ENGINE COOLING SYSTEM

1988 Toyota Celica

1987-88 TOYOTA
Engine Cooling Systems

Celica

DESCRIPTION

The basic liquid cooling system consists of a radiator, water pump, thermostat, cooling fan, pressure cap, heater (if equipped), and various connecting hoses and cooling passages in the block and cylinder head. In addition, many cars use a fan clutch (incorporating a thermostatic control) or flexible fan blade. These reduce noise and power requirements at higher engine speeds.

Some models may use a thermostatic vacuum switch to advance ignition timing in the event of overheating. Most models use a coolant recovery system to prevent loss of anti-freeze.

MAINTENANCE

DRAINING

Remove radiator cap and open heater control valve to maximum heat position. Open drain cocks or remove plugs in bottom of radiator and in engine block. In-line engines usually have one plug or cock, while "V" type engines will have two, one in each bank of cylinders.

CLEANING

A good cleaning compound removes most rust and scale. Follow manufacturer's instructions in the use of cleaner. If considerable rust and scale has to be removed, flushing should be used. Clean radiator air passages by blowing with compressed air from back to front of radiator.

FLUSHING

CAUTION: Some manufacturers use an aluminum and plastic radiator on some models (identified by a note below the filler neck). Material used for cleaning and flushing must be compatible with aluminum, according to manufacturer's recommendations.

1) Back flushing is a very effective means of removing rust and scale from a cooling system. For best results, the radiator, engine and heater core should be flushed separately.

2) To flush radiator, connect flushing gun to water outlet of radiator and disconnect water inlet hose. Use a leadaway hose, connected to radiator inlet, to prevent flooding engine. Use air in short bursts only, as this will prevent damage to radiator. Continue flushing until water runs clear.

3) To flush engine, first remove thermostat and replace housing. Connect flushing gun to water outlet of engine. Disconnect heater hoses from engine. Flush using short air bursts until water runs clean. Flush heater core as described for radiator. Make sure heater valve is set to maximum heat position before flushing heater.

REFILLING

Engine should be running while refilling cooling system to

prevent air from being trapped in the engine block. After system is full, continue running engine until thermostat is open, then recheck fill level. Do not overfill system.

THERMOSTAT

1) Visually inspect thermostat for corrosion and proper sealing of valve and seat. If satisfactory, suspend thermostat and a thermometer in a container with a 50/50 mixture of anti-freeze and water. See Fig. 1.

2) Do not allow either thermostat or thermometer to touch bottom of container, as this concentration of heat could cause an incorrect reading. Heat water until thermostat just begins to open.

