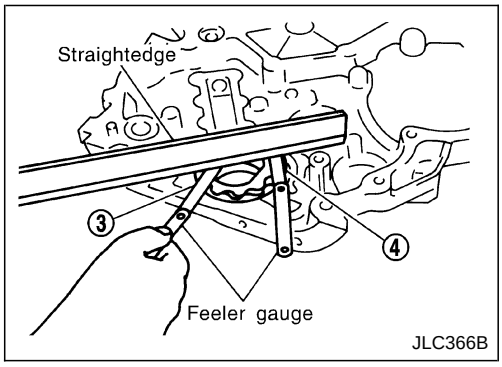

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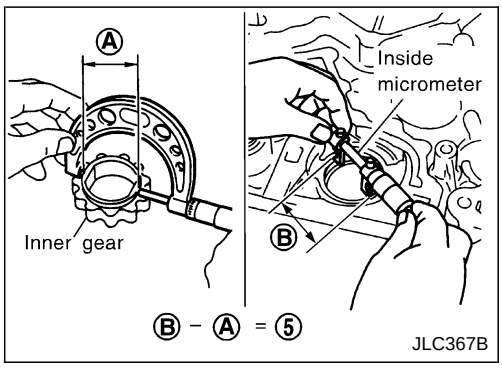

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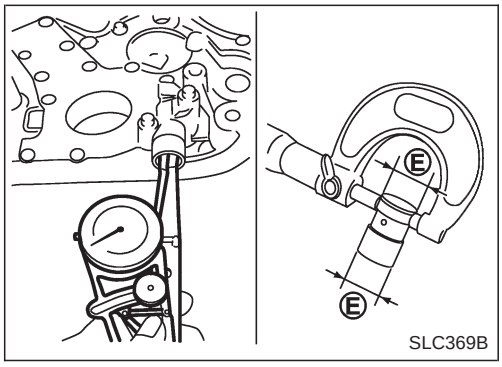
- **If the tip clearance (②) exceeds the limit, replace gear set.**
- **If body to gear clearances (①, ③, ④, ⑤) exceed the limit, replace oil pump body assembly.**

REGULATOR VALVE INSPECTION

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

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



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4. Check regulator valve to oil pump cover clearance.

Clearance:

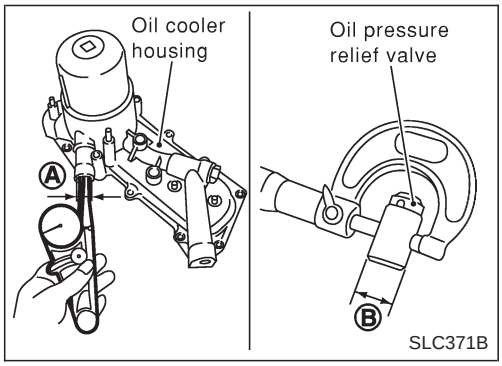
⑥ : 0.040 - 0.097 mm (0.0016 - 0.0038 in)

If it exceeds the limit, replace oil pump cover.

Oil Pump (Cont'd)

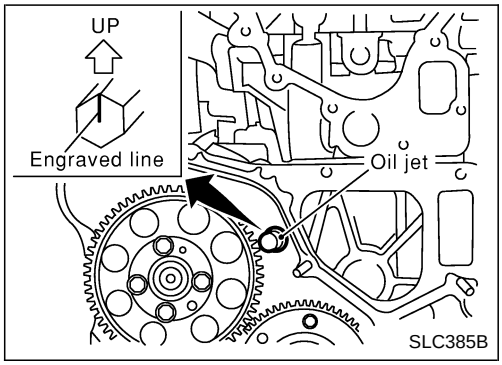
OIL PRESSURE RELIEF VALVE AND BYPASS VALVE INSPECTION (For oil cooler)

1. 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 in place by tapping it.



2. Check oil pressure relief valve to oil cooler housing clearance.
   Clearance:
   Ⓒ: 0.032 - 0.068 mm (0.0013 - 0.0027 in)

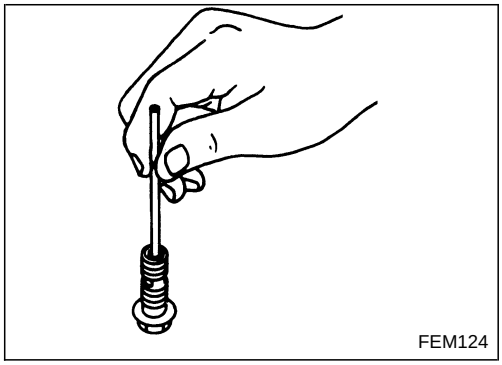
If it exceeds the limit, replace oil cooler housing.



