# SERVICE MANUAL MATIZ (MY2003)

### FOREWORD

This manual includes procedure for maintenance, adjustment, service operation and removal and installation of components.

All information, illustrations and specifications contained in this manual are based on the latest product information available at the time of manual approval.

The right is reserved to make changes at any time without notice.



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# **SECTION 1A**

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# **DESCRIPTION AND SYSTEMOPERATION**

### **CLEANLINESS AND CARE**

An automobile engine is a combination of many machined, honed, polished and lapped surfaces with tolerances that are measured in the ten-thousandths of an inch. When any internal engine parts are serviced, care and cleanliness are important. A liberal coating of engine oil should be applied to friction areas during assembly, to protect and lubricate the surfaces on initial operation. Proper cleaning and protection of machined surfaces and friction areas is part of the repair procedure. This is considered standard shop practice even if not specifically stated.

Whenever valve train components are removed for service, they should be kept in order. They should be installed in the same locations, and with the same mating surfaces, as when they were removed. Battery cables should be disconnected before any major work is performed on the engine. Failure to disconnect cables may result in damage to wire harness or other electrical parts.

### **ON-ENGINE SERVICE**

Caution: Disconnect the negative battery cable before removing or installing any electrical unit, or when a tool or equipment could easily come in contact with exposed electrical terminals. Disconnecting this cable will help prevent personal injury and damage to the vehicle. The ignition must also be in B unless otherwise noted.

**Notice:** Any time the air cleaner is removed, the intake opening should be covered. This will protect against accidental entrance of foreign material, which could follow the intake passage into the cylinder and cause extensive damage when the engine is started.

# **COMPONENT LOCATOR**

### **ENGINE COMPARTMENT (TYPICAL)**

#### (Left-Hand Drive Shown, Right-Hand Drive Similar)



- 1 Power Steering Oil Reservoir
- 2 Coolant Reservoir
- 3 Canister
- 4 Canister Solenoid
- 5 Manifold Absolute Pressure (MAP) Sensor
- 6 Intake Manifold
- 7 Ignition Coil
- 8 Idle Air Control (IAC) Valve
- 9 Throttle Position (TP) Sensor
- 10 Throttle Body
- 11 Brake Fluid Reservoir
- 12 Wiper Motor

- 13 Battery
- 14 Fuse Box
- 15 Air Cleaner Housing
- 16 Resonator
- 17 PCV Hose
- 18 Distributor
- 19 Exhaust Manifold
- 20 Snorkel
- 21 Engine
- 22 Washer Fluid Reservoir
- 23 Oil Level Gauge
- 24 Oil Filler Cap

### **ENGINE COMPARTMENT (EURO III)**





- 1 Power Steering Oil Reservoir
- 2 Coolant Reservoir
- 3 Canister Purge Solenoid
- 4 Manifold Absolute Pressure (MAP) Sensor
- 5 Intake Manifold
- 6 Throttle Position (TP) Sensor
- 7 Throttle Body
- 8 Idle Air Control (IAC) Valve
- 9 Brake Fluid Reservoir
- 10 Wiper Motor

- 11 Battery
- 12 Fuse Box
- 13 Air Cleaner Housing
- 14 Resonator
- 15 Electronic Ignition System Ignition Coil
- 16 Exhaust Manifold
- 17 Snorkel
- 18 Engine
- 20 Washer Fluid Reservoir
- 19 Oil Level Gauge
- 21 Oil Filler Cap

# DIAGNOSTIC INFORMATION PROCEDURE

### **GENERAL DIAGNOSIS**

Condition		Probable cause	Correction
Hard Starting (With normal cranking)	Malfunction of Ignition System	• Faulty fuse.	Replace the fuse.
		• Faulty spark plug.	<ul> <li>Clean, adjust the plug gap or replace.</li> </ul>
		<ul> <li>Electric leakage at the high tension cable.</li> </ul>	• Replace the cable.
		<ul> <li>Poor connection of the high tension cable or lead wires.</li> </ul>	• Replace the cable or wires.
		<ul> <li>Worn distributor cap or accumulated carbon in the distributor cap.</li> </ul>	<ul> <li>Replace or clean the distributor cap.</li> </ul>
		<ul> <li>Damaged distributor rotor or cap.</li> </ul>	• Replace the rotor or the cap.
		• Improper ignition timing.	<ul> <li>Adjust the ignition timing.</li> </ul>
		• Faulty ignition coil.	<ul> <li>Replace the ignition coil.</li> </ul>
	Malfunction of Fuel	• Lock of fuel in the fuel tank.	• Feed the fuel.
	System	• Dirty or clogged fuel filter.	Replace the filter.
		<ul> <li>Clogged fuel pipe.</li> </ul>	<ul> <li>Clean the fuel pipe.</li> </ul>
		• Malfunction of the fuel pump.	<ul> <li>Replace the fuel pump.</li> </ul>
		<ul> <li>Malfunction of the fuel injector.</li> </ul>	• Replace the injector.
		<ul> <li>The foreign material in the fuel tank.</li> </ul>	• Clean the fuel tank.
	Decline of Compression	• Poor tightening spark plug.	<ul> <li>Tighten to the specified torque.</li> </ul>
F	Pressure	<ul> <li>Cracked cylinder head gasket.</li> </ul>	• Replace the gasket.
		<ul> <li>Inadequate the valve clearance.</li> </ul>	<ul> <li>Adjust the clearance.</li> </ul>
		<ul> <li>Leakage of the valve clearance.</li> </ul>	• Repair the valve.
		<ul> <li>Interference of the valve stem.</li> </ul>	<ul> <li>Replace the valve or the valve guide.</li> </ul>
		<ul> <li>Low elasticity or damage of the valve spring.</li> </ul>	• Replace the valve spring.
		<ul> <li>Abnormal interference of pistons and cylinders.</li> </ul>	• Replace the piston ring.
		• Excessive wear of pistons, rings, or cylinders.	<ul> <li>Replace the ring or the piston and boring or replace the cylinder.</li> </ul>

