

# Exhaust Emission Systems

## 1972-73 TOYOTA TRANSMISSION CONTROLLED SPARK

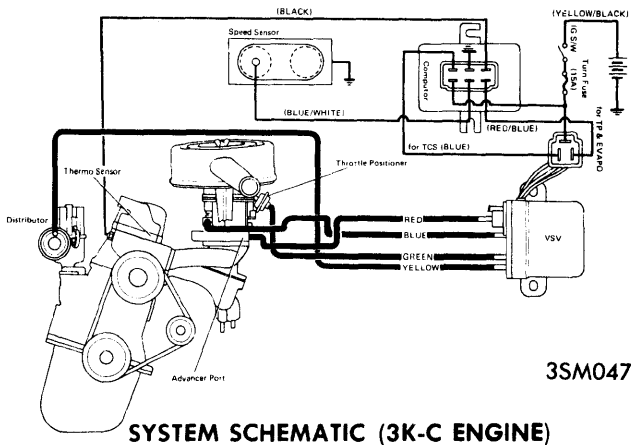
- 2T-C Engine
  - Corolla (1972-73)
  - Carina (1972-73)
- 18R-C Engine
  - Corona (1972-73)
  - Corona Mk II (1972)
  - Celica (1972-73)
  - Hi-Lux (1972-73)
- 4M Engine
  - Crown (1972-73)
  - Corona Mk II (1973)
- F Engine
  - Land Cruiser (1972-73)
- 3K-C Engine
  - Corolla (1972-73)

**NOTE** — 4M engine used in Corona Mk II and Crown, and the 1973 F engine used in Land Cruiser, are equipped with an air injection system in addition to T.C.S. system.

**NOTE** — Some engines use other systems. See Toyota Improved Combustion System (With Transmission Controlled Spark).

### DESCRIPTION

T.C.S. system is designed to control NOx and hydrocarbon emissions by controlling ignition timing advance. System consists of a thermo-sensor, vacuum switching