Oil Jet

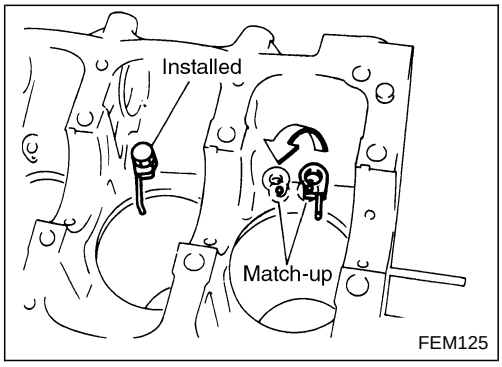
INSPECTION (For timing chain)

Make sure that the holes are not clogged. Clean them with a wire if necessary.
Drive oil jet into place after positioning alignment mark on.



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.

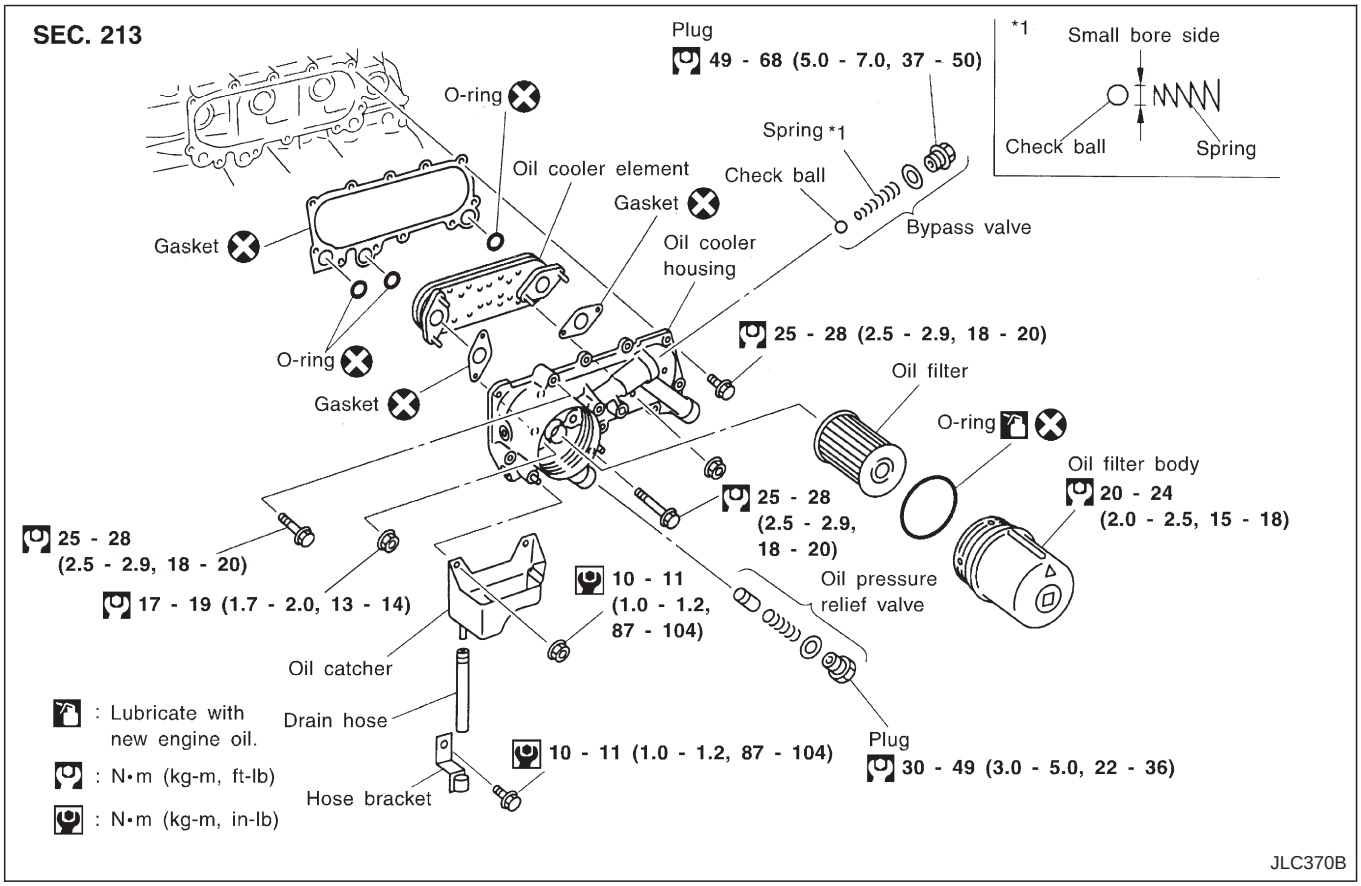
Oil jet:
: 30 - 39 N·m (3.0 - 4.0 kg-m, 22 - 28 ft-lb)

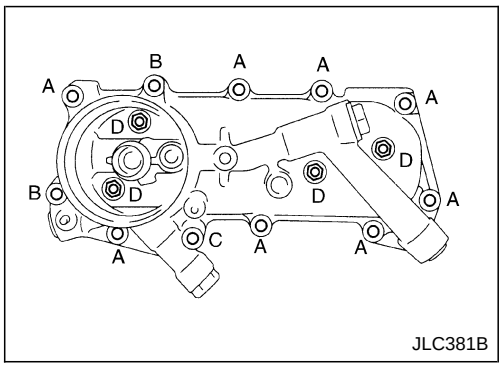
Oil Jet (Cont'd)

OIL FILTER

The oil filter is an element type. Refer to "Changing Oil Filter" in MA section.