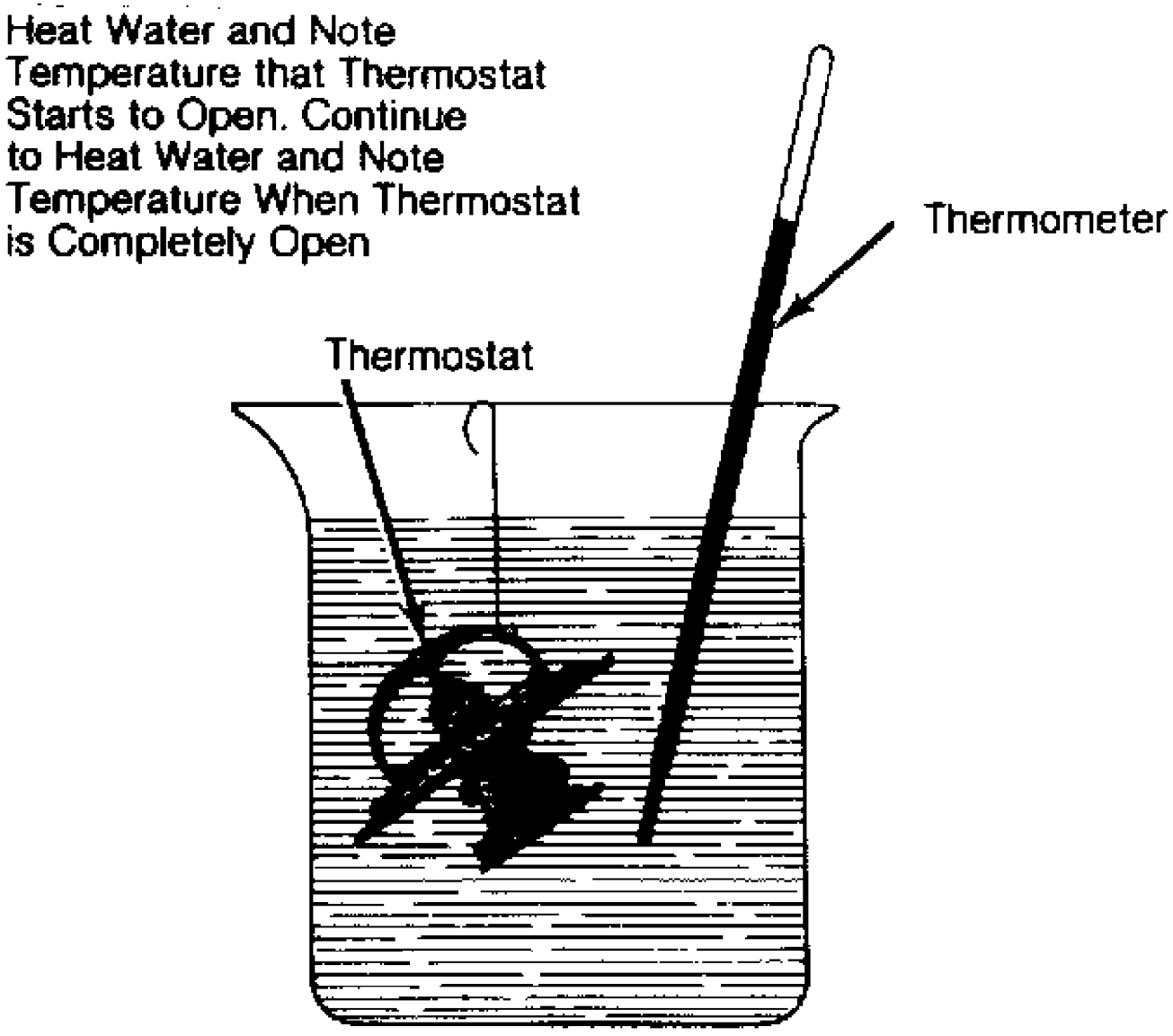

Fig. 1: Testing Thermostat in Anti-Freeze/Water Solution
Support thermometer so it does not touch bottom of container.

3) Read temperature on thermometer. This is the initial opening temperature and should be within specifications. Continue

heating water until thermostat is fully open and note temperature. This is the fully opened temperature. If either reading is outside of specifications, replace thermostat, as it is not adjustable.

NOTE: General Motors Imports recommends hanging thermostat in 33% glycol solution at 25°F (4°C) above temperature stamped on thermostat. Valve should open. Remove thermostat from solution and place in similar solution at 10 F (-12° C) below stamped temperature. Valve should close.

PRESSURE TESTING

A pressure testing tool is used to test both radiator cap and complete cooling system. Test as follows, following tool manufacturer's instructions.

Radiator Cap

Visually inspect radiator cap, then dip cap in water and connect to tester. Pump tester to bring pressure to upper limit of cap specifications. If cap fails to hold pressure within specifications, replace cap.

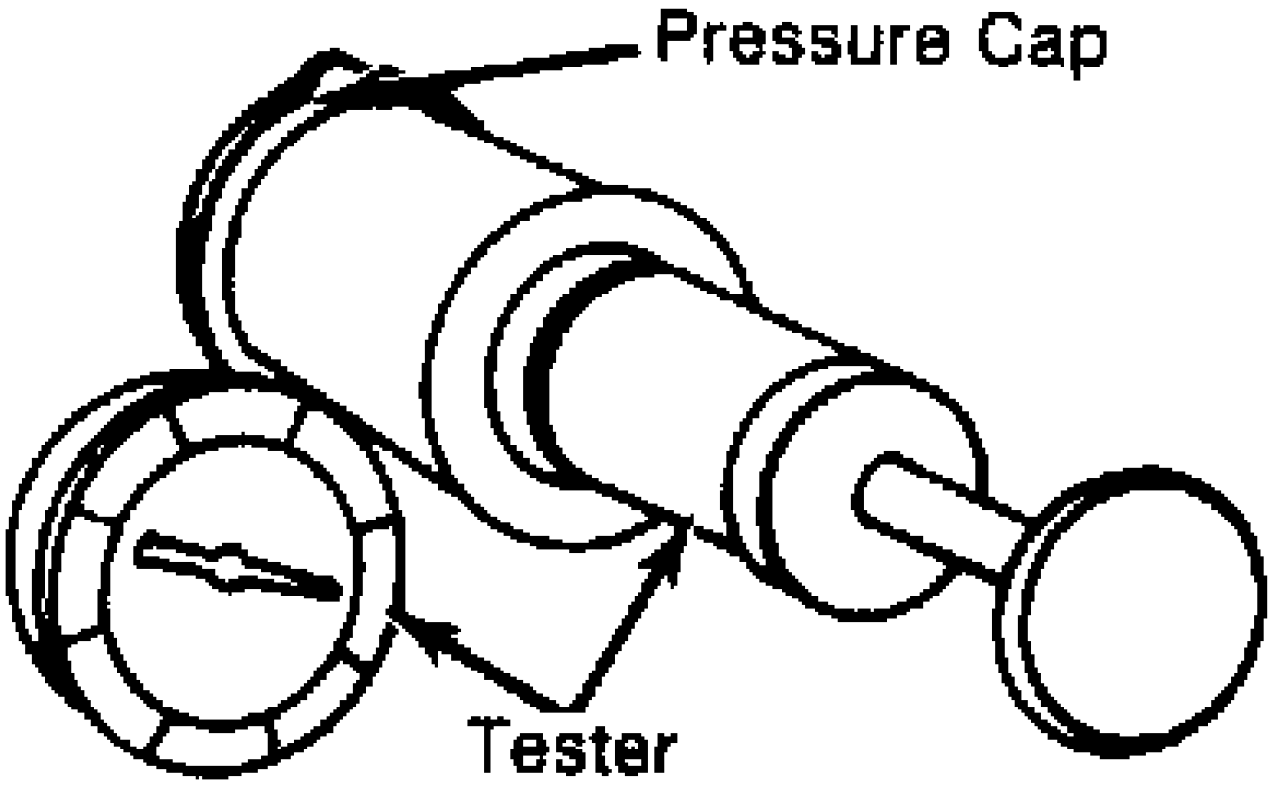

Fig. 2: Testing Radiator Pressure Cap
Wet cap gasket before testing.