Condition		Probable cause	Correction
Hard Starting (With normal cranking)	Others	<ul> <li>Broken timing belt.</li> </ul>	<ul> <li>Replace the belt.</li> </ul>
		<ul> <li>Malfunction of Positive Crankcase Ventilation (PCV) valve.</li> </ul>	<ul> <li>Check and replace Positive Crankcase Ventilation (PCV) valve if needed.</li> </ul>
		<ul> <li>Loosening, damage or leakage of the vacuum hose.</li> </ul>	<ul> <li>Connect the hose correctly or replace it.</li> </ul>
		• Leakage of intake system.	Replace intake system.
Lack of Engine Power	Decline of Compression Pressure	<ul> <li>Refer to "Page 1A–5".</li> </ul>	<ul> <li>Refer to "Page 1A–5".</li> </ul>
	Malfunction of	<ul> <li>Improper ignition timing.</li> </ul>	<ul> <li>Adjust the ignition timing.</li> </ul>
	Ignition System	<ul> <li>Faulty spark plug.</li> </ul>	<ul> <li>Adjust or replace the spark plug.</li> </ul>
		<ul> <li>Malfunction of the distributor.</li> </ul>	<ul> <li>Repair or replace the distributor. Check the rotor.</li> </ul>
		<ul> <li>Electric leakage or poor connection of the high tension cable.</li> </ul>	<ul> <li>Connect the cable correctly or replace it.</li> </ul>
	Malfunction of	<ul> <li>Clogged fuel pipe.</li> </ul>	<ul> <li>Clean the pipe.</li> </ul>
	Fuel System	<ul> <li>Clogged or contaminated fuel filter.</li> </ul>	• Replace the filter.
	Others	<ul> <li>Clogged exhaust system.</li> </ul>	<ul> <li>Check and repair the system.</li> </ul>
		<ul> <li>Clogged or contaminated air cleaner element.</li> </ul>	<ul> <li>Clean or replace the air cleaner element.</li> </ul>
		<ul> <li>Leak of the intake manifold gasket.</li> </ul>	• Replace the gasket.
		Dragging brakes.	<ul> <li>Repair or replace the brakes.</li> </ul>
		Slipping clutch.	• Adjust or replace the clutch.
Rough Engine Idling	Decline of Compression Pressure	<ul> <li>Refer to "Page 1A–5".</li> </ul>	<ul> <li>Refer to "Page 1A–5".</li> </ul>
	Malfunction of Fuel System	Clogged fuel pipe.	Clean the pipe.
		<ul> <li>Clogged or contaminated fuel filter.</li> </ul>	<ul> <li>Replace the filter.</li> </ul>
		<ul> <li>Malfunction of the fuel pressure regulator.</li> </ul>	<ul> <li>Replace the regulator.</li> </ul>
	Malfunction of Ignition System	<ul> <li>Malfunction of the spark plug.</li> </ul>	<ul> <li>Adjust or replace the spark plug.</li> </ul>
		<ul> <li>Electric leakage or poor connection of the high tension cable.</li> </ul>	<ul> <li>Connect the cable correctly or replace it.</li> </ul>
		<ul> <li>Worn distributor cap terminal or accumulated carbon in the distributor cap.</li> </ul>	<ul> <li>Replace or clean the distributor cap.</li> </ul>

#### Condition **Probable cause** Correction Rough Engine Idling Malfunction of • Replace the rotor or cap. Loosening or damage of the Ignition System distributor rotor or cap. Poor ignition timing. • Adjust the ignition timing. • Malfunction of the ignition • Replace the ignition coil. coil. Others Clogged or contaminated air • Clean or replace the air cleaner element. cleaner element. • Leak of the intake manifold • Replace the gasket. gasket. Malfunction of Positive • Check the valve or replace it Crankcase Ventilation (PCV) if needed. valve. Poor connection or damage • Connect the hose correctly or leakage of the vacuum or replace it. hose. Engine Hesitate (Upon Decline of • Refer to "Page 1A-5". • Refer to "Page 1A-5". pressing accelerating Compression pedal, the engine Pressure makes delayed Malfunction of Poor ignition timing. Adjust the ignition timing. response. This Ignition System situation is remarkable Poor spark plug or poor • Replace the plug or adjust • when cruising or adjustment of the plug gap. the gap. starting.) Electric leakage or poor • Connect the cable correctly connection of the high or replace it. tension cable. Malfunction of the air cleaner Others • Clean or replace the air system. cleaner system. • Leak of the intake manifold • Replace the gasket. gasket. **Engine Surging** Decline of • Refer to "Page 1A-5". • Refer to "Page 1A-5". (Engine power makes Compression fluctuation in a fixed Pressure speed and speed Malfunction of • Clogged fuel pipe. Clean the pipe. changes without Fuel System operating the Clogged or contaminated • Replace the filter. accelerating pedal.) fuel filter. • Malfunction of the fuel • Replace the fuel pressure pressure regulator. regulator. Malfunction of • Adjust or replace the spark Malfunction of the spark Ignition System plug. plug. • Electric leakage or poor • Connect the cable correctly connection of the high or replace it. tension cable. Worn distributor cap terminal • Clean or replace the or accumulated carbon in distributor cap. the distributor cap. Loosening or damage of the • Replace the distributor rotor distributor rotor or the cap. or the cap.

Poor ignition timing.

Adjust the ignition timing.

Condition		Probable cause	Correction
Engine Surging (Engine power makes fluctuation in a fixed speed and speed changes without operating the accelerating pedal.)	Others	<ul> <li>Leak of the intake manifold gasket.</li> </ul>	<ul> <li>Clean or replace the gasket.</li> </ul>
		<ul> <li>Leakage of the vacuum hose.</li> </ul>	<ul> <li>Connect the hose correctly or replace it.</li> </ul>
Excessive Detonation (According to the	Overheated Engine	<ul> <li>Refer to "Overheat" in this page.</li> </ul>	<ul> <li>Refer to "Overheat" in this page.</li> </ul>
throttle valve,	Malfunction of	<ul> <li>Abnormal spark plug.</li> </ul>	<ul> <li>Replace the spark plug.</li> </ul>
knocking sound of metallic is made with	Ignition System	• Poor ignition timing.	<ul> <li>Adjust the ignition timing.</li> </ul>
abnormal explosion.)		<ul> <li>Electric leakage or poor connection of the high tension cable.</li> </ul>	<ul> <li>Connect the cable correctly or replace it.</li> </ul>
	Malfunction of Fuel System	<ul> <li>Clogged or contaminated fuel filter and fuel pipe.</li> </ul>	<ul> <li>Clean or replace the fuel filter and the fuel pipe.</li> </ul>
	Others	<ul> <li>Leak of the intake manifold gasket.</li> </ul>	• Replace the gasket.
		<ul> <li>Excessive carbon deposit due to abnormal combustion.</li> </ul>	• Remove the carbon.
Overheat	Malfunction of	<ul> <li>Lack of coolant.</li> </ul>	Refill coolant.
	Cooling System	• Malfunction of the thermostat.	• Replace the thermostat.
		<ul> <li>Malfunction of the cooling fan.</li> </ul>	<ul> <li>Check or replace the cooling fan.</li> </ul>
		<ul> <li>Poor water pump performance.</li> </ul>	<ul> <li>Replace the pump.</li> </ul>
		<ul> <li>Clogged or leaky radiator.</li> </ul>	<ul> <li>Clean, repair or replace the radiator.</li> </ul>
	Malfunction of Lubrication System	<ul> <li>Poor engine oil.</li> </ul>	<ul> <li>Replace engine oil with the specified one.</li> </ul>
		<ul> <li>Blocking oil filter or strainer.</li> </ul>	<ul> <li>Clean or replace the oil filter or the strainer.</li> </ul>
		<ul> <li>Lack of engine oil.</li> </ul>	Refill oil.
		• Poor oil pump performance.	• Replace or repair the pump.
		<ul> <li>Leakage of oil.</li> </ul>	• Repair.
	Other	<ul> <li>Damaged cylinder head gasket.</li> </ul>	<ul> <li>Replace the gasket.</li> </ul>
Poor Fuel Consumption	Decline of Compression Pressure	<ul> <li>Refer to "Page 1A–5".</li> </ul>	● Refer to "Page 1A–5".
	Malfunction of Fuel System	<ul> <li>Leakage of the fuel tank or the fuel pipe.</li> </ul>	<ul> <li>Repair or replace the fuel tank or the fuel pipe.</li> </ul>