Oil Cooler





REMOVAL AND INSTALLATION

1. Drain engine oil and coolant.
   Remove catalyst and turbocharger. Refer to "CATALYST AND TURBOCHARGER" in EM section.
2. Remove bolts A to C then remove oil cooler assembly.

- **Do not remove "D" nuts when removing oil cooler assembly.**
  Bolt length:
  A: 20 mm (0.79 in)
  B: 45 mm (1.77 in)
  C: 65 mm (2.56 in)

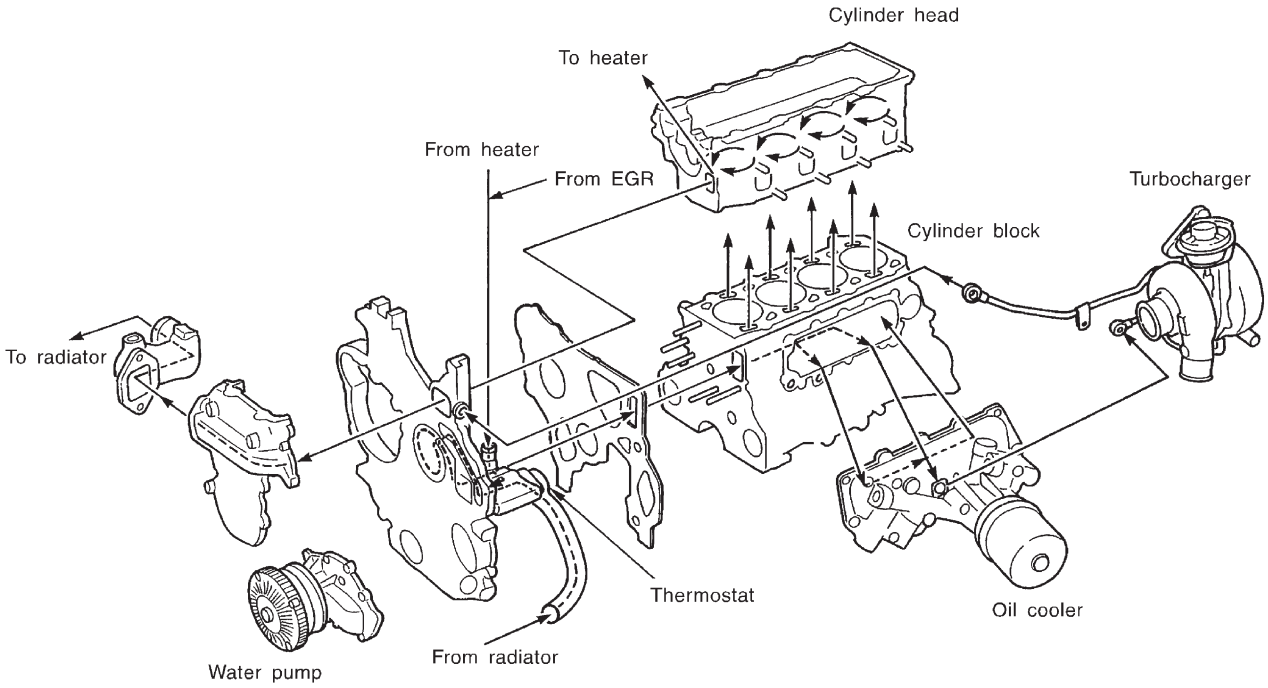
3. Installation is in reverse order of removal.

