

ENGINE LUBRICATION & COOLING SYSTEMS

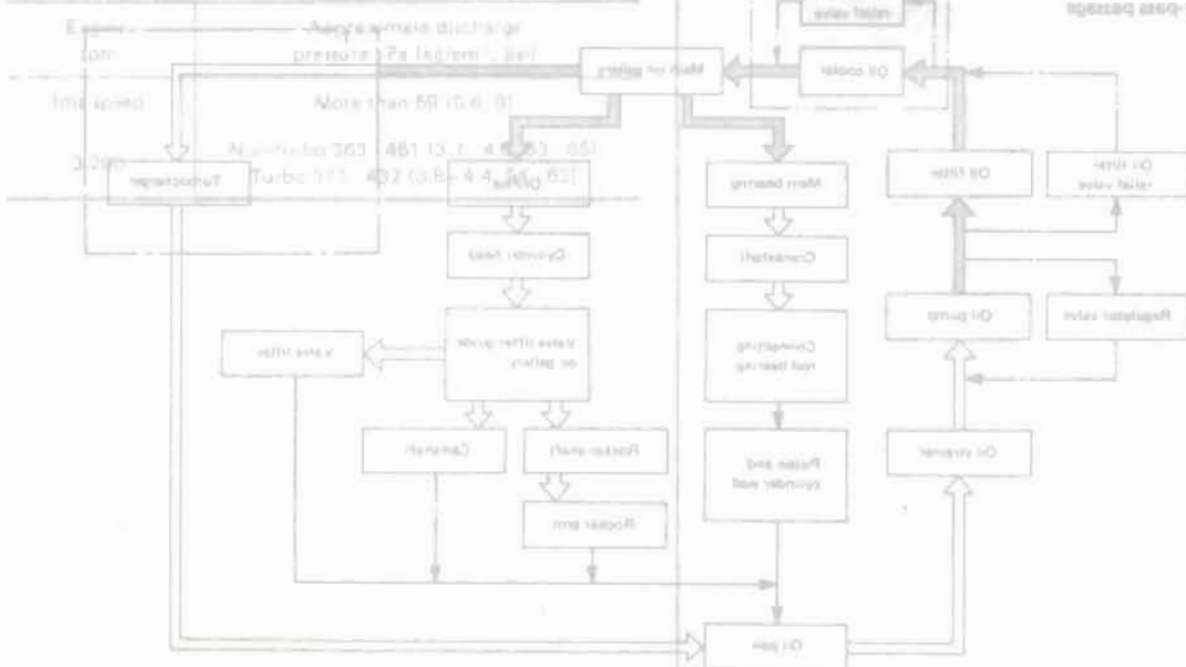
SECTION LC

LC

CONTENTS

ENGINE LUBRICATION SYSTEM	LC- 2
ENGINE LUBRICATION SYSTEM — For Turbocharged Models	LC- 6
ENGINE COOLING SYSTEM	LC- 7
ENGINE COOLING SYSTEM — For Turbocharged Models	LC-13
SERVICE DATA AND SPECIFICATIONS (S.D.S.)	LC-15
SPECIAL SERVICE TOOLS	LC-17

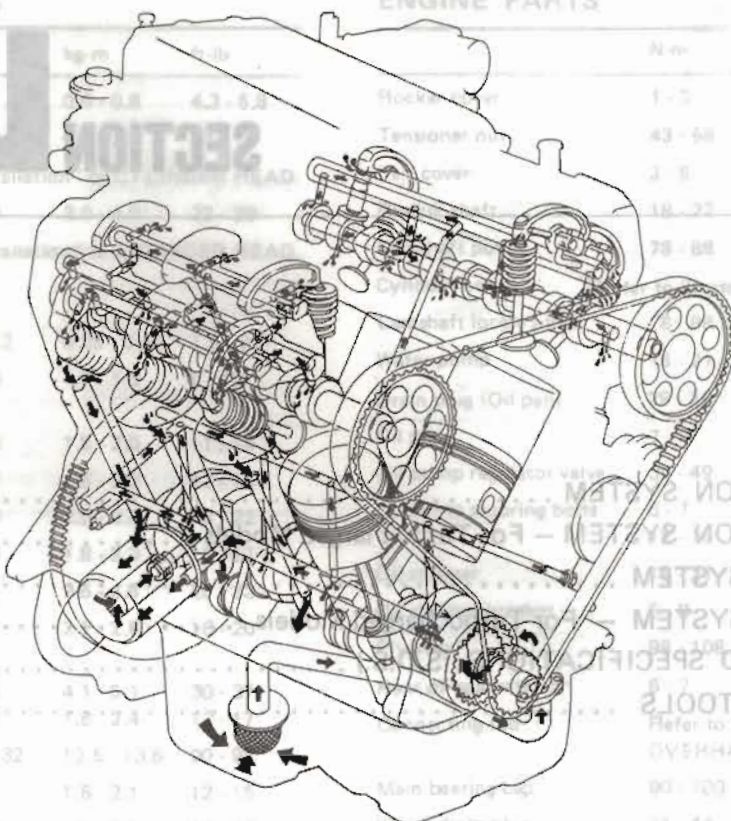
3. Install pressure gauge.
4. Start engine and watch for oil pressure. When oil pressure is established, check oil temperature and, then check oil pressure with engine running under no-load.



Lubrication Circuit

	Num
Collector cover	8-8
Collector	8-10
Throttle chamber	Refer to 15-1
Intake relief valve	20-1
Intake manifold	Refer to 15-1
Intake manifold	
Intake manifold	
Intake manifold	
Cylinder head temperature sensor	12-15
Thermal transmitter	15-20
Exhaust manifold	18-22
Exhaust outlet	20-20
Exhaust control valve	18-22
E.O.R. valve	18-22
Exhaust control valve	22-20
Exhaust gas	40-20
Turbo	18-22
Crankshaft pulley	12-1
Water inlet	10-21
Detonation sensor	25-34
Note:	
P.C.V. valve	20-19
Oil passage	4-8-6
Oil gallery in cylinder	14-12
By-pass passage	9-6
Starter motor	30-3

ENGINE PARTS



Note:

NOTE:
P.C.V. 40/100

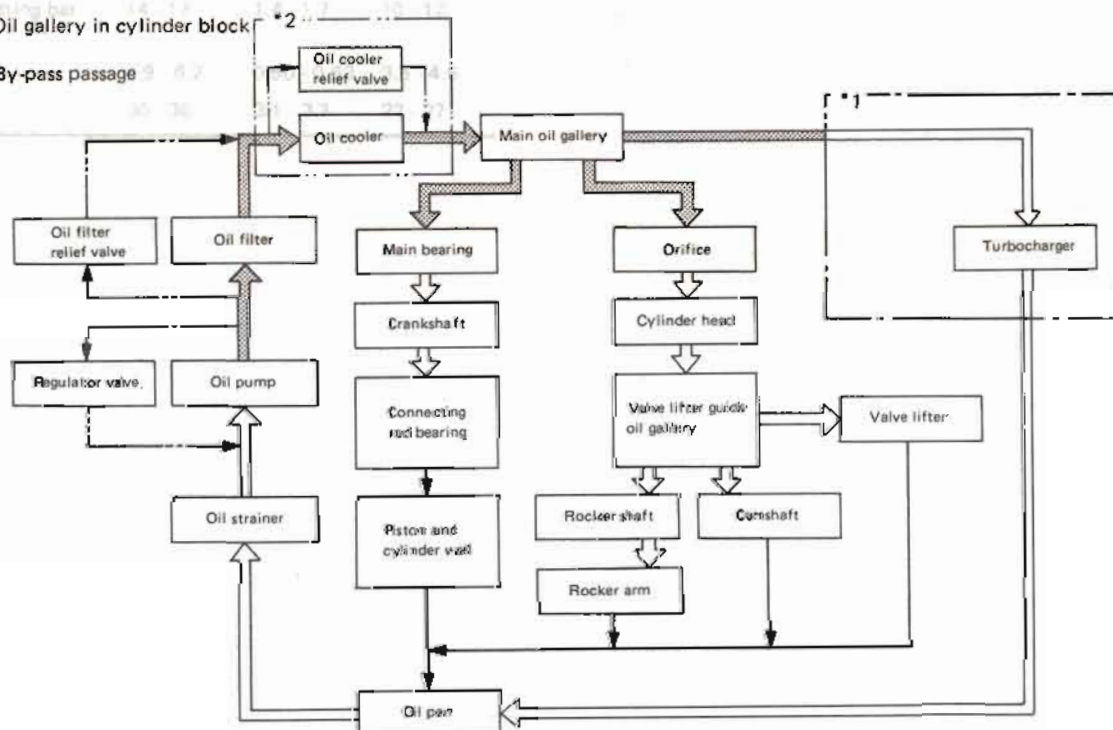
*1: Additional lubrication circuit for turbocharged model