Condition		Probable cause	Correction
Poor Fuel Consumption	Malfunction of Ignition System	Improper ignition timing.	<ul> <li>Adjust the ignition timing.</li> </ul>
		<ul> <li>Abnormal spark plug (Excessive carbon deposit, inadequate gap, burnt electrode).</li> </ul>	<ul> <li>Replace the plug.</li> </ul>
		<ul> <li>Electric leakage or poor connection of the high tension cable.</li> </ul>	<ul> <li>Connect the cable normally or replace it.</li> </ul>
	Malfunction of Cooling System	<ul> <li>Malfunction of the thermostat.</li> </ul>	<ul> <li>Replace the thermostat.</li> </ul>
	Others	Improperly installed valve.	• Repair or replace the valve.
		Slipping clutch.	• Repair or replace the clutch.
		• Low pressure of tires.	<ul> <li>Adjust the pressure of tires.</li> </ul>
Excessive	Leakage of	<ul> <li>Loosened oil drain plug.</li> </ul>	<ul> <li>Tighten the plug.</li> </ul>
Engine Oil	Engine Oil	<ul> <li>Loosened oil pan bolt.</li> </ul>	<ul> <li>Tighten the bolt.</li> </ul>
		Loosened oil filter.	<ul> <li>Tighten the filter.</li> </ul>
		<ul> <li>Loosened oil pressure switch.</li> </ul>	<ul> <li>Tighten the switch.</li> </ul>
		<ul> <li>Leakage of camshaft front oil seal.</li> </ul>	• Replace the seal.
		<ul> <li>Leakage of crankshaft front oil seal.</li> </ul>	• Replace the seal.
		<ul> <li>Leakage at the cylinder head cover gasket.</li> </ul>	• Replace the gasket.
		<ul> <li>Damage of the cylinder head gasket.</li> </ul>	• Replace the gasket.
	Oil Mixing in Combustion Chamber	<ul> <li>Stuck piston ring.</li> </ul>	<ul> <li>Remove carbon and replace the ring.</li> </ul>
		• Worn piston or cylinder.	<ul> <li>Replace the piston or the cylinder.</li> </ul>
		<ul> <li>Worn piston ring or ring groove.</li> </ul>	• Replace the piston or ring.
		<ul> <li>Inadequate position of the piston ring cutting part.</li> </ul>	<ul> <li>Adjust the position.</li> </ul>
		<ul> <li>Abrasion or damage of the valve system.</li> </ul>	<ul> <li>Replace the valve system.</li> </ul>
Low Oil Pressure	Malfunction of Lubrication System	Inadequate oil viscosity.	<ul> <li>Replace with the specified one.</li> </ul>
		• Loosening of the oil pressure switch.	• Tighten the switch.
		• Lack of engine oil.	Refill oil.
		Blocking oil strainer.	Clean the strainer.

GENERAL	DIAGNOSIS	(Cont'd)
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Condition	on	Probable cause	Correction
Low Oil Pressure Malfunction of Lubrication System	<ul> <li>Lowered function of the oil pump.</li> </ul>	• Replace the pump.	
	System	<ul> <li>Abrasion or damage of the oil pump relief valve.</li> </ul>	<ul> <li>Replace the valve.</li> </ul>
Engine Noise	Valve Noise	• Inadequate valve clearance.	• Adjust the valve clearance.
		<ul> <li>Abrasion of valve stem or guide.</li> </ul>	<ul> <li>Replace the valve stem or the guide.</li> </ul>
		<ul> <li>Weak valve spring.</li> </ul>	<ul> <li>Replace the spring.</li> </ul>
	Piston, Ring, Cylinder Noise	<ul> <li>Abrasion of the piston, the ring or the cylinder.</li> </ul>	<ul> <li>Boring the cylinder or replace the piston, the ring or the cylinder.</li> </ul>
	Connecting Rod Noise	<ul> <li>Abrasion of the connecting rod bearing.</li> </ul>	• Replace the bearing.
		<ul> <li>Loosened the connecting rod nut.</li> </ul>	<ul> <li>Tighten to the specified torque.</li> </ul>
	Crankshaft Noise	<ul> <li>Abrasion of the crankshaft bearing.</li> </ul>	• Replace the bearing.
		<ul> <li>Abrasion of the crankshaft journal.</li> </ul>	<ul> <li>Grind or replace the crankshaft journal.</li> </ul>
		• Loosened bearing cap bolt.	<ul> <li>Tighten to the specified torque.</li> </ul>
		• Excessive clearance of the crankshaft thrust bearing.	• Adjust or replace.
		• Low oil pressure.	<ul> <li>Refer to "Low Oil Pressure" in this section.</li> </ul>

### CHECKING ENGINE FLUID LEVEL

Check the engine fluid level or condition. If needed, refill or replace the oil.

Check the engine oil level within engine normal operating temperature as follows ;

- 1. After stopping the engine, wait for a few minutes to accumulate oil into the oil pan.
- 2. After pulling out the oil level gauge (a), check the oil level.
- 3. Clean the oil level gauge and insert the gauge into guide.
- 4. After pulling out the oil level gauge again, recheck the oil level and insert the gauge into guide again.

**Important:** Oil level should be between "MIN" mark and "MAX" mark.

5. If oil level is below the "MIN" mark, refill engine oil as much as the demanded quantify.

**Important:** If checking oil level under the engine cold condition, oil is not accumulated into oil pan quickly and correct level checking can not be performed. Therefore, wait until temperature reaches the normal operating condition and check the engine oil level.



## CHANGING ENGINE OIL OR OIL FILTER

#### **Tools Required**

09915-47341 Oil Filter Wrench.

When checking engine oil level or condition, if needed, change engine oil (including the filter) as follows ;

- 1. After stopping the engine, wait for a few minutes to accumulate oil into the oil pan.
- 2. Remove the oil filter cap (b).

3. Remove the oil drain plug (c) and draw oil off.



- 4. After drawing oil completely, tighten the oil drain plug to 30–40 N•m (22–30 lb-ft).
- 5. Replace the oil filter using the oil filter wrench 09915–47341 (d).
  - Remove the air cleaner/resonator/snorkel assembly.
  - After removing the bolts, remove the heat shield.
  - Loosen the power steering pump cap screw and pull the power steering hose into the front.
  - Remove the oil filter.

**Important:** Whenever changing engine oil, replace the oil filter. When replacing new oil filter, apply engine oil on oil filter sealing.



## **CHECKING ENGINE TIMING BELT**

After checking the timing belt for looseness, crack, wear or tension, replace the belt if necessary.

### CHECKING ACCESSORY BELT

After checking the alternator belt (e), air conditioning/ power steering belt (f), air conditioning belt (g), power steering belt (h), for looseness, crack, wear or tension, replace the belt if necessary.