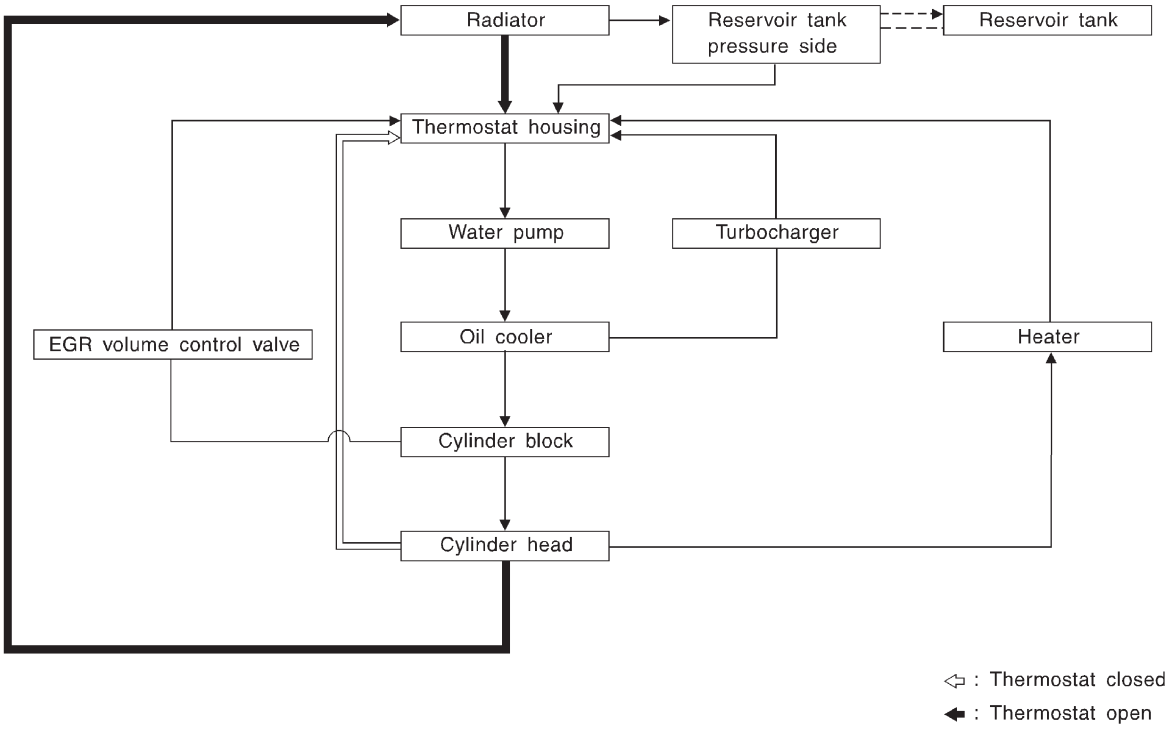
- **Do not spill coolant on the drive belt.**

INSPECTION

1. Check oil cooler for cracks.
2. Check oil cooler for clogging by blowing through coolant inlet. If necessary, replace oil cooler assembly.

Cooling Circuit





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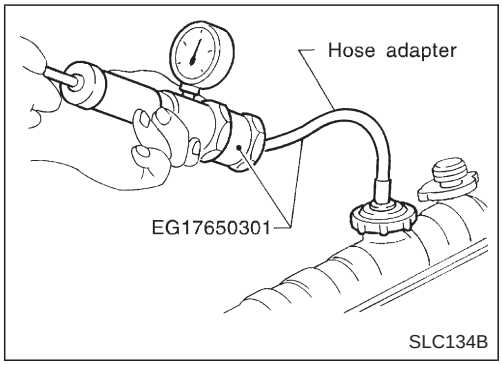
System Check

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

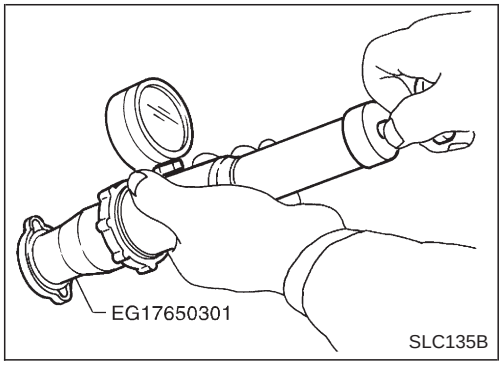


CHECKING COOLING SYSTEM FOR LEAKS

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

Testing pressure:
98 kPa (0.98 bar, 1.0 kg/cm^2, 14 psi)

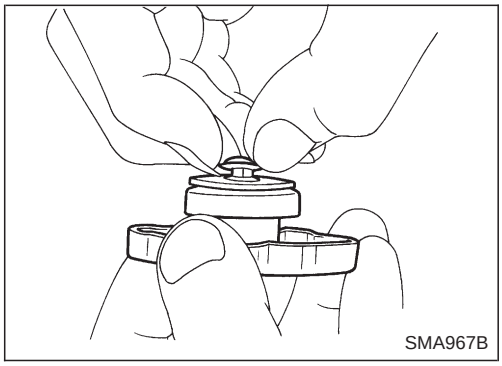
CAUTION:
Higher pressure than specified may cause radiator damage.