*2: Additional oil cooler for turbo A/T model

← : Oil passage

 : Oil gallery in cylinder block

By-pass passage

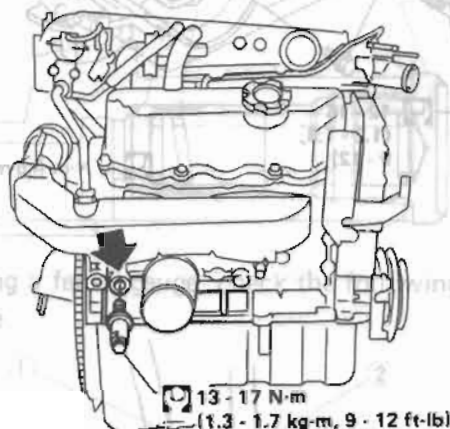


ENGINE LUBRICATION SYSTEM

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.

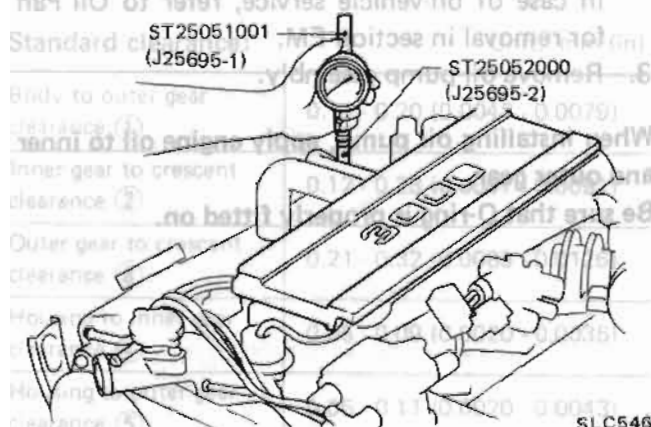


SLC545

3. Install pressure gauge.
4. Start engine and warm it up to normal operating temperature and, then check oil pressure with engine running under no-load.

Engine rpm	Approximate discharge pressure kPa (kg/cm ² , psi)
Idle speed	More than 59 (0.6, 8)
3,200	Non-turbo 363 - 461 (3.7 - 4.6, 53 - 65) Turbo 373 - 432 (3.8 - 4.4, 54 - 63)

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



SLC546

5. Install oil pressure switch.

Use proper liquid sealant.

Ⓜ : 13 - 17 N·m (1.3 - 1.7 kg·m, 9 - 12 ft·lb)

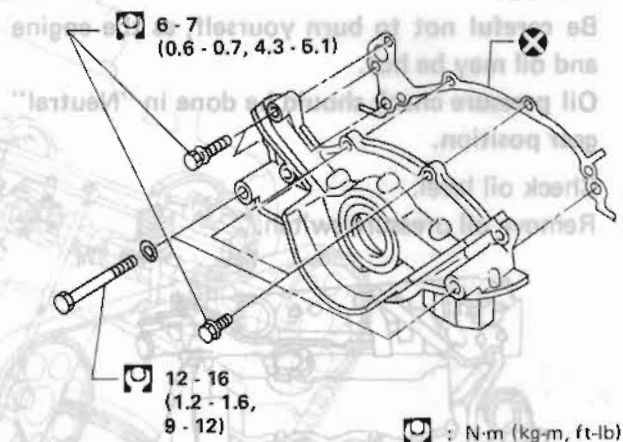
ENGINE LUBRICATION SYSTEM

Oil Pump Disassembly and Assembly

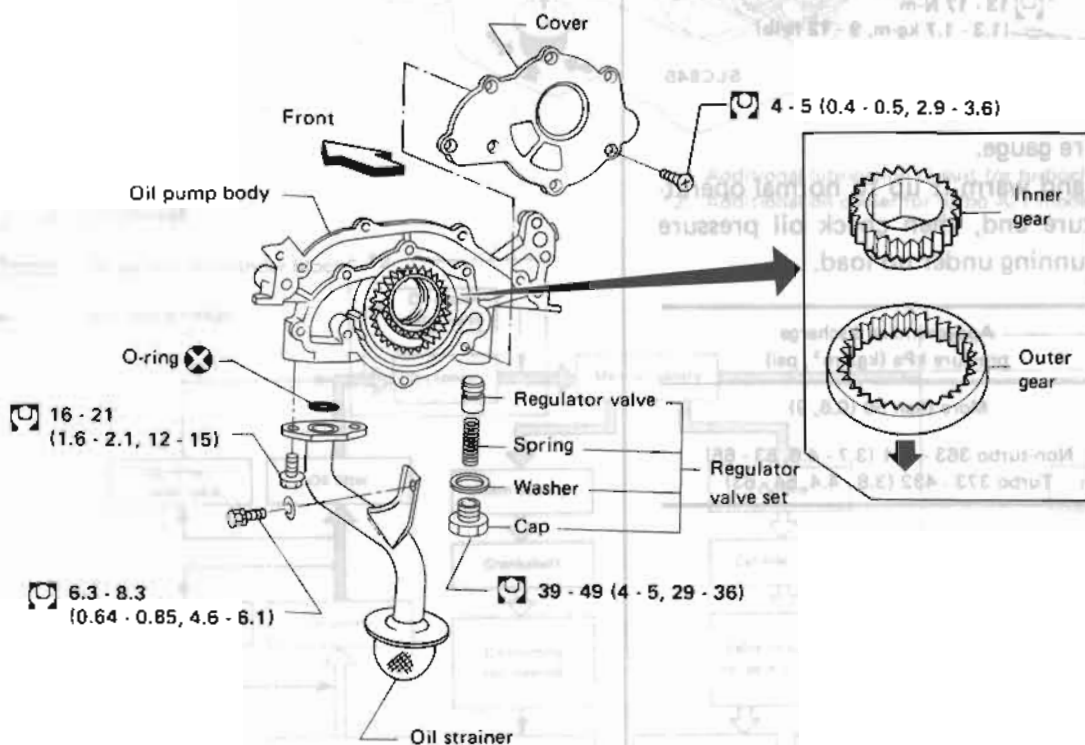
1. Drain oil.
2. Remove oil pan.
In case of on-vehicle service, refer to Oil Pan for removal in section EM.
3. Remove oil pump assembly.

When installing oil pump, apply engine oil to inner and outer gear.

Be sure that O-ring is properly fitted on.