## **CHECKING SPARK PLUG**

After checking the spark plug for bad clearance, excessive carbon deposit, worn electrode or damaged insulator, replace the new one if necessary.

Remove and check the spark plug as follows ;

 Pull the high tension cable cap portion (i), and disconnect the high tension cable from the spark plug. If pulling the high tension cable (j), circuit could be disconnected. Therefore, the cap portion should be used.



- 2. Remove the spark plugs from cylinder head using a wrench.
- 3. Measure the spark plug clearance (k) with the filler gauge. If measured value is not within the specified value, adjust the grounding electrode.

When installing new spark plug, check the clearance for equality and install it.



### CHECKING AIR CLEANER ELEMENT

If the air cleaner element becomes dirty, engine efficiency could be deteriorated.

Be sure to check the element often.

Especially, if a vehicle frequently runs on a dusty road, check and replace the element often.

## **CHECKING FUEL FILTER**

If fuel filter is used over the specified period, engine efficiency is deteriorated by dust or foreign material.

Therefore, replace a new one within the specified period.

## CHECKING FUEL SYSTEM

Check the fuel system as follows ;

- Check the fuel line or line connection portion for damage or leakage.
- Check the fuel hose surface for damage.
- Check the fuel cap for looseness.

### **CHECKING HOSE SYSTEM**

Check the engine vacuum hose, PCV hose or canister hose as follows ;

- Check the hose surface for damage by heat or machine.
- Check the hose for hardening, crack, tear, or coming off.

# **SPECIFICATIONS**

## **GENERAL SPECIFICATIONS**

Application		Description	
	Maximum Speed		144 km/h (90 mph)
Vehicle Capacity	Gradeability		0.420 tan θ
	Minimum Turning Radius		4.5 m (14.8 ft)
	Bore × Stroke		68.5 × 72.0 mm (2.70 × 2.83 inch)
	Displacement		796 cm <sup>3</sup> (48.6 in <sup>3</sup> )
	Compression F	atio	9.3 : 1
	Maximum Pow	er	37.5 KW (6,000 rpm)
Engine Information	Maximum Torq	ue	68.6 N•m (50.59 lb-ft) (at 4,600 rpm)
	Ignition Timing	(Ignition Sequence)	5° BTDC (1–3–2) / 10° BTDC (1–3–2)
		Air Conditioning System (ON)	1,000 ± 50 rpm
	Idle Speed	Air Conditioning System (OFF)	950 rpm
	Engine		Overhead Cam L–3
	Ignition Type		Direct Ignition System (DIS) / High Energy Ignition (HEI)
	Distributor		Optical Sensor Type
	Starter		SD 80
		Unleaded	BPR5EY-11, RN9YC4, WR8DCX
	Spark–Plug	Leaded	BPR5EY, RN9YC, WR8DC
	Fuel Injection T	уре	MPI
	Fuel Pump		Electric Motor Pump
Engine Part Type	Fuel Filter		Cartridge
	Lubricating Typ	e	Forced Feed Type
	Oil Pump		Rotary Pump Type
Cooling Type			Forced Water Circulation
	Radiator		Cross – Flow
	Water Pump		Centrifugal
	Thermostat		Pellet Type
	Air Cleaner Ele	ment	Non Woven Fablic
	Muffler		Catalytic Converter, Closed Circuit
	Battery		MF
Engine Part	Engine Oil		SJ Grade SAE 5W30, SAE 10W30, SAE 15W40
Capacity	Refrigerant		Four Seasons
		Engine Disassembly	3.0 L (3.17 qt)
	Engine Oil	Oil Change (Including filter)	2.7 L (2.85 qt)
	Engine Oli	Oil Change (Not including filter)	2.5 L (2.64 qt)
		Oil Level Gauge	1 L (1.06 qt) (MIN to MAX)
	Coolant		3.8 L (4.02 qt)
Engine Information	Battery		12V–35 AH, 246 CCA
	Generator		65 A
	Starter		0.8 kW
	Fuel Pump	Output Capacity	90 – 133 Lph
		Output Pressure	380 kPa (55.1 Psi)
	Fuel Tank Capacity		35 L (9.2 gal), 38 L (10 gal)



### **ENGINE PERFORMANCE CURVE**

# **SECTION 1B**

# SOHC ENGINE MECHANICAL

CAUTION: Disconnect the negative battery cable before removing or installing any electrical unit or when a tool or equipment could easily come in contact with exposed electrical terminals. Disconnecting this cable will help prevent personal injury and damage to the vehicle. The ignition must also be in B unless otherwise noted.

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# **DESCRIPTION AND OPERATION**

### **ENGINE TYPE**

The engine is 4-cycle, water-cooled, in-line 3 cylinders with displacement of 796cc ( $68.5 \times 72.0$ mm) ( $2.70 \times 2.83$  in.).

Engine model (Specifications)	F8C Type SOHC / 2 Valve (MPI)
Maximum power (kw/rpm)	37.5 / 6,000
Maximum torque (N•m/rpm)	68.6 / 4,600
Compression ratio	9.3 : 1



## **ENGINE LUBRICATION**

The engine lubrication is of the wetsump method to draw up the oil forced by the oil pump. The oil pump is of a trochoid type, and mounted on crankshaft at crankshaft pulley side (a). Oil is drawn up through oil pump pickup tube (b) and passed through pump (c) to oil filter (d). The filtered oil flows into two paths in engine block. In one path (e), oil reaches crankshaft journal bearings. Oil from crankshaft journal bearings is supplied to connecting rod bearings by means of intersecting passages drilled in crankshaft, and then injected from a small hole provided on big end of connecting rod to lubricate piston (f), rings, and cylinder wall. In another path (g), oil goes up to cylinder head and lubricates rocker arm (i), valve (j), camshaft (k), etc. through the oil hole provided on the rocker arm shaft (h).



## CYLINDER HEAD AND VALVE TRAIN

The cylinder head is made of cast aluminum alloy for better strength in hardness with lightweight, and camshaft (k) and rocker arm shaft (h) arranged in-line support.



The combustion chambers are formed into the manifold combustion chambers with increased squish parts for better combustion efficiency and its intake and exhaust parts are installed in the cross flow arrangement. The rocker arm (i) operates in seesaw motion to close and open the intake and exhaust valves (j) with camshaft by turning the rocker arm shaft of each intake and exhaust part.

### **ENGINE BLOCK**

As the largest part of the engine components. the block (I) has all the necessary parts attached to outer surface of it.

On the inside surface of block, there are bore surfaces by horning, which are cylinders, and on the periphery of the cylinders, there are the passages to prevent the over-heated and to lubricate the engine block.

### CRANKSHAFT

The crankshaft (m) is to convert the rectilinear motion into the rotation motion through the connecting rod (n) which transmits the power generated by combustion.

On the one side of it, oil pump, crankshaft pulley and timing belt pulley are attached, and oil seal housing and flywheel are on the other side.

A special steel of high grade cast iron is used for the material to stand the bending load and distortion. The material of the main bearing (o) is aluminum alloy. The split thrust bearings (p) are inserted in the journal bearing part (No.3).