CHECKING RADIATOR CAP

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

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

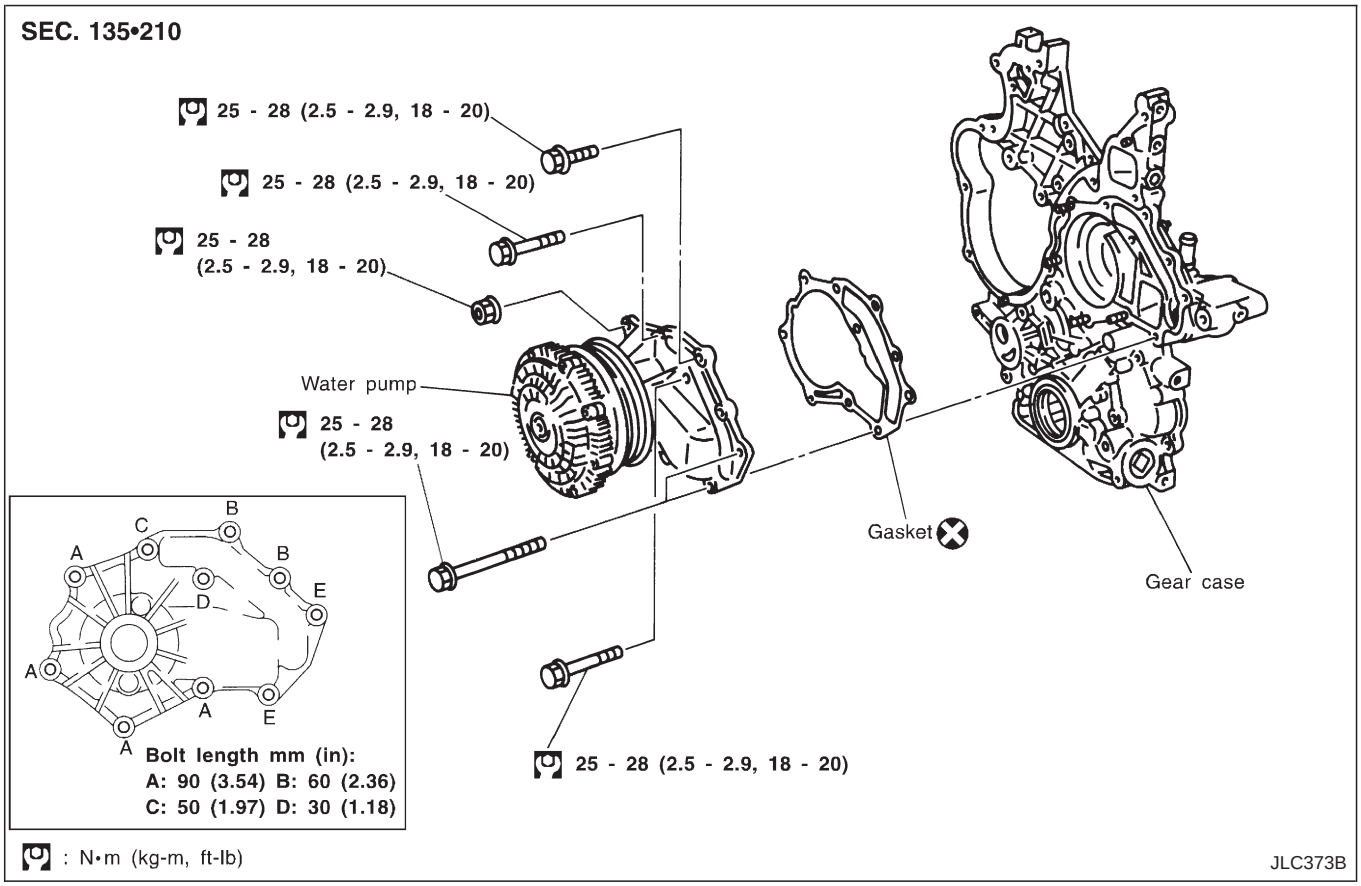


Pull the negative pressure valve to open it.
Check that it closes completely when released.

Water Pump

CAUTION:

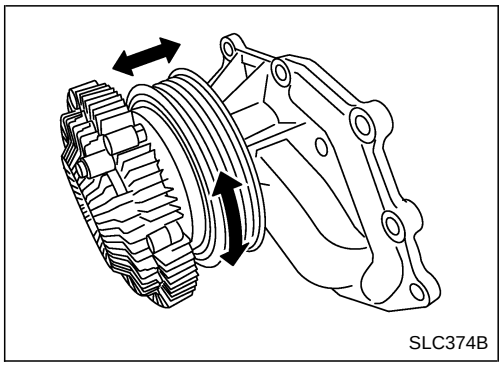
- **When removing water pump assembly, be careful not to get coolant on drive belt.**
- **Water pump cannot be disassembled and should be replaced as a unit.**
- **Always replace with new gasket.**
- **After installing water pump, connect hose and clamp securely, then check for leaks using radiator cap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



REMOVAL AND INSTALLATION

1. Drain coolant from radiator and cylinder block. Refer to MA section (“Changing Engine Coolant”, “ENGINE MAINTENANCE”).
2. Remove radiator upper hose.
3. Remove radiator shroud.
4. Remove cooling fan.
5. Remove drive belt. Refer to MA section, “Checking Drive Belt”.
6. Remove insulator.
7. Remove vacuum pipe.
8. Remove TDC sensor. Refer to TDC sensor removal and installation in “TIMING GEAR”.
9. Remove fan coupling with water pump.
10. Install in the reverse order of removal.