Cooling System

1) With engine off, wipe radiator filler neck seat clean. Fill radiator to correct level. Attach tester to radiator and pump until pressure is at upper limit of radiator rating.

2) If pressure drops, inspect for external leaks. If no leaks are apparent, detach tester and run engine until normal operating temperature is obtained. Reattach tester and observe. If

pressure builds up immediately, a possible leak exists from a faulty head gasket or crack in head or block.

CAUTION: Pressure may build up quickly. Release any excess pressure or cooling system damage may result.

3) If there is no immediate pressure build up, pump tester to within system pressure range (on radiator cap). Vibration of gauge pointer indicates compression or combustion leak into cooling system. Isolate leak by shorting each spark plug wire to cylinder block. Gauge pointer should stop or decrease vibration when leaking cylinder is shorted.

CAUTION: Do not disconnect spark plug wires while engine is operating, or operate engine with spark plug shorted for more than 1 minute, as catalytic converter may be damaged.

4) Remove engine and transmission (automatic only) oil dipsticks and check if water drops appear in oil. If so, a serious internal leak is indicated. If all checks are negative and system holds pressure for 2 minutes, there are no serious leaks in system.

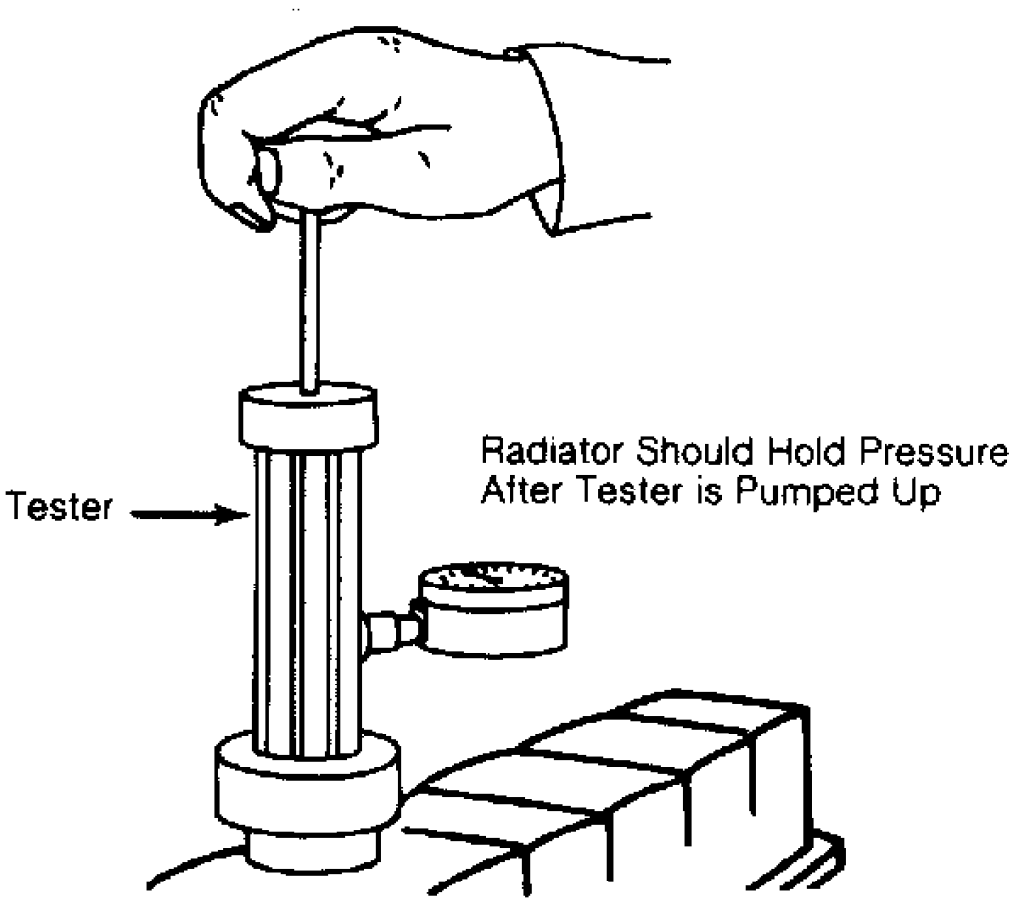

Fig. 3: Pressure Testing Cooling System
Pump up to specified pressure.

ANTI-FREEZE CONCENTRATION

NOTE: On models using aluminum engines or cooling system components, refer to Owners Manual for anti-freeze requirements and recommendations. Aluminum components require a different formulation of anti-freeze to prevent corrosion.

On all cooling systems, test anti-freeze concentration using anti-freeze tester. Tester should have a temperature-compensating feature, as failing to take temperature into consideration could cause an error as large as 30°F (16°C). Follow tester manufacturer's instructions for correct use of tester.