### CONNECTING ROD

The connecting rods (n) are made of forged steel, and its section is typed "l" with its big end connected to

crankshaft (m) and its small end to piston pin to transmit the power.

The big end is detachable, and its upper and lower parts are fastened by bolting after the metal bearings (q) are inserted.

# PISTON, PISTON RING AND PISTON PIN

#### Piston

The piston (r) is of the open skirt type and its crown is exposed in the combustion chamber to generate power. Its land and skirt parts are made of coat aluminum alloy which is light and has excellent heat conductivity in order to meet its continuous and high speed reciprocation movement.

#### **Piston Ring**

It is composed of two compression rings (s) and one oil ring (t) and installed between the grooves of the piston to make the high speed reciprocating movement maintaining a remarkable air tightness as well as cylinders. It is a critical parts to affect the compression pressure, oil consumption, compression, blow by pressure and engine performance.

#### **Piston Pin**

The pin (u) is not fixed to the piston or connecting rod and its both ends are assembled by the circlip (v) in the full floating type. The pin is used to transmit the power from the crown part of piston to connecting rod.



## TIMING BELT AND PULLEY

The timing belt connects the camshaft timing pulley (w) and the crankshaft timing pulley (x). The timing belt coordinates the crankshaft and the camshaft and keeps them synchronized. The timing belt also turns the coolant pump (y). The timing belt and the pulleys are toothed so that there is no slippage between them. There is a tension pulley (z) that maintains the correct timing belt tension. The timing belt is made of a tough reinforced rubber similar to that used on the serpentine drive belt. The timing belt requires no lubrication.



# **ENGINE MOUNT**

This is to absorb or reduce the engine vibration and impact from the wheeled road. Engine mount is attached to the engine–front side, the engine-right side and the engine-rear side and one transaxle mount is attached to the transaxle side.





# **COMPONENT LOCATOR**

**CYLINDER HEAD** 



- 1 Oil Filler Cap
- 2 Cylinder Head Cover
- 3 Cylinder Head Cover (Euro III)
- 4 Distributor Case
- 5 Camshaft
- 6 Exhaust Rocker Arm

- 7 Cylinder Head Gasket
- 8 Cylinder Head
- 9 Intake Rocker Arm
- 10 Exhaust Valve
- 11 Intake Valve

# **ENGINE BLOCK**



- 1 Oil Level Gauge Stick
- 2 Piston
- 3 Connecting Rod
- 4 Engine Block
- 5 Oil Filter

- 6 Flywheel
- 7 Crankshaft
- 8 Oil Pan
- 9 Oil Pump Strainer
- 10 Oil Pump Assembly

## **MANIFOLD & AIR FLOW SYSTEM**



- 1 Intake Manifold
- 2 Exhaust Gas Recirculation (EGR) Pipe3 Exhaust Gas Recirculation (EGR) Valve and Solenoid
- 4 Throttle Body Assembly
- 5 Air Filter Assembly
- 6 Resonator

- 7 Snorkel
- 8 Oxygen Sensor
- 9 Exhaust Manifold
- 10 Exhaust Manifold Heat Shield
- 11 Exhaust Manifold Heat Shield (Euro III)
- 12 Exhaust Manifold (Euro III)

## **TIMING BELT & ENGINE MOUNT**



- 1 Engine Mount Damping Block
- 2 Engine Mount Intermediate Bracket
- 3 Engine Mount Brace Bracket
- 4 Transaxle Mount Bracket
- 5 Transaxle Mount Damping Block
- 6 Engine Mount Front Bracket
- 7 Engine Mount Front Damping Bush
- 8 Timing Belt

- 9 Timing Belt Tensioner
- 10 Crankshaft Gear
- 11 Timing Belt Upper Front Cover
- 12 Timing Belt Lower Front Cover
- 13 Crankshaft Pulley
- 14 Engine Mount Lower Bracket
- 15 Engine Mount Upper Bracket

# DIAGNOSTIC INFORMATION AND PROCEDURE

## COMPRESSION PRESSURE CHECK

#### **Tools Required**

09915-64510 Compression Pressure Gauge

Check the compression pressure in the following procedures:

- 1. Warm up the engine to the normal operating temperature (Cooling temperature : 80–90°C (176–194°F)).
- 2. Stop the engine and then remove the high tension cable and the spark plug.
- 3. Disconnect the distributor optical sensor connector.
- 4. Install the compression pressure gauge 09915–64510(a) in the hole of spark plug.



- 5. Disengage the clutch in Neutral (to lighten starting load on engine upon cranking), and depress the accelerator all the way to make the throttle fully open.
- 6. Crank the engine with the starting motor, and read the highest pressure on the compression pressure gauge.
- The difference of measured value between cylinders is 98.06kPa (14.22 psi) and less.
- On checking, make the connection perfectly airtight between the hole of spark plug and compression pressure gauge.

	Unit	Standard	Limit
Compression Pressure – 400 rpm	kPa(psi)	1,225.75 (177.73)	1,176.72– 1,274.78 (170.62– 184.84)

7. After checking, remove the gauge and install the removed parts.

# **OIL PRESSURE CHECK**

### **Tools Required**

09915–77310 Oil Pressure Gauge

Prior to check oil pressure, check the followings:

- Check oil level and add if required.
- Replace the discolored, deteriorated or diluted oil.
- Check any oil leakage and repair the defective parts.

Check the compression pressure in the following procedures:

- 1. Remove the oil pressure switch (b) from the cylinder block.
- 2. Install the oil pressure gauge 09915–77310 (c) to the mounting place of the oil pressure switch.



- 3. Start the engine and warm up to the normal operating temperature.
- 4. Raise the engine speed up to 2,000rpm and then read oil pressure.

Item	Unit	Standard
Oil Pressure – 2000rpm	kPa (psi)	245.15–294.18 (35.55–42.66)

- 5. After checking, wrap the threads of oil pressure switch with a seal tape and tighten it to the specified torque 12–16 N•m (106–144 lb-in).
- 6. Start the engine and check oil pressure switch for oil leakage.

### ADJUSTMENT OF VALVE CLEARANCE

Adjust the valve clearance in the following procedures:

- 1. Remove the air filter/resonator assembly and the relevant parts installed on the cylinder head cover.
- 2. Remove the cylinder head cover hexagon bolts and remove the cover.
- 3. Turn over the crankshaft to make No.1 cylinder matched with the compression top dead center. (When the camshaft sprocket notch (d) is aligned with the timing belt rear cover triangle pointer (e) and the crankshaft sprocket point (f) is aligned with the oil pump housing point (g), the compression top dead center is on the ignition sequence for No. 1 cylinder.)



4. Check the valve clearance for No. 1 cylinder compression top dead center.

Condition	Cylinder No.	1	2	3
Compression top	Intake	0	0	
No.1 cylinder	Exhaust	0		0

- $* \bigcirc$  marks indicates the place where the valve clearance can be checked and adjusted.
- 5. If the checking for the valve clearance of No.1 cylinder compression top dead center is over, position No.1 cylinder on the exhaust top dead center as rotating the crankshaft in a 360–degree arc. (When the camshaft sprocket point (h) is aligned with the timing belt rear cover triangle pointer (e), the exhaust top dead center is on the ignition sequence for No. 1 cylinder.)