SLC936



⊗ : N·m (kg·m, ft·lb)

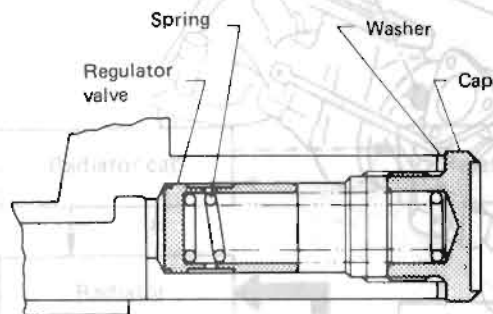
SLC936

ENGINE LUBRICATION SYSTEM

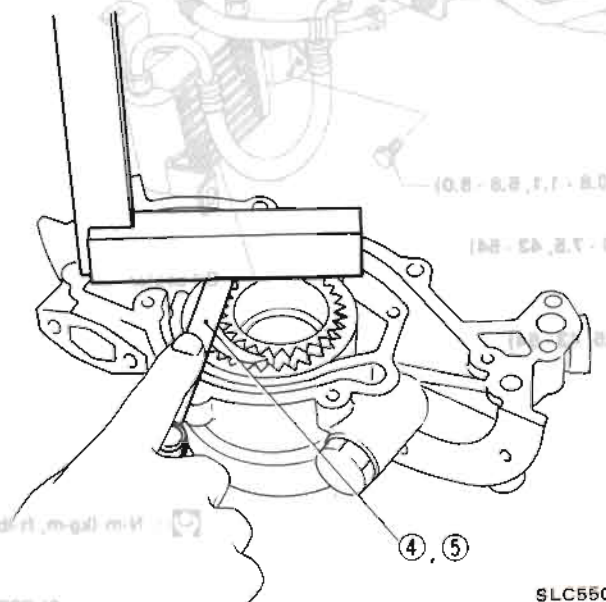
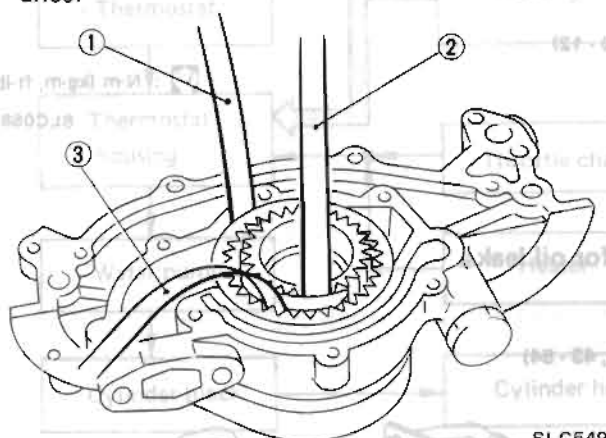
Oil Pump Inspection

1. Visually inspect components for wear and damage.
2. Check oil pressure regulator valve sliding surface and valve spring.

If damaged, replace as a valve set.



3. Using a feeler gauge, check the following clearance.



If excessive wear is found, replace gear set or entire oil pump assembly.

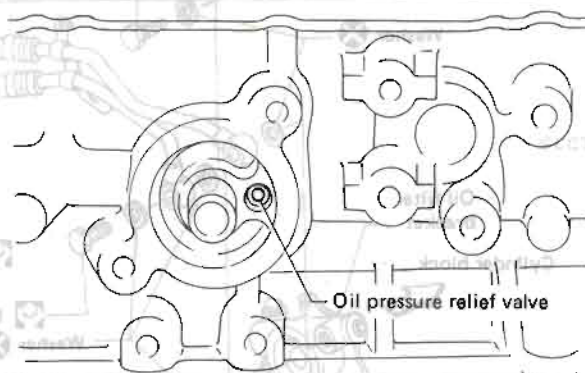
Standard clearance:

Unit: mm (in)

Body to outer gear clearance ①	0.11 - 0.20 (0.0043 - 0.0079)
Inner gear to crescent clearance ②	0.12 - 0.23 (0.0047 - 0.0091)
Outer gear to crescent clearance ③	0.21 - 0.32 (0.0083 - 0.0126)
Housing to inner gear clearance ④	0.05 - 0.09 (0.0020 - 0.0035)
Housing to outer gear clearance ⑤	0.05 - 0.11 (0.0020 - 0.0043)

Oil Pressure Relief Valve Inspection

Inspect for smooth operation by pushing ball.



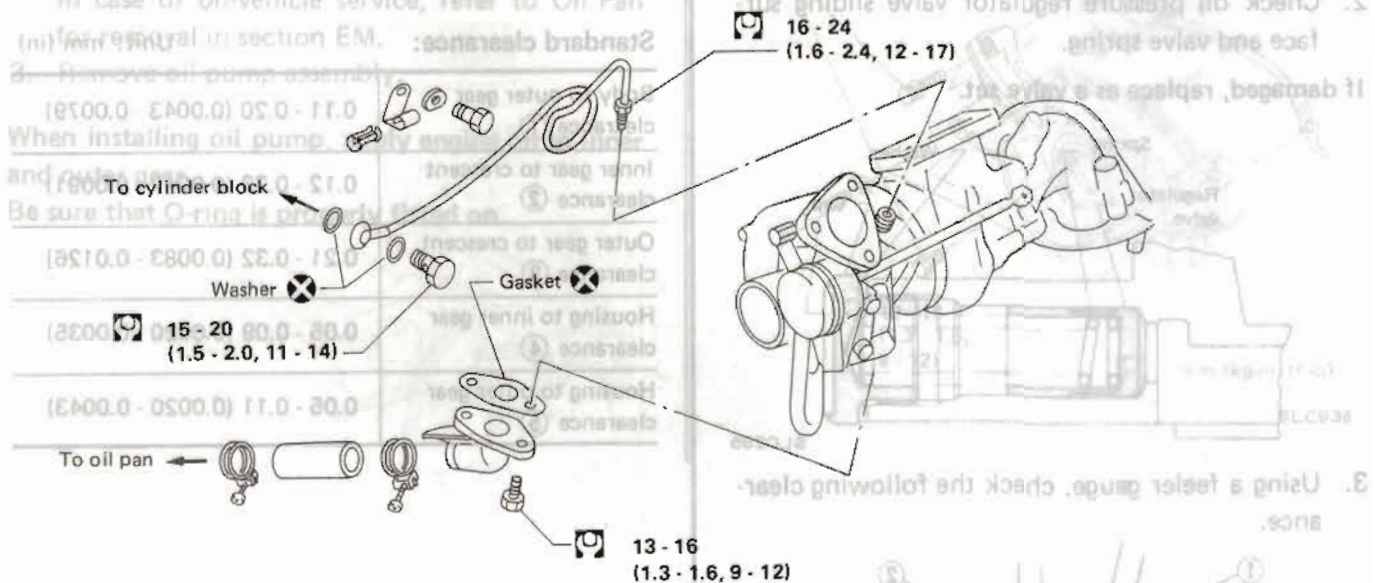
Replace as a valve assembly, when replacing.