Water Pump (Cont'd)

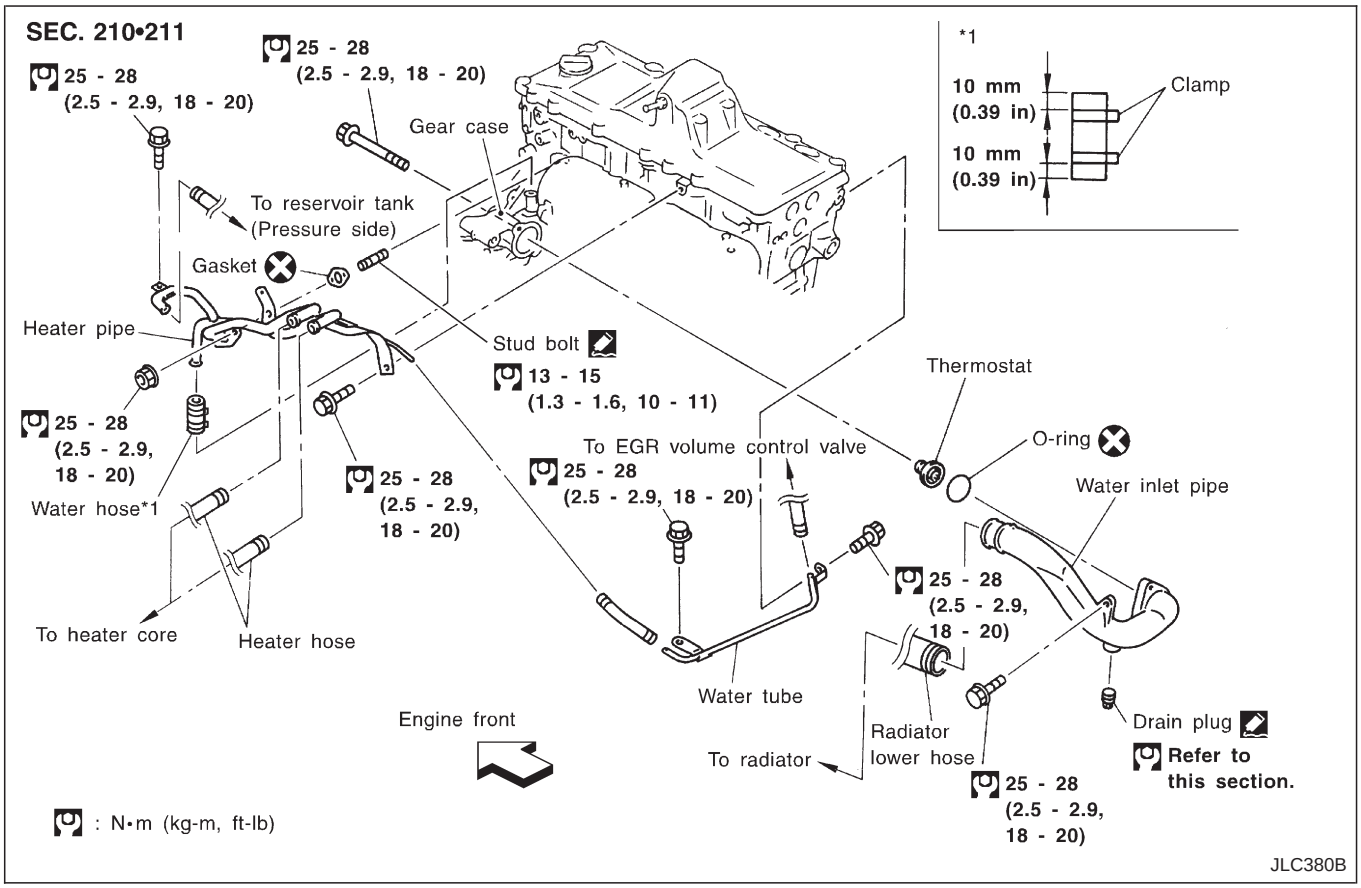


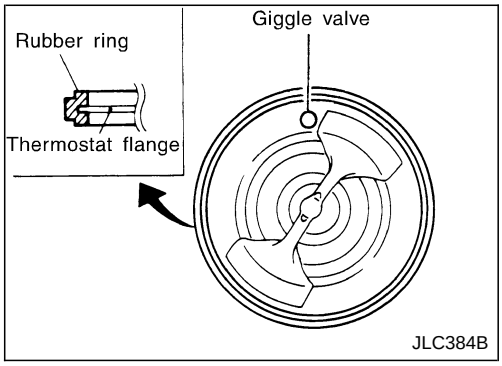
INSPECTION

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

CAUTION:
Do not disassemble water pump coupling assembly.