6. Check the valve clearance for the No. 1 cylinder exhaust top dead center.

Condition	Cylinder No.	1	2	3
Exhaust top dead	Intake			0
cylinder	Exhaust		$\bigcirc$	

- $\boldsymbol{*} \bigcirc$  marks indicates the place where the valve clear-ance can be checked and adjusted.
- Check and adjust the valve clearance (i) using thickness gauge (j).





The measured value of valve clearance should meet the specified value. If not, adjust the valve clearance.

**Important:** In case of hot engine, warm up the engine until the electric cooling fan begins to work and stop the engine to adjust the clearance with 20–30 minutes there from.

				Unit : mm (in.)	
	Item			Specified value	
	0.11	Intake	0.15±0.02 (0.0059±0.0008)		
	Valve	Cold	Exhaust	0.32±0.02 (0.0126±0.0008)	
Clearance	11-4	Intake	0.25±0.02 (0.0098±0.0008)		
			Hot	Exhaust	0.42±0.02 (0.0165±0.0008)

 When adjusting the valve clearance, loosen the adjust nut (k) and then tighten or loosen the adjust rod (I) properly.



### IGNITION TIMING CHECK AND ADJUSTMENT (TYPICAL)

**Note:** Ignition timing could not be adjusted for Direct Ignition System (Euro Stage III).

Check and adjust the ignition timing in the following procedures:

- 1. Warm up the engine to the normal operating temperature.
- 2. Turn off the lamp and audio system and shift the shift gear lever in Neutral.



- Connect terminal A and terminal C of ALDL connector using the wire (m) or connect the scan tool (n) with ALDL connector.
- 4. Connect the timing light (o) with No. 1 cylinder high tension cable and check the specified value for the ignition timing, flashing notch on the crankshaft pulley.

Item	Specified Value
Ignition timing – 950rpm	10° BTDC

**Important:** In flashing the timing light, if crankshaft pulley notch (p) is matched with the mark (10) for timing check, the ignition timing is  $10^{\circ}$  BTDC.





 If the ignition timing exceeds the specified value, loosen the distributor bolts and adjust it to the specified ignition timing by turning the distributor body (s).



# VALVE TIMING CHECK AND ADJUSTMENT

Check the valve timing in the following procedures:

1. After removing the high headlamp, loosen the bolts (a) and remove the timing belt front upper cover (b).



Turning the crankshaft clockwise twice, align the notch (d) on the crankshaft pulley (c) with the mark 0 (e) for the timing check on the timing belt front lower cover.



3. Check if the notch (f) on the camshaft sprocket is aligned with the triangle pointer (g) on the timing belt rear cover.

**Important:** Notch (f) should be aligned with pointer (g) to set the valve timing normally.



Adjust the valve timing in the following procedures:

1. Loosen the bolt and remove the timing belt pulley (c). In loosening the bolt, use the driver (h) in the picture shown.



2. Remove the oil level gauge guide tube (i) and the timing belt front lower cover (j).



3. Remove the timing belt tensioner (k) and the timing belt (l).



4. Using the bolt, turn the crankshaft clockwise to align the mark (m) on the crankshaft sprocket with the pointer (n) on the oil pump housing. Then, turn the camshaft to align the notch (f) with the pointer (g).



5. Install the timing belt (I) and the tensioner (k). (Do not tighten the tensioner bolt completely.)

Turning the crankshaft clockwise twice, align the mark (m) with the pointer (n) and tighten the tensioner bolt to  $15-23 \text{ N} \cdot \text{m}$  (11-17 lb-ft).



6. Install all removed parts.

# **SECTION 1D**

# **ENGINE COOLING**

CAUTION: Disconnect the negative battery cable before removing or installing any electrical unit or when a tool or equipment could easily come in contact with exposed electrical terminals. Disconnecting this cable will help prevent personal injury and damage to the vehicle. The ignition must also be in B unless otherwise noted.

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# **DESCRIPTION AND OPERATION**

### **GENERAL DESCRIPTION**

The cooling system maintains the engine temperature at an efficient level during all engine operating conditions. When the engine is cold the cooling system cools the engine slowly or not at all. This slow cooling of the engine allows the engine to warm up quickly.

The cooling system includes a radiator(a) and cooling fan(b), a thermostat and housing(c), a coolant pump(d), a coolant pump drive belt and coolant hose. The timing belt drives the coolant pump.

All components must function properly in order for the cooling system to operate. The coolant pump draws the coolant from the radiator. The coolant then circulates through water jackets in the engine block and the cylinder head, distributor case(e), throttle body(f). When the coolant reaches the operating temperature of the thermostat, the thermostat opens. The coolant then goes back to the radiator where it cools.

This system directs some coolant through the hoses to the heater core(g). This provides for heating and defrosting. The surge tank(h) is connected to the radiator and throttle body to recover the coolant displaced by expansion from the high temperatures. The surge tank maintains the correct coolant level.

The cooling system for this vehicle has no radiator cap and drain cock. The coolant is added to the cooling system through the surge tank. To drain the cooling system, disconnect the lower radiator hose and drain the coolant.

### RADIATOR

This vehicle has a lightweight tube-and-fin aluminum radiator.

### **SURGE TANK**

The surge tank is a transparent plastic reservoir, similar to the windshield washer reservoir.

The surge tank is connected to the radiator and throttle body by a hose. As the vehicle is driven, the engine coolant heats and expands. The portion of the engine coolant displaced by this expansion flows from the radiator into the surge tank. The air trapped in the radiator is degassed into the surge tank.

When the engine is stops, the engine coolant cools and contracts. The displaced engine coolant is then drawn back into the radiator. This keeps the radiator filled with the coolant to the desired level at all times and increases the cooling efficiency.

Maintain the coolant level between the MIN and the MAX marks on the surge tank when the system is cold.



### **COOLANT PUMP**

The belt-driven centrifugal coolant pump consists of an impeller, a drive shaft, and a belt pulley.

The impeller is supported by a completely sealed bearing.

The coolant pump is serviced as an assembly and, therefore, cannot be disassembled.

### THERMOSTAT

A wax pellet-type thermostat controls the flow of the engine coolant through the engine cooling system. The thermostat(i) is mounted in the thermostat housing.

The thermostat stops the flow of the engine coolant from the engine to the radiator in order to provide faster warm-up, and to regulate the coolant temperature. The thermostat remains closed while the engine coolant is cold, preventing circulation of the engine coolant through the radiator. At this point, the engine coolant is allowed to circulate only throughout the heater core to warm it quickly and evenly.

As the engine warms, the thermostat opens. This allows the engine coolant to flow through the radiator, where the heat is dissipated through the radiator. This opening and closing of the thermostat permits enough engine coolant to enter the radiator to keep the engine within proper engine temperature operating limits.