ENGINE LUBRICATION SYSTEM — For Turbocharged Models

Removal and Installation

OIL DELIVERY SYSTEM

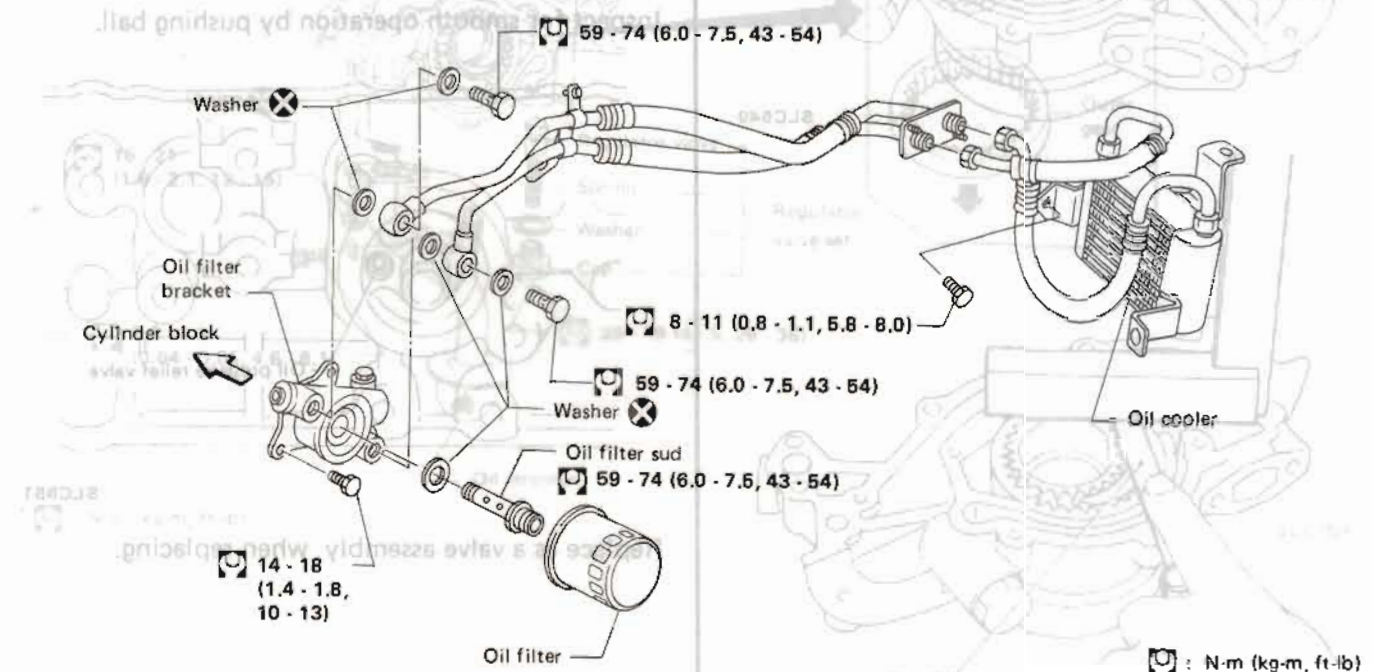
After installation, run engine for a few minutes and check for leaks.



ENGINE OIL COOLER (A/T models)

Be careful not to burn yourself as engine oil is hot.

After installation, run engine for a few minutes and check for oil leaks.



ENGINE COOLING SYSTEM

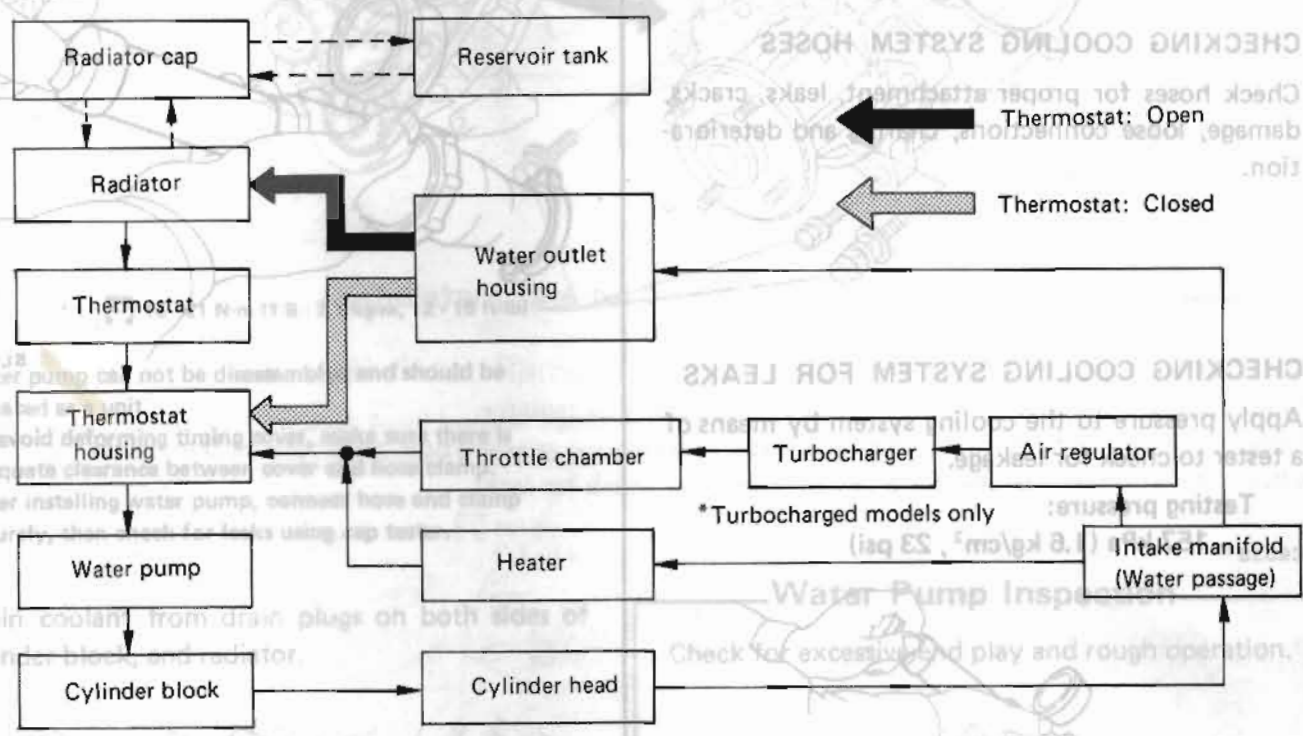
Water Pump Removal Cooling Circuit (On-vehicle service)

To avoid danger of being scalded, never attempt to drain coolant when engine is hot.

If it is necessary to remove radiator cap when radiator is hot, turn cap slowly counterclockwise to the first stop. After all pressure in the cooling system is released, turn cap past the stop and remove it.

Always replace with new gasket and O-ring.

Refer to MA section for changing engine coolant.



WARNING:

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

Thermostat: Open

Thermostat: Closed

CHECKING COOLING SYSTEM FOR LEAKS

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

Testing pressure: 1.6 kg/cm² (23 psi)

*Turbocharged models only

Water Pump Inspection

Check for excessive end play and rough operation.



CAUTION:

When removing water pump assembly, be careful not to get coolant on timing belt.

ENGINE LUBRICATION SYSTEM

ENGINE COOLING SYSTEM

Checking Cooling System

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 remove the cap by turning it a quarter turn to allow built-up pressure to escape and then turn the cap all the way off.

CHECKING COOLING SYSTEM HOSES

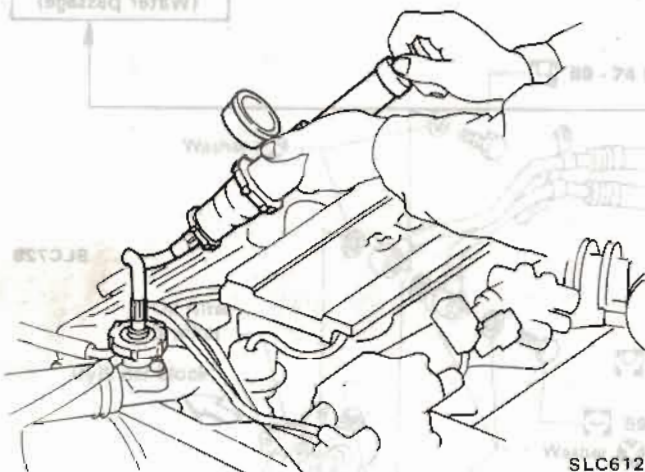
Check hoses for proper attachment, leaks, cracks, damage, loose connections, chafing and deterioration.