COOLANT RECOVERY SYSTEMS

DESCRIPTION

A coolant recovery system differs from other cooling systems in that an overflow bottle is connected to the radiator overflow hose. Overflow bottle is transparent or translucent to permit checking of coolant level without removing radiator cap. No adjustment or test is required except keeping vent hole or hose clean and checking pressure relief of radiator cap.

OPERATION

As coolant temperature rises and pressure in system exceeds pressure relief valve of radiator cap, excess coolant flows into overflow bottle. As engine cools and coolant contracts, vacuum is formed in the system. Vacuum draws coolant, stored in overflow bottle, back into radiator. In a properly maintained cooling system, the only coolant losses will be through evaporation.

Overflow bottle captures and releases coolant according to temperature. See Fig. 4.

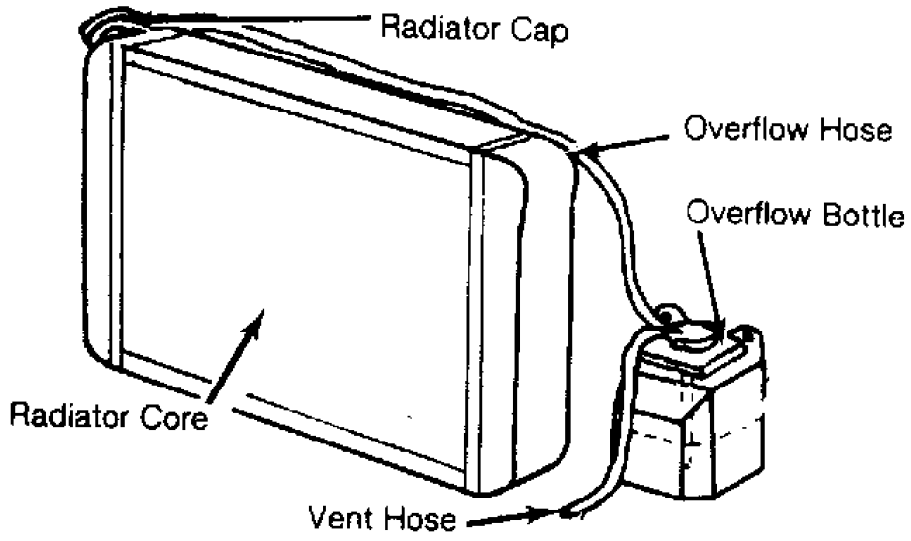

Fig. 4: Typical Coolant Recover System

THERMOSTATICALLY CONTROLLED ELECTRIC FANS

DESCRIPTION

Electrically-driven fans are actuated by thermal relay switches. Thermal switches turn fan motor on when necessary and shut fan motor off when not needed. Air conditioned vehicles are equipped with over-ride switches. These switches turn fan motor on whenever air conditioning system is operating. When system is turned off, fan motor control is returned to thermal relay.