The wax pellet in the thermostat is hermetically sealed in a metal case(j). The wax element of the thermostat expands when it is heated and contracts when it is cooled.

As the vehicle is driven and the engine warms, the engine coolant temperature increases. When the engine coolant reaches a specified temperature, the wax pellet element in the thermostat expands and exerts pressure against the metal case, forcing the valve open. This allows the engine coolant to flow through the engine cooling system and cool the engine.

As the wax pellet cools, the contraction allows a spring to close the valve.

The thermostat begins to open at  $82^{\circ}C$  ( $180^{\circ}F$ ) and is fully open at  $95^{\circ}C$  ( $203^{\circ}F$ ). The thermostat closes at  $80^{\circ}C$  ( $176^{\circ}F$ ).



## **ELECTRIC COOLING FAN**

Caution: Keep hands, tools, and clothing away from the engine cooling fans to help prevent personal injury. This fan is electric and can turn ON whether or not the engine is running.

Caution: If a fan blade is bent or damaged in any way, no attempt should be made to repair or reuse the damaged part. A bent or damaged fan assembly should always be replaced with a new one.

The cooling fans are mounted behind the radiator in the engine compartment. The electric cooling fans increase the flow of air across the radiator fan and across the condenser on air conditioner (A/C)-equipped vehicles. This helps to speed cooling when the vehicle is at idle or moving at low speeds.



#### 1D-4 ENGINE COOLING

The main fan size is 320 mm (12.6 in.) in diameter with seven blades(k) to aid the air flow through the radiator and the condenser. An electric motor(I) attached to the radiator support drives the fan.

#### A/C OFF or Non-A/C Model

- The cooling fan is actuated by the electronic control module (ECM) using a low speed cooling fan relay and a high speed cooling fan relay. On A/C equipped vehicles, a series/parallel cooling fan relay is also used.
- The ECM will turn the cooling fan on at low speed when the coolant temperature reaches 93°C (199°F) and high speed at 100°C (212°F).
- The ECM will change the cooling fan from high speed to low speed at 97°C (207°F) and turn the cooling fans off at 90°C (194°F).

#### A/C ON

• The ECM will only turn the cooling fan on at high speed when the A/C system is on regardless of any condition.

# ENGINE COOLANT TEMPERATURE SENSOR

The engine coolant temperature (ECT) sensor (n) uses a thermistor to control the signal voltage to the engine control module (ECM).



### **COOLANT TEMPERATURE SENSOR**

The coolant temperature sensor(m) controls the instrument panel temperature indicator. The coolant temperature sensor is located on the distributor case with the ECT sensor on an SOHC engine.

# **COMPONENT LOCATOR**

### **COOLANT HOSE AND COMPONENTS**



- 1 Radiator Coolant Return Hose
- 2 Upper Radiator Hose
- 3 Not Used
- 4 Radiator Assembly
- 5 Lower Radiator Hose
- 6 Throttle Body Assembly
- 7 Surge Tank hose
- 8 Surge Tank
- 9 Coolant Temperature Sensor
- 10 Engine Coolant Temperature Sensor

- 11 Surge Tank Return Hose
- 12 Water Inlet Cap
- 13 Heater Outlet Hose
- 14 Heater Inlet Hose
- 15 Distributor Case
- 16 Thermostat
- 17 Thermostat Housing
- 18 Throttle Body Inlet Hose
- 19 Throttle Body Outlet Hose
- 20 Hose Bracket

## RADIATOR/FAN



1 Radiator Assembly

2 Electric Cooling Fan Assembly

# DIAGNOSTIC INFORMATION AND PROCEDURE

### **COOLANT LEAKS TEST**

- 1. Remove the surge tank cap after the engine cools.
- 2. Check the coolant level.
- Install a suitable cooling system pressure tester(b) to the surge tank filler neck using the adapter(a) and pressurize (110–120 kPa (16.0–17.4 psi)).
- 4. Check the coolant leaks on the hoses and connections during 2 minutes.
- 5. If the leak is checked, replace the parts or repair the connections.



## SURGE TANK CAP TEST

The surge tank cap(c) is equipped with the pressure valve(d) and the vacuum valve(e). Therefore, the surge tank cap maintains proper pressure. And The surge tank cap protects the system from high-pressure by opening a pressure valve, and protects the coolant hoses from collapsing because of a vacuum.

- 1. Wash any sludge from the surge tank cap and the valve seat of the vacuum pressure valve for the surge tank cap.
- 2. Check for any damage or deformity to the vacuum pressure valve for the surge tank cap. If any damage or deformity is found, replace the cap.
- 3. Install a suitable cooling system pressure tester(b) to the cap using the Adapter(a).
- 4. Pull the vacuum pressure valve to the open position. If the surge tank cap does not seal properly, replace the surge tank cap.
- 5. Pressurize the cap to 90 to 120kPa (13 to 17psi).
- 6. Wait 10 seconds and check the pressure held by the tank cap tester.
- 7. If the pressure held by the cooling system pressure tester falls below 80kPa (11.6psi) replace the surge tank cap.



### THERMOSTAT TEST

- 1. Remove the thermostat(f) from the vehicle. Refer to "Thermostat" in this section.
- 2. Make sure the valve spring is tight when the thermostat is fully closed. If the spring is not tight, replace the thermostat.
- 3. Suspend the thermostat and a thermometer in a pan of 50/50mixture of ethylene glycol and water. Do not let the thermostat or the thermometer rest on the bottom of the pan because the uneven concentration of heat on the bottom could result in inaccurate temperature measurements.
- 4. Heat the pan on a burner.
- 5. Use the thermometer to measure the temperature of the heated solution.
- 6. The thermostat should begin to open at 82°C (180°F) and it should be fully open at 95°C (203.4°F) and it should be fully close at 80°C (176.4°F). If it does not open or close at these temperature, replace the thermostat. Also, the thermostat rod's stroke from the initially open to the fully open should be 8mm (0.31 in.).