CHECKING COOLING SYSTEM FOR LEAKS

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

Testing pressure:

157 kPa (1.6 kg/cm², 23 psi)

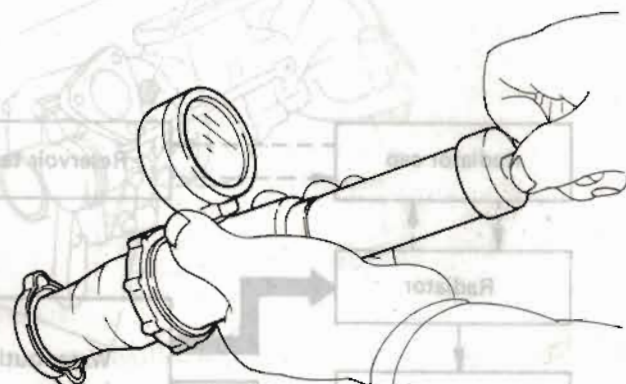


CHECKING RADIATOR CAP

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

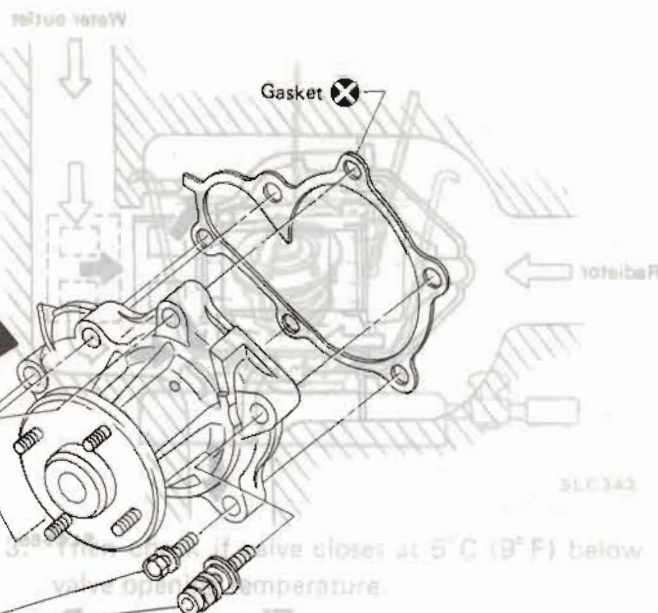
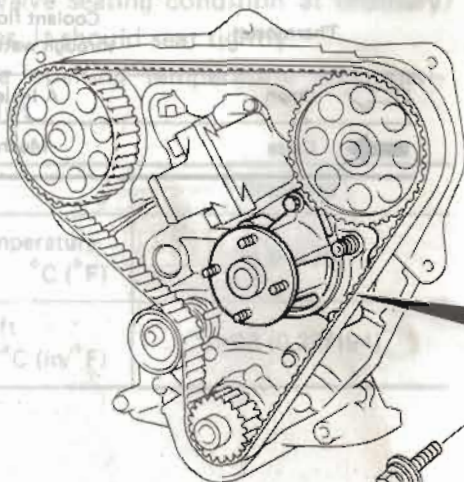
Radiator cap relief pressure:

78 - 98 kPa (0.8 - 1.0 kg/cm², 11 - 14 psi)



ENGINE COOLING SYSTEM

Water Pump Removal and Installation (On-vehicle service)



16 - 21 N·m (1.6 - 2.1 kg-m, 12 - 15 ft-lb)

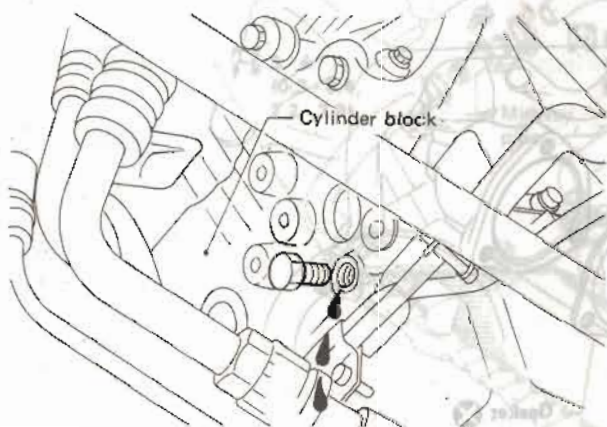
Water pump can not be disassembled and should be replaced as a unit.

To avoid deforming timing cover, make sure there is adequate clearance between cover and hose clamp.

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

SLC938

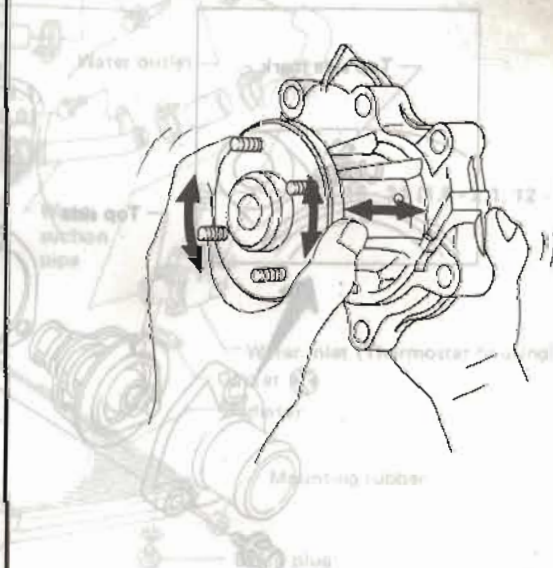
Drain coolant from drain plugs on both sides of cylinder block, and radiator.



SLC815

Water Pump Inspection

Check for excessive end play and rough operation.



SLC738

CAUTION:

When removing water pump assembly, be careful not to get coolant on timing belt.

ENGINE COOLING SYSTEM

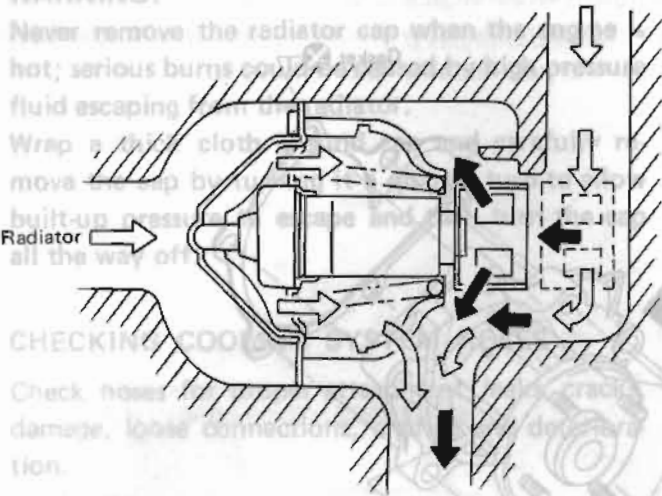
Thermostat Description (Bottom by-pass coolant flow)

WARNING:

Never remove the radiator cap when the engine is hot; serious burns may result. To avoid this, wait until the engine has cooled. Wrap a thick cloth over the cap and move it up carefully. Do not use built-up pressure to remove the cap. Turn the cap all the way off.

Radiator

Water outlet



SLC565

CHECKING RADIATOR

Thermostat	Coolant flow out through water outlet
→ Open	A little
→ Close	Much

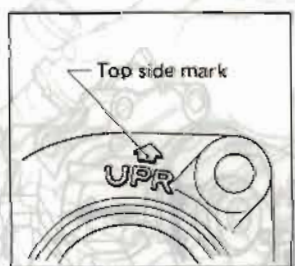
Thermostat Removal and Installation

CAUTION:

Drain coolant from drain cocks on cylinder block side and radiator. Remove radiator shroud, cooling fan and water suction pipe securing bolt, then remove thermostat. After installation, run engine for a few minutes, and check for leaks.

Testing pressure:
157 kPa (1.6 kg/cm², 23 psi)

Water Pump Inspection



Top side mark

UPR

Top side

Gasket

16 - 21 N·m (1.6 - 2.1 kg·m, 12 - 15 ft·lb)

CAUTION:

When removing water pump assembly, be careful not to get coolant on timing belt.