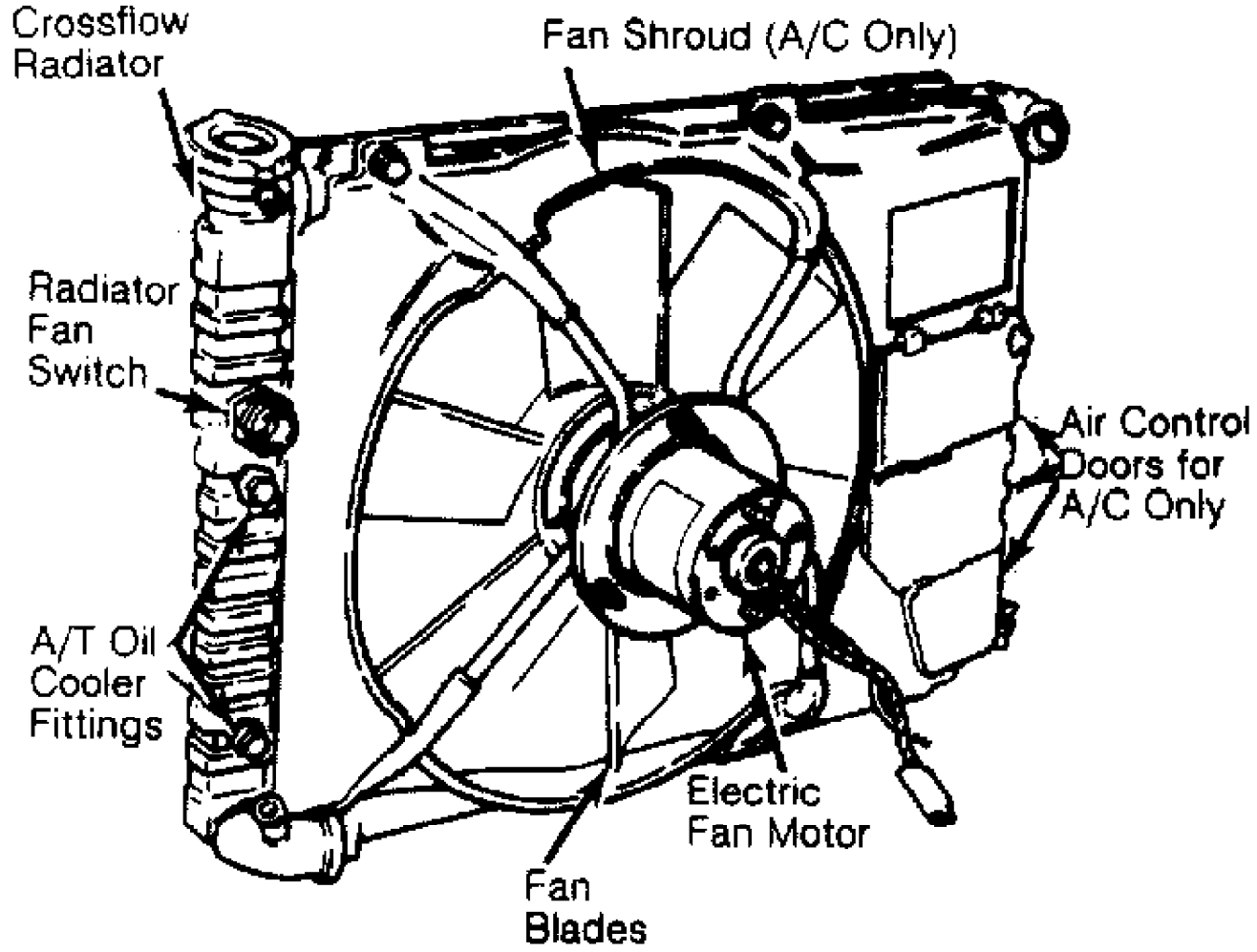

Fig. 5: Typical Thermostatically Controlled Electric Fan

VARIABLE SPEED COOLING FANS - FLEX-BLADE FANS

DESCRIPTION

This unit is a flexible blade assembly designed to flex blades as engine RPM increases. As RPM increases, blade pitch decreases, thereby saving power and decreasing noise level. Keep fan belt adjusted to proper tension as necessary.

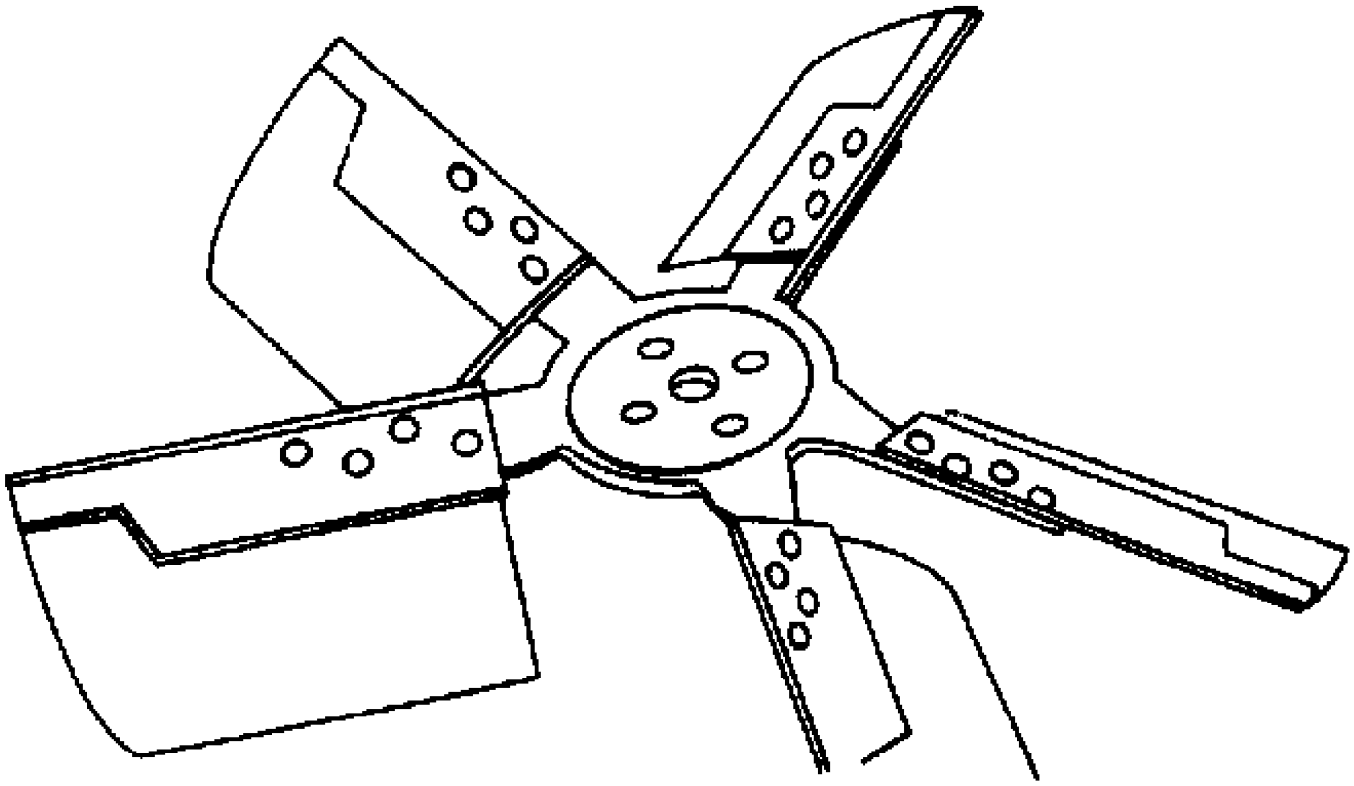

Fig. 6: Flex Blade Fan Assembly

VARIABLE SPEED COOLING FANS FAN CLUTCH WITH THERMOSTATIC CONTROL

DESCRIPTION

Most air conditioned models use a thermostatically controlled fluid fan and torque control clutch. Thermal control drive is a silicone-filled coupling connecting fan to a fan pulley, and is operated by a control valve. Control valve is operated by a temperature sensitive bi-metallic coil or strip and controls flow of silicone through the clutch.