## **COOLING SYSTEM DIAGNOSIS**

Condition	Probable Cause	Correction
Engine Overheats	A loss of the coolant.	Add the coolant.
	<ul> <li>A weak coolant solution.</li> </ul>	• Confirm that the coolant solution is a 50/50 mixture of ethylene glycol and water.
	<ul> <li>Any dirt, any leaves, or any insects on the front of the radiator.</li> </ul>	• Clean the front of the radiator.
	• The leakage from the hoses, the coolant pump, the heater, the thermostat housing, the radiator, the heater core, or the head gasket.	<ul> <li>Replace any damaged components.</li> </ul>
	A faulty thermostat.	<ul> <li>Replace a damaged thermostat.</li> </ul>
	<ul> <li>Retarded ignition timing.</li> </ul>	<ul> <li>Perform an ECM code diagnosis.</li> <li>Confirm the integrity of the timing belt.</li> </ul>
	<ul> <li>An improperly operating electric cooling fan.</li> </ul>	<ul> <li>Replace the electric cooling fan.</li> </ul>
	<ul> <li>Plugged or rotted radiator hoses.</li> </ul>	<ul> <li>Replace any damaged radiator hoses.</li> </ul>
	• A faulty water pump.	<ul> <li>Replace a faulty water pump.</li> </ul>
	<ul> <li>A faulty surge tank cap.</li> </ul>	<ul> <li>Replace a faulty surge tank cap.</li> </ul>
	<ul> <li>A cracked or plugged cylinder head or engine block.</li> </ul>	<ul> <li>Repair the damaged cylinder head or the damaged engine block.</li> </ul>
	A faulty radiator.	<ul> <li>Replace a faulty radiator.</li> </ul>
Loss of Coolant	• A leak in the radiator.	Replace a damaged radiator.
	• A leak in the surge tank or the hose.	• Replace the surge tank or the hose.
	<ul> <li>Looseness or damage of radiator hoses, heater hoses, or connections.</li> </ul>	<ul><li>Reseat the hoses.</li><li>Replace the hoses or the clamps.</li></ul>
	<ul> <li>Leaks in the coolant pump seal.</li> </ul>	<ul> <li>Replace the coolant pump seal.</li> </ul>
	• Leaks in the coolant pump gasket.	Replace the coolant pump gasket.
	<ul> <li>An improper cylinder head torque.</li> </ul>	<ul> <li>Tighten the cylinder head bolts to specifications.</li> <li>Replace the cylinder head gasket, if needed.</li> </ul>
	<ul> <li>Leaks in the intake manifold, cylinder head gasket, heater core.</li> </ul>	<ul> <li>Repair or replace any components, as needed to correct the leak.</li> </ul>
Engine Fails to Reach Normal Operating	• Thermostat to be stuck open or to be wrong type.	<ul> <li>Install a new thermostat of the correct type and heat range.</li> </ul>
from the Heater	<ul> <li>The coolant level below the MIN mark on the surge tank.</li> </ul>	<ul> <li>Add sufficient coolant to raise the fluid to the specified mark on the surge tank.</li> </ul>

# **REPAIR INSTRUCTIONS**

# **ON-VEHICLE SERVICE**



# DRAINING AND REFILLING THE COOLING SYSTEM

Caution: Do not remove the surge tank cap while the engine and the radiator are hot. Scalding fluid and steam may be blown out under pressure.

- 1. Place a pan below the vehicle to catch the draining coolant.
- 2. Drain the coolant.
  - Remove the surge tank cap (1).
  - Disconnect the lower radiator hose (2).

Caution: Dispose of the used coolant to a used coolant holding tank to be picked up with the used oil for disposal. Never pour the used coolant down the drain. Ethylene glycol antifreeze is an extremely toxic chemical. Disposing of it into the sewer system or the ground water can contaminate the local environment.



- 3. Connect the lower radiator hose.
- 4. Clean the cooling system.
  - Remove all sludge and dirt from inside the surge tank. And install the surge tank. Refer to "Surge Tank" in this section (1).



- Add the clean water to the surge tank (2).
- 5. Run the engine until the thermostat opens. You can tell the thermostat is open when both radiator hoses are hot to the touch.
- 6. Stop the engine and disconnect the lower radiator hose to drain the coolant.
- 7. Repeat steps 3 through 6 until the drained water is clear and free of coolant and rust.

**Notice:** Never use an antifreeze mixture more concentrated than 60 percent antifreeze to 40 percent water. The solution freezing point increases above this concentration.

- 8. Fill the cooling system through the surge tank with a mixture of ethylene glycol antifreeze and water. The mixture must be at least 50 percent antifreeze, but not more than 60 percent antifreeze for cold weather operation.
- 9. Fill the surge tank to the specified MAX fill mark on the outside of the tank.
- 10. Install the surge tank cap.



### **SURGE TANK**

#### Removal Procedure

Caution: To prevent personal injury, do not remove the surge tank cap while the engine and the radiator are hot, because the heat causes the system to remain under pressure scalding fluid and steam may be blown out under pressure.

- 1. Drain the engine coolant to below the level of the surge tank.
- 2. Remove the surge tank.
  - Loosen the overflow hose clamps and disconnect the overflow hoses from the surge tank (1).
  - Remove the surge tank (2).
- 3. Clean the inside and the outside of the surge tank and the surge tank cap with soap and water.
- 4. Rinse the surge tank and the cap thoroughly.
- 5. Check the surge tank and the cap for crack or other damage.









#### Installation Procedure

- 1. Install the surge tank to the vehicle.
  - Install the surge tank with pressing down (1).
  - Connect the overflow hoses to the surge tank (2).
- 2. Secure the overflow hoses to the surge tank with the hose clamps.
- 3. Fill the surge tank with coolant to the MAX mark.

## ELECTRIC COOLING FAN

#### **Removal Procedure**

- 1. Disconnect the negative battery cable.
- 2. Remove the electric cooling fan assembly.
  - Disconnect the cooling fan electrical connector (1).
  - Remove the bolts (2).
  - Remove the electric cooling fan assembly (3).

#### Installation Procedure

1. Install the electric cooling fan assembly with the bolts.

### Tighten

Tighten the bolts to 3.5–4.5 N•m (31–40 lb-in).

- 2. Connect the cooling fan electrical connector.
- 3. Connect the negative battery cable.

## RADIATOR

#### **Removal Procedure**

- 1. Disconnect the negative battery cable.
- 2. Disconnect the lower radiator hose and drain the engine cooling system. Refer to "Draining and Refilling the Cooling System" in this section.
- 3. Disconnect the upper radiator hose and the surge tank hose.
  - Loosen the upper radiator hose clamp and disconnect the upper radiator hose (1).
  - Loosen the surge tank hose clamp and disconnect the surge tank hose (2).









- 4. Remove the electric cooling fan. Refer to "Electric Cooling Fan" in this section.
- 5. Remove the radiator.
  - Remove the bolts (1).
  - Remove the radiator support brackets (2).
  - Remove the radiator (3).
- 6. Check the radiator for breaking, clog or other damage.

**Important:** The radiator still contains a substantial amount of coolant. Drain the remainder of the coolant from the radiator into a drain pan.

#### Installation Procedure

1. Install the radiator with the mounting bolts (1) and the support brackets (2).

#### Tighten

Tighten the support bracket bolts to 3.5-4.5 N•m (31-40 lb-in).

- 2. Install the electric cooling fan. Refer to "Electric Cooling Fan" in this section.
- 3. Connect the upper radiator hose to the radiator (1).
- 4. Connect the surge tank hose to the radiator (2).
- 5. Secure each hose with hose clamps.
- 6. Refill the engine cooling system. Refer to "Draining and Refilling the Cooling System" in this section.
- 7. Connect the negative battery cable.

## **THERMOSTAT (TYPICAL)**

#### **Removal Procedure**

Caution: To prevent personal injury, do not remove the surge tank cap while the engine and the radiator are hot because the heat causes the system to remain under pressure. Scalding fluid and steam may be blown out under pressure.

- 1. Remove air filter assembly. Refer to Section 1B, SOHC Engine Mechanical.
- Disconnect the lower radiator hose and drain the coolant. Refer to "Drain and Refilling the Cooling System"
- 3. Disconnect the upper radiator hose.