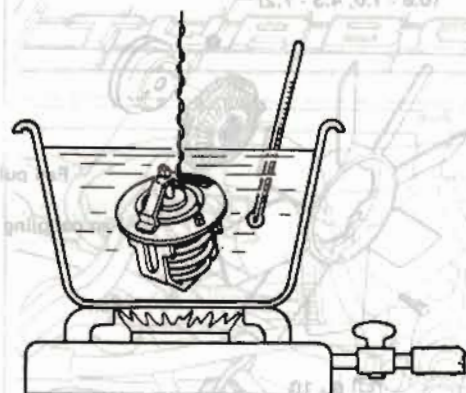
SLC939

ENGINE COOLING SYSTEM

Thermostat Inspection

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

	Standard
Valve opening temperature °C (°F)	76.5 (170)
Maximum valve lift mm/°C (in/°F)	10/90 (0.39/194)



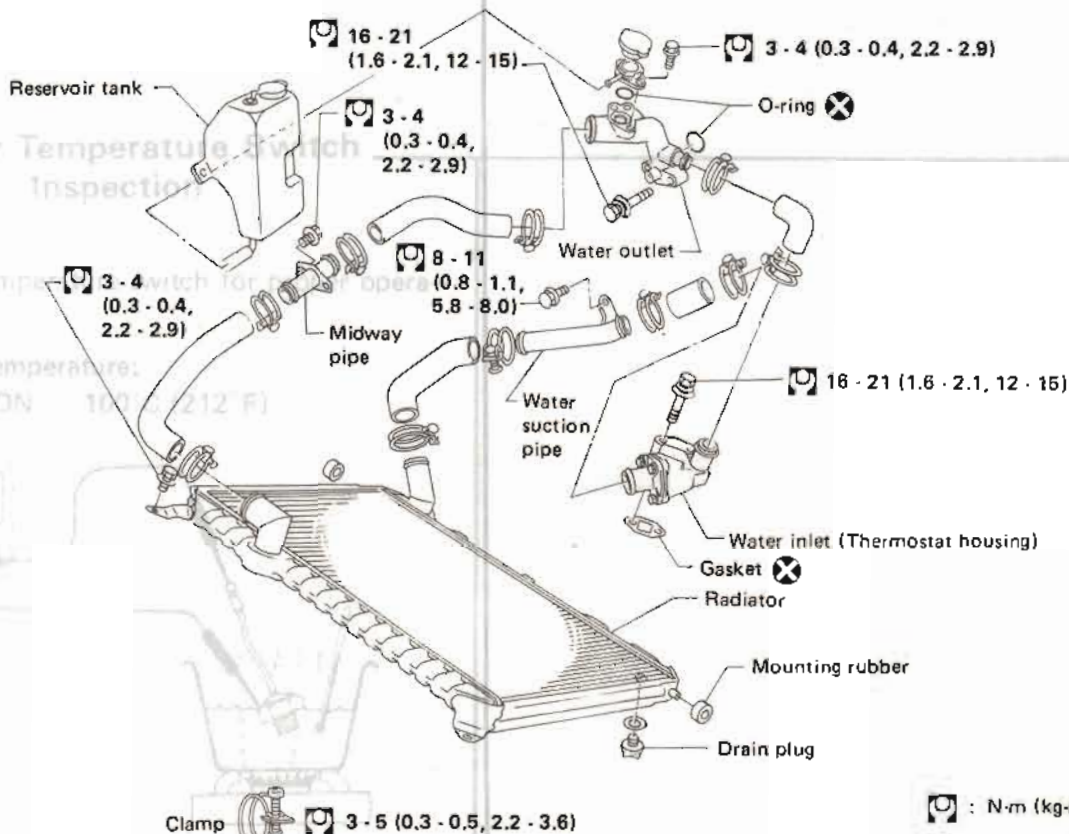
SLC343

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

Radiator Removal and Installation

Before removing radiator, remove front bumper assembly.

When filling radiator with coolant, refer to MA section.



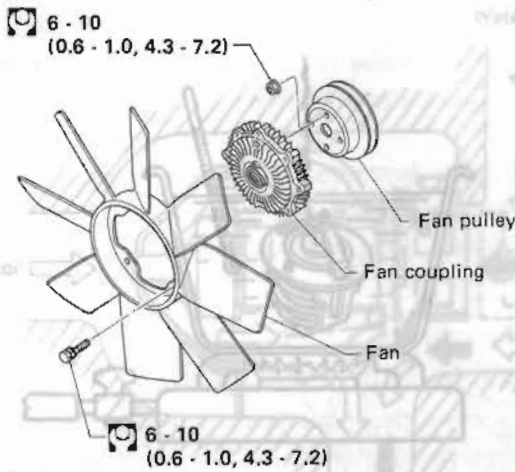
: N·m (kg-m, ft-lb)

SLC985

ENGINE COOLING SYSTEM

Cooling Fan Disassembly

and Assembly

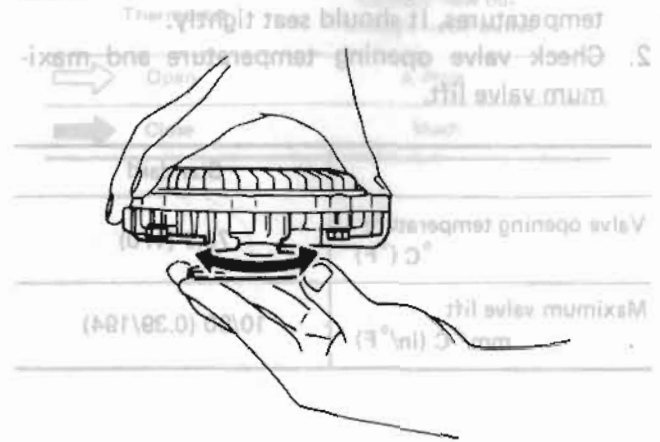


6 - 10
(0.6 - 1.0, 4.3 - 7.2)

SLC558

Cooling Fan Inspection

Check fan coupling for oil leakage or bent bimetal.



SLC072

Thermostat Removal and Installation

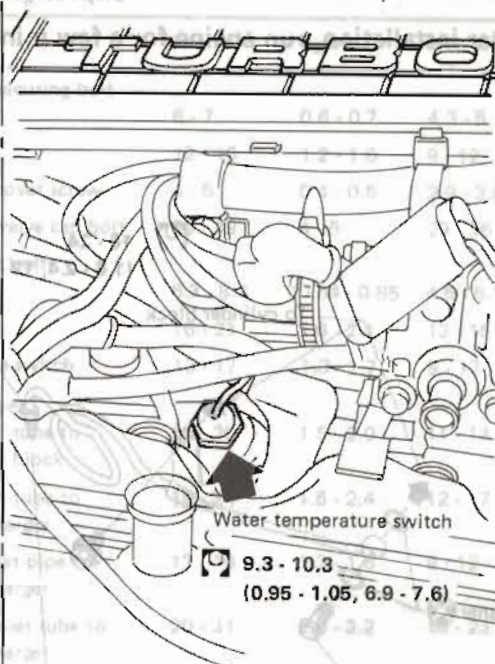
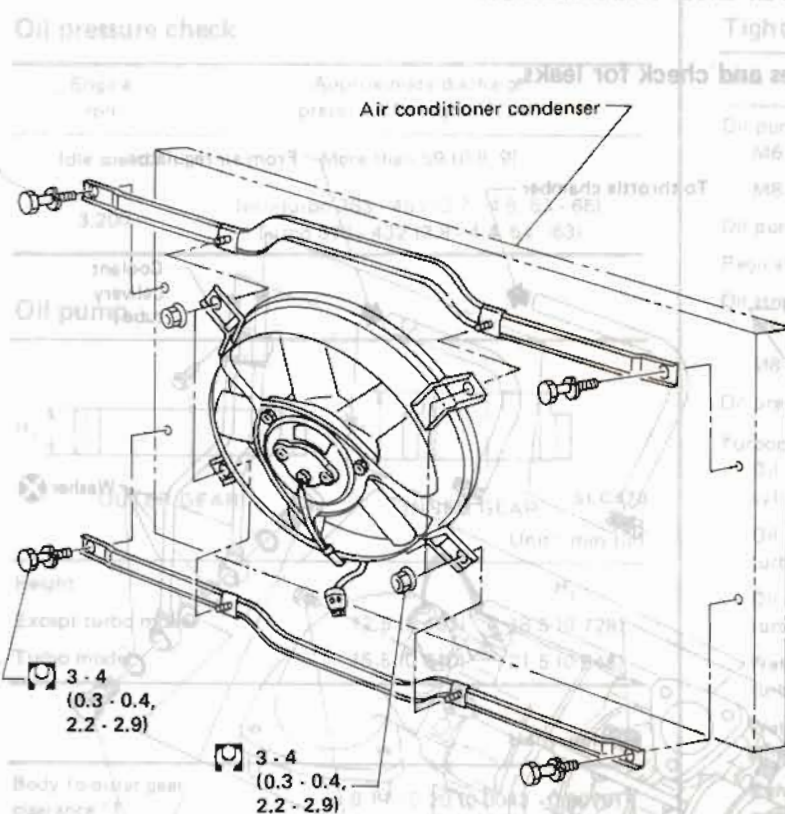
CAUTION