During periods of operation when radiator discharge air temperature is low, fan clutch speeds are slowed, decreasing load on fan belt. High radiator discharge air temperature causes bi-metallic coil or strip to allow a greater flow of silicone to enter clutch. This increases drag between driven member and driving member resulting in a higher fan speed and increased cooling.

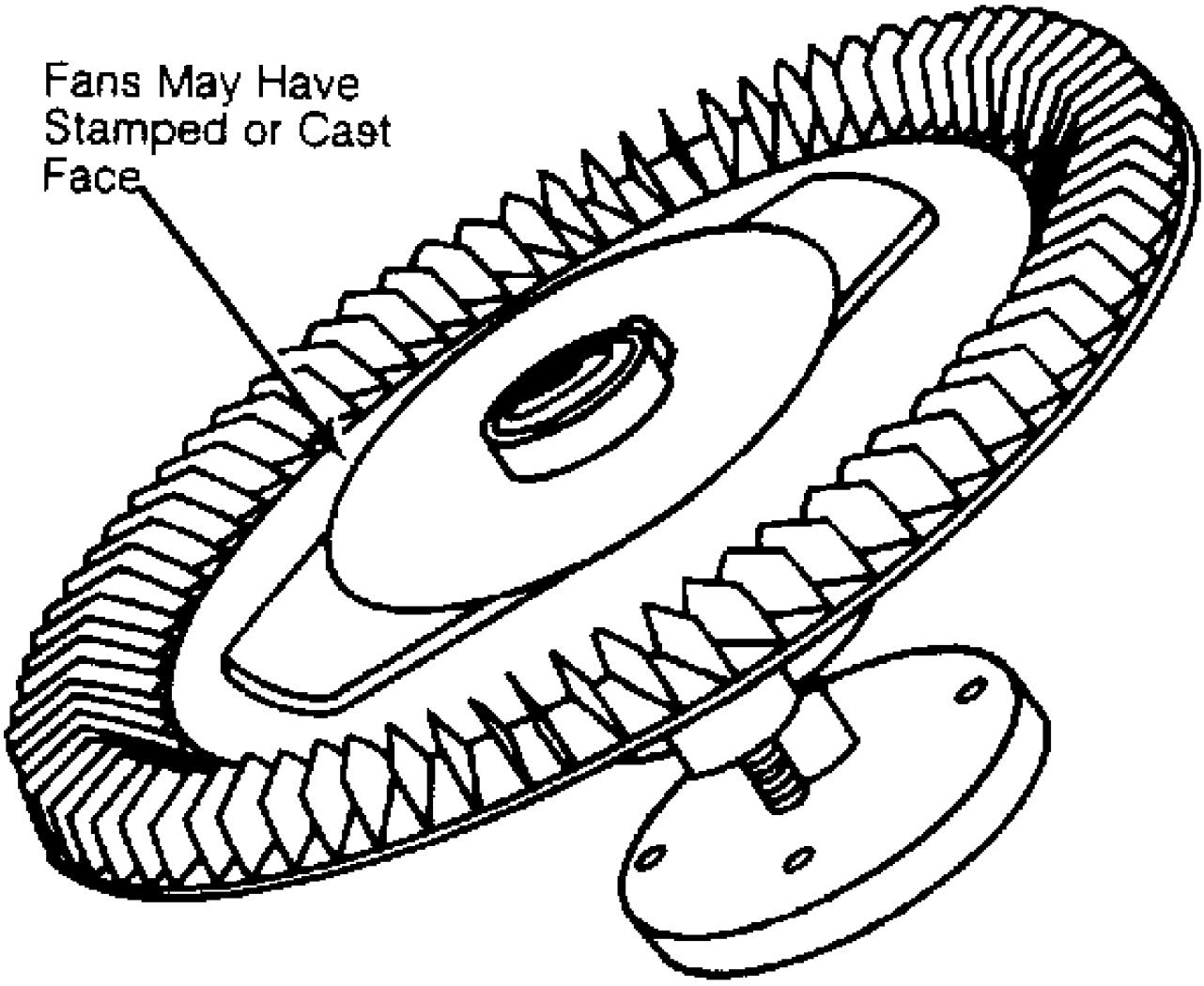

Fig. 7: Thermostatically Controlled Fan Assembly
Shown with stamped face and bi-metallic coil spring.

COOLING FAN QUICK TEST

1) Ensure engine is cold. Turn ignition to "ON" position. Fan should not run. If so, check cooling fan relay, radiator fan switch and wiring.

2) With ignition on, unplug radiator fan switch. Fan motor should operate. If not, check cooling fan relay, fan motor, engine main relay, fuse, and wiring. Connect radiator fan switch.

COMPONENT TESTING

Cooling Fan Relay

Cooling fan relays are located in engine compartment relay and fuse box. See Fig. 8 as guide to test relay.