Thermostat



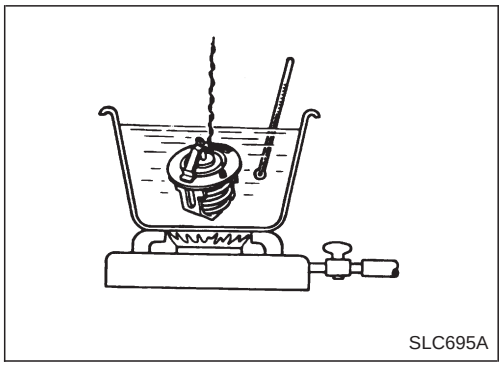


REMOVAL AND INSTALLATION

1. Drain engine coolant. Refer to MA section, "Changing Engine Coolant".
2. Remove left side battery. (If so equipped)
3. Remove radiator upper hose.
4. Remove radiator shroud.
5. Remove intake air duct, inlet pipe.
6. Remove harness and connectors.
7. Install in reverse order of removal.

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

Thermostat (Cont'd)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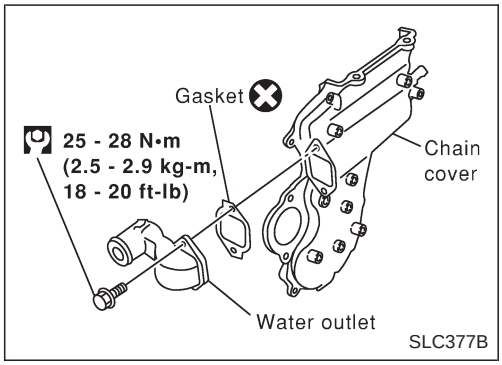
INSPECTION

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

	Tropical type and Gulf standard model	Standard type and Australia model	Frigid type
Valve opening temperature °C (°F)	76.5 (170)	82 (180)	88 (190)
Maximum valve lift mm/°C (in/°F)	10/90 (0.39/194)	10/95 (0.39/203)	10/100 (0.39/212)

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



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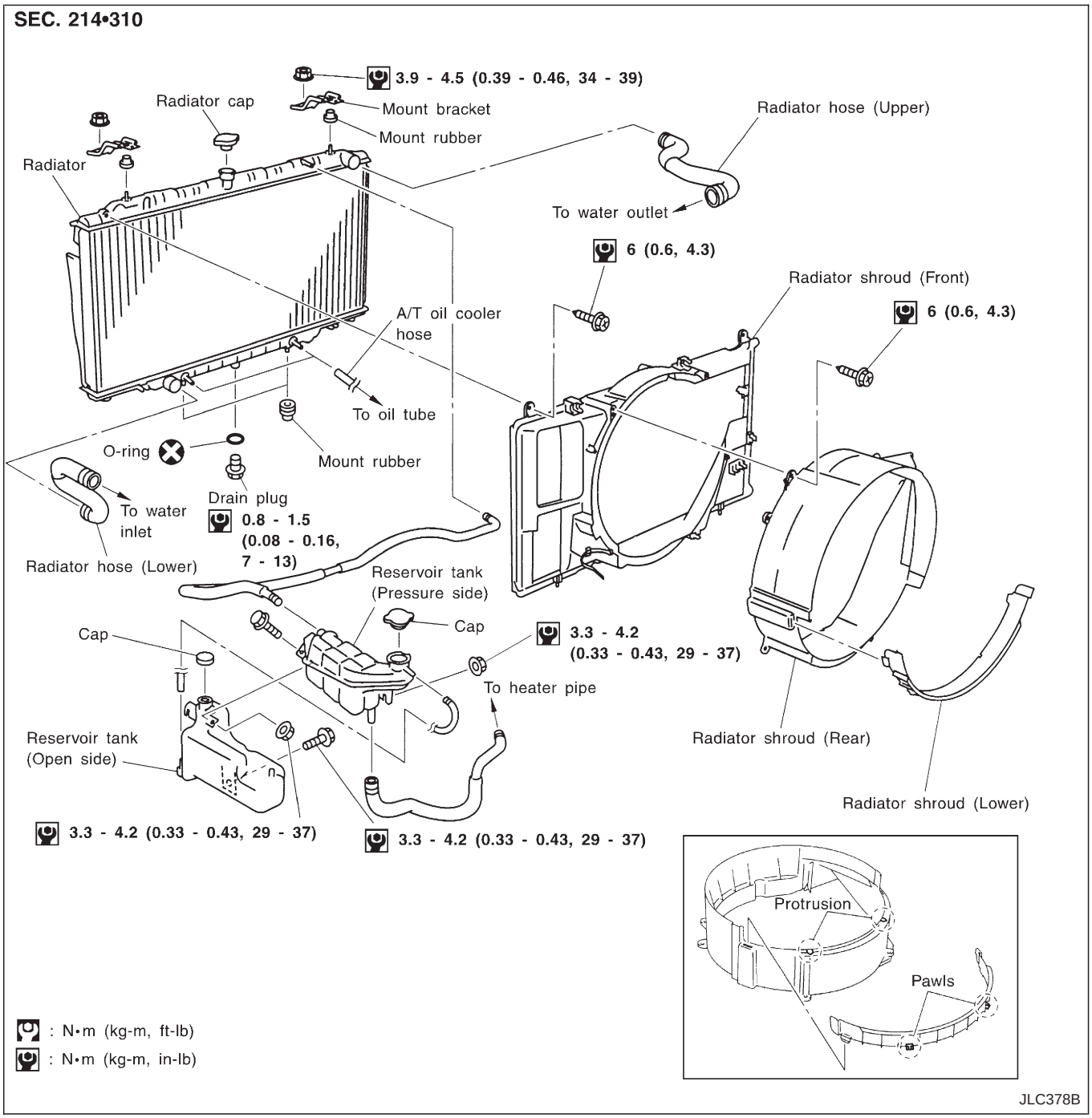
Water Outlet