Before removing radiator, remove front bumper assembly. Remove radiator shroud, cooling fan and water suction pipe, then remove thermostat. When filling radiator with coolant, refer to MA section. After installation, run engine for a few minutes, and check for leaks.



ENGINE COOLING SYSTEM—For Turbocharged Models

Electric Cooling Fan Removal and Installation

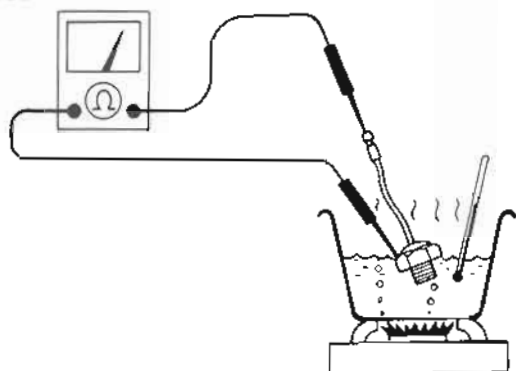


Water Temperature Switch Inspection

Check water temperature switch for proper operation.

Operating temperature:

OFF → ON 100°C (212°F)



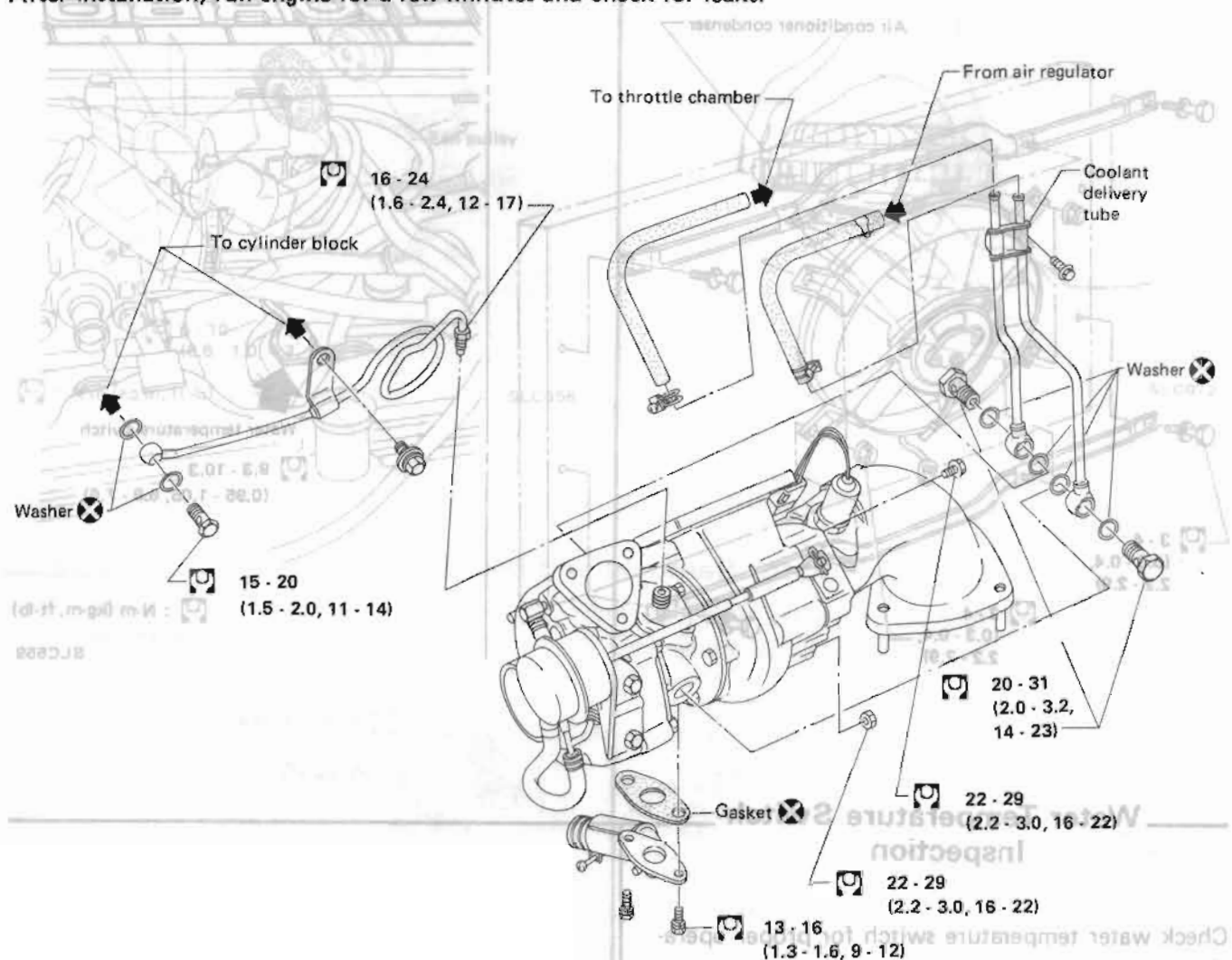
SEF7388

ENGINE COOLING SYSTEM—For Turbocharged Models

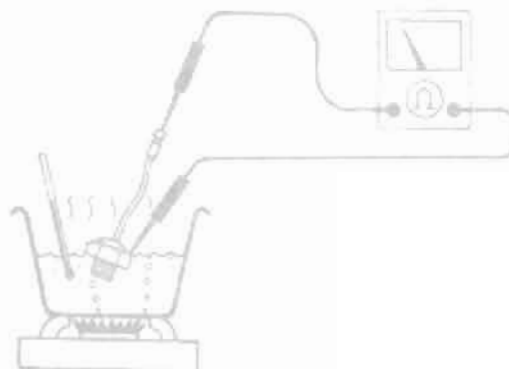
Cooling Fan Drive
and Assembly

Coolant Delivery System Removal and Installation

After installation, run engine for a few minutes and check for leaks.



SLC069A



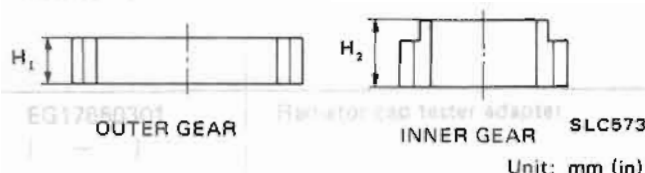
SERVICE DATA AND SPECIFICATIONS (S.D.S.)