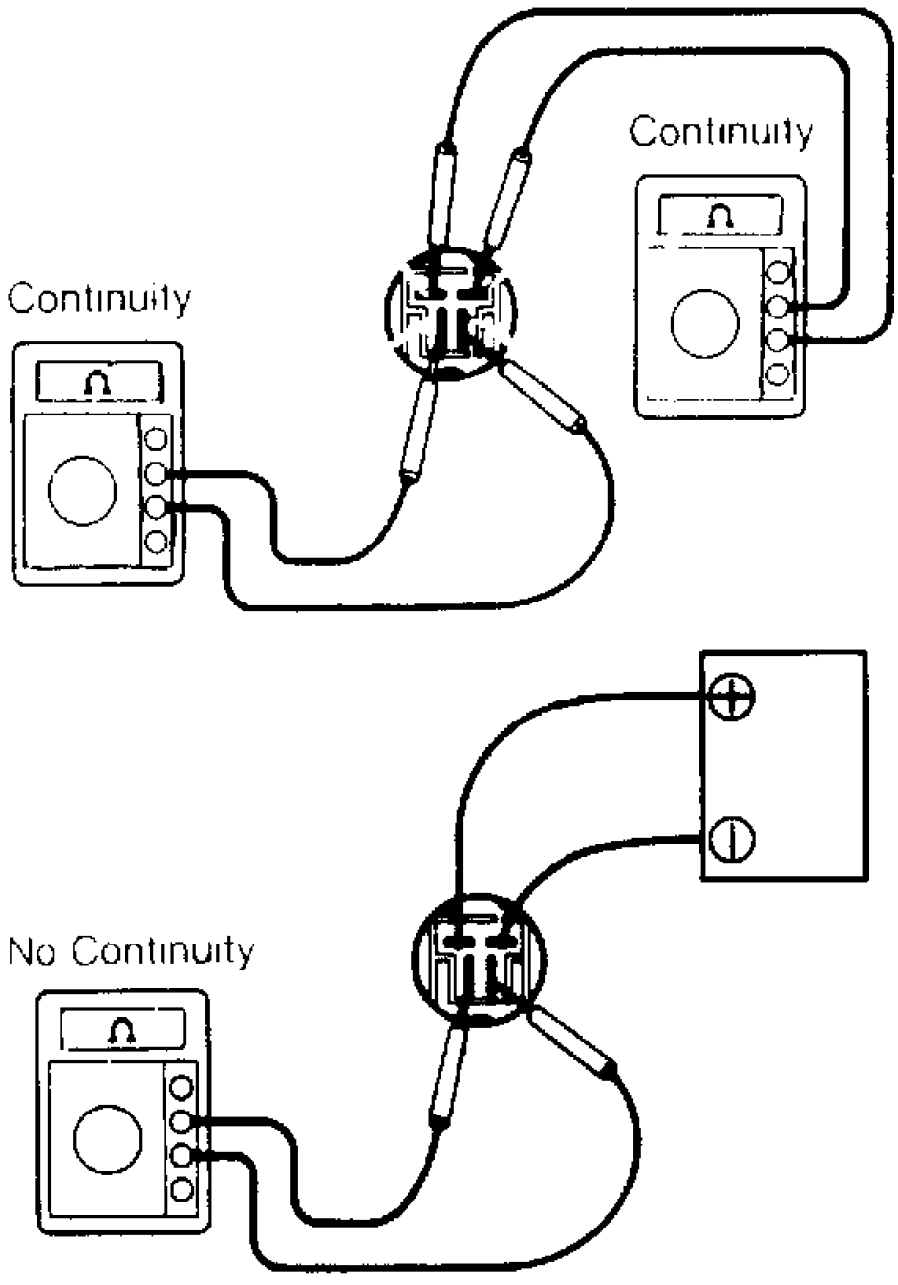

Fig. 8: Testing Cooling Fan Relay
Courtesy of Toyota Motor Sales, U.S.A., Inc.

Engine Main Relay
Engine main relay supplies power to cooling fan relay. Relay

is located in engine compartment relay and fuse box. Use illustration as guide to test relay. See Fig. 9