INSPECTION

Visual inspection for water leaks. If there is leakage, replace gasket.

Radiator



REMOVAL AND INSTALLATION

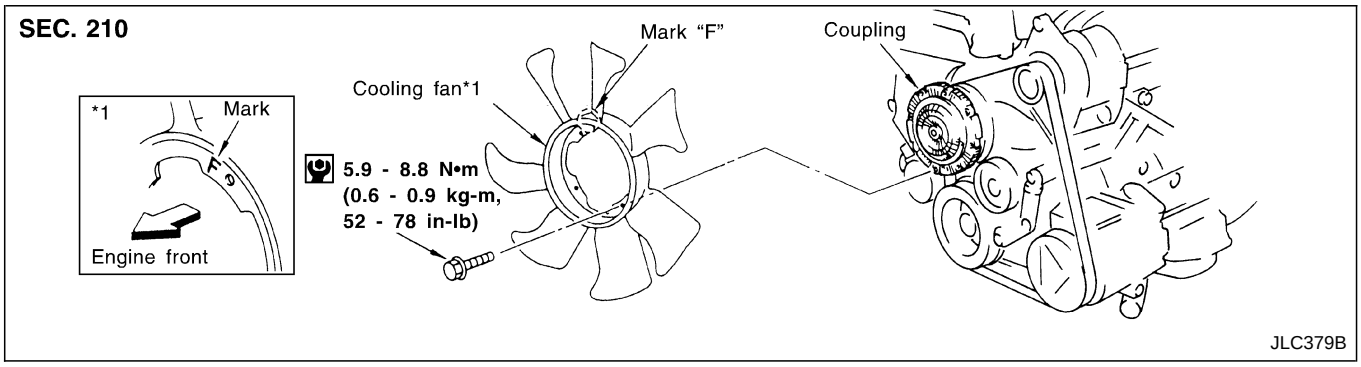
1. Remove under cover.
2. Drain engine coolant. Refer to MA section, “Changing Engine Coolant”.
3. Remove air cleaner case, air duct and resonator.
4. Remove battery (right side).
5. Move window washer tank.
6. Remove radiator shroud (lower).
7. Remove radiator shroud (front).
8. Disconnect radiator hose (upper and lower).
9. Disconnect reservoir tank hose.
10. Disconnect A/T oil cooler hose (Only A/T models).

Radiator (Cont'd)

11. Remove radiator.
12. After repairing or replacing radiator, install all removed parts in reverse order of removal.

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.
- 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.

Engine Lubrication System

Oil pressure check

Engine speed rpm	Approximate discharge pressure kPa (bar, kg/cm^2, psi)
Idle speed	More than 147 (1.47, 1.5, 21)
2,000	More than 539 (5.39, 5.5, 78)
4,000	More than 736 (7.36, 7.5, 107)

Oil pump

Unit: mm (in)

Body to outer gear radial clearance ①	0.114 - 0.200 (0.0045 - 0.0079)
Inner gear to outer gear tip clearance ②	Less than 0.180 (0.0071)
Body to inner gear axial clearance ③	0.05 - 0.09 (0.0020 - 0.0035)
Body to outer gear axial clearance ④	0.050 - 0.105 (0.0020 - 0.0041)
Inner gear to brazed portion of housing clearance ⑤	0.045 - 0.091 (0.0018 - 0.0036)
Regulator valve to oil pump cover clearance ⑥	0.040 - 0.097 (0.0016 - 0.0038)

Engine Cooling System

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 10/95 (0.39/203)	More than 10/95 (0.39/203)