Engine Lubrication System

Oil pressure check

Engine rpm	Approximate discharge pressure kPa (kg/cm ² , psi)
Idle speed	More than 59 (0.6, 9)
3,200	Non-turbo 363 - 451 (3.7 - 4.6, 53 - 65) Turbo 373 - 432 (3.8 - 4.4, 54 - 63)

Oil pump



Height	H ₁	H ₂
Except turbo model	12.5 (0.492)	18.5 (0.728)
Turbo model	15.5 (0.610)	21.5 (0.846)

Unit: mm (in)

Body to outer gear clearance ①	0.11 - 0.20 (0.0043 - 0.0079)
Inner gear to crescent clearance ②	0.12 - 0.23 (0.0047 - 0.0091)
Outer gear to crescent clearance ③	0.21 - 0.32 (0.0083 - 0.0126)
Housing to inner gear clearance ④	0.05 - 0.09 (0.0020 - 0.0035)
Housing to outer gear clearance ⑤	0.05 - 0.11 (0.0020 - 0.0043)

Tightening torque

Unit	N·m	kg·m	ft·lb
Oil pump securing bolt			
M6	6 - 7	0.6 - 0.7	4.3 - 5.1
M8	12 - 16	1.2 - 1.6	9 - 12
Oil pump cover screw	4 - 5	0.4 - 0.5	2.9 - 3.6
Regulator valve cap bolt	39 - 49	4 - 5	29 - 36
Oil strainer bolt			
M6	6.3 - 8.3	0.64 - 0.85	4.6 - 6.1
M8	16 - 21	1.6 - 2.1	12 - 15
Oil pressure switch	13 - 17	1.3 - 1.7	9 - 12
Turbocharger			
Oil inlet tube to cylinder block	15 - 20	1.5 - 2.0	11 - 14
Oil inlet tube to turbocharger	16 - 24	1.6 - 2.4	12 - 17
Oil outlet pipe to turbocharger	13 - 16	1.3 - 1.6	9 - 12
Water inlet tube to turbocharger	20 - 31	2.0 - 3.2	14 - 23
Water outlet tube to turbocharger	20 - 31	2.0 - 3.2	14 - 23
Exhaust outlet to turbocharger	22 - 29	2.2 - 3.0	16 - 22
Turbocharger unit	22 - 29	2.2 - 3.0	16 - 22
Engine oil cooler			
Oil filter bracket to cylinder block	14 - 18	1.4 - 1.8	10 - 13
Oil filter stud	59 - 74	6.0 - 7.5	43 - 54
Oil cooler tube to oil filter bracket	59 - 74	6.0 - 7.5	43 - 54
Oil cooler	8 - 11	0.8 - 1.1	5.8 - 8.0

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

Engine Cooling System

Radiator

Unit: kPa (kg/cm², psi)

Cap relief pressure 78 - 98 (0.8 - 1.0, 11 - 14)

Leakage test pressure 157 (1.6 - 23)

Thermostat

Standard

Valve opening temperature 76.5 (170)
°C (°F)

Maximum valve lift 10/90 (0.39/194)
mm/°C (in/°F)

Temperature switch (Turbocharged model)

Operating temperature 100 (212)
°C (°F)
OFF → ON

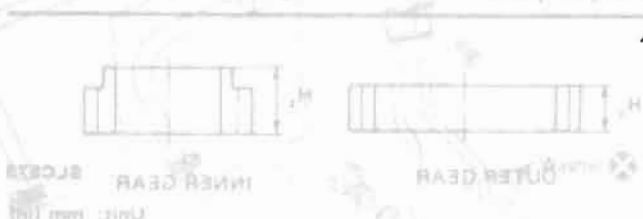
Tightening torque

Unit	N·m	kg·m	ft·lb
Water pump securing bolt	16 - 21	1.6 - 2.1	12 - 15
Thermostat housing securing bolt	16 - 21	1.6 - 2.1	12 - 15
Water inlet securing bolt	16 - 21	1.6 - 2.1	12 - 15
Water outlet securing bolt	16 - 21	1.6 - 2.1	12 - 15
Coolant filler housing bolt	3 - 4	0.3 - 0.4	2.2 - 2.9
Radiator securing bolt	3 - 4	0.3 - 0.4	2.2 - 2.9
Radiator hose clamp	3 - 5	0.3 - 0.5	2.2 - 3.6
Midway pipe to body securing bolt	3 - 4	0.3 - 0.4	2.2 - 2.9
Water suction pipe securing bolt	8 - 11	0.8 - 1.1	5.8 - 8.0
Cooling fan securing bolt	6 - 10	0.6 - 1.0	4.3 - 7.2
Fan coupling securing bolt	6 - 10	0.6 - 1.0	4.3 - 7.2
Electric cooling fan securing bolt and nut	3 - 4	0.3 - 0.4	2.2 - 2.9
Water temperature switch	9.3 - 10.3	0.95 - 1.05	6.9 - 7.6
Coolant delivery tube	31 - 41	3.2 - 4.2	23 - 30

Oil pressure check

Engine rpm	Approximate discharge pressure kPa (kg/cm ² , psi)
Idle speed (min)	More than 55 (0.6, 9)
3,300	Turbo 378 - 432 (3.8 - 4.4, 54 - 62) Non-turbo 383 - 481 (3.7 - 4.8, 53 - 69)

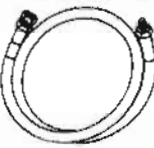
Oil pump



Height	Turbo model	Except turbo model
mm (in)	15.5 (0.61)	17.5 (0.69)

Unit: mm (in)	Clearance
Body to outer gear	0.11 - 0.30 (0.0043 - 0.012)
Clearance ①	0.13 - 0.33 (0.0047 - 0.013)
Inner gear to crescent	0.31 - 0.32 (0.0083 - 0.0128)
Clearance ②	0.08 - 0.09 (0.0031 - 0.0035)
Housing to inner gear	0.08 - 0.10 (0.0031 - 0.0039)
Clearance ③	0.08 - 0.10 (0.0031 - 0.0039)
Housing to outer gear	0.08 - 0.10 (0.0031 - 0.0039)
Clearance ④	0.08 - 0.10 (0.0031 - 0.0039)

SPECIAL SERVICE TOOLS

Tool number (Kent-Moore No.)	Tool name	
ST25051001 (J25695-1)	Oil pressure gauge	
ST25052000 (J25695-2)	Hose	
EG17650301 ()	Radiator cap tester adapter	
CONTENTS PRECAUTIONS ENGINE AND EMISSION CONTROL PARTS LOCATION E.C.C.S. DIAGRAM E.C.C.S. CHART		EF & EC- 7 EF & EC- 8 EF & EC- 9 EF & EC-10 EF & EC-11 EF & EC-12 EF & EC-14 EF & EC-31 EF & EC-61 EF & EC-91 EF & EC-94 EF & EC-96 EF & EC-97 EF & EC-101 EF & EC-102 EF & EC-104 EF & EC-106 EF & EC-108 EF & EC-112 EF & EC-114 EF & EC-116 EF & EC-118 EF & EC-120
FUEL FLOW SYSTEM DESCRIPTION AIR FLOW SYSTEM DESCRIPTION E.C.C.S. CIRCUIT DIAGRAM E.C.C.S. WIRING DIAGRAM E.C.C.S. DESCRIPTION DIAGNOSTIC PROCEDURE SELF-DIAGNOSIS ELECTRONIC CONTROL SYSTEM INSPECTION CRANK ANGLE SENSOR AIR FLOW METER CYLINDER HEAD TEMPERATURE SENSOR VEHICLE SPEED SENSOR IGNITION SIGNAL FUEL PUMP IDLE SWITCH ENGINE CONTROL UNIT E.G.R. FUNCTION EXHAUST GAS SENSOR DETONATION SENSOR EXHAUST GAS TEMPERATURE SENSOR FUEL TEMPERATURE SENSOR THROTTLE SENSOR INJECTOR LEAK START SIGNAL INJECTOR POWER SOURCE & GROUND CIRCUIT FOR E.C.C.S.		EF & EC- 9 EF & EC-10 EF & EC-11 EF & EC-12 EF & EC-14 EF & EC-31 EF & EC-61 EF & EC-91 EF & EC-94 EF & EC-96 EF & EC-97 EF & EC-101 EF & EC-102 EF & EC-104 EF & EC-106 EF & EC-108 EF & EC-112 EF & EC-114 EF & EC-116 EF & EC-118 EF & EC-120