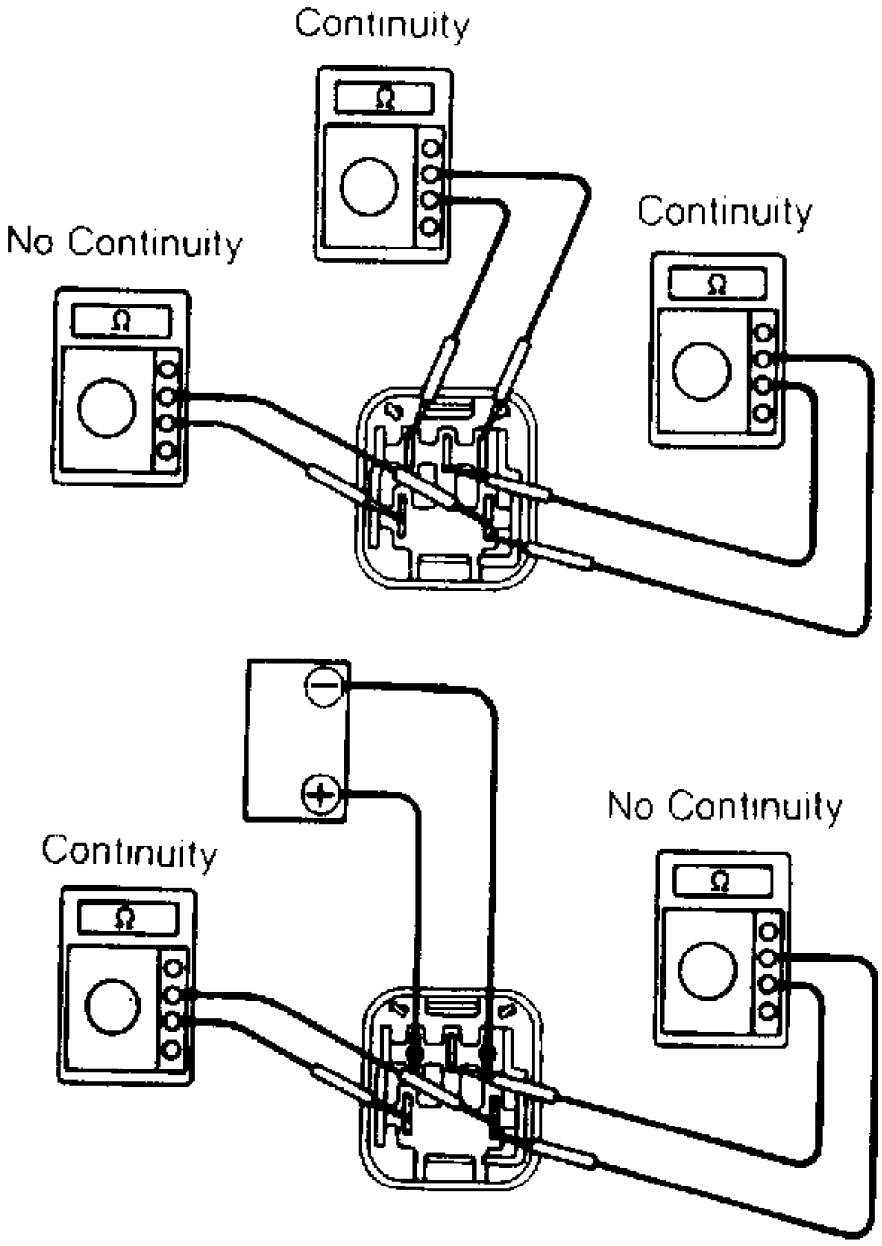

Fig. 9: Testing Engine Main Relay
Courtesy of Toyota Motor Sales, U.S.A., Inc.

Fan Motor
Unplug fan motor connector. Connect battery and ammeter to

fan motor. Fan should operate smoothly and amperage draw should be within range. See FAN MOTOR AMPERAGE DRAW SPECIFICATIONS table.

FAN MOTOR AMPERAGE DRAW SPECIFICATIONS TABLE

Model	Amps
M/T	3.2-4.4
A/T	5.8-7.4

Radiator Fan Switch

1) Radiator fan switch is located in upper radiator hose coolant inlet on engine. Switch has single wire.

2) To test switch, remove switch from vehicle. Using ohmmeter, ensure continuity is correct between wire connector and switch body. Switch may be gradually heated in water for testing. See appropriate RADIATOR FAN SWITCH CONTINUITY table.

RADIATOR FAN SWITCH CONTINUITY (1) TABLE

Model	No Continuity °F (°C)	Continuity °F (°C)
Celica	Above 199 (93)	Below 181 (83)

(1) - As measured between between wire connector and switch body.

ENGINE COOLANT SPECIFICATIONS

THERMOSTAT

Most thermostats are thermal wax pellet type. As coolant temperature rise the wax begins to expand. This expansion overcomes spring tension allowing the thermostat to open. Some thermostats also incorporate an additional bleed hole to allow a small amount of circulation and eliminate air blocks.

PRESSURE CAP

Modern cooling systems use a closed system type cap. This system allows for coolant to expand and build pressure, some coolant is permitted to bleed past the cap into the overflow tank. When the engine cools and coolant contracts, the cap allows the coolant in the overflow tank to siphon back into the system.

The pressure cap also increases pressure in the cooling system. The increased pressure raises the boiling point, one pound of pressure increases the boiling point approximately 3°F (1.66°C).

COOLANT MIXTURE

Engine coolant must be mixed with water to a specific percent. A 100 % coolant mixture could cause system overheating or premature system failure. Coolants are designed to function best when mixed with water. The percentage of coolant to water can vary depending on climate condition, but a 50/50 mixture is a standard percentage. Engine coolant should also include an aluminum protection additive. This will help protect against metal deterioration.

MAINTENANCE

Periodic maintenance is necessary for extended cooling system and engine life, because engine and cooling system are made of different metals. Changing the coolant at scheduled maintenance periods reduces electrolysis and removes sediments.

COOLING SYSTEM APPLICATION CHART

APPLICATION	PRESSURE CAP PSI	COOLANT CAPACITY	THERMOSTAT OPEN		COOLING FAN	
			°F(°C)	°F(°C)	°F(°C)	°F(°C)
Celica	11-15	7.2 (6.8)	180 (82)	203 (95)	194 (90)	181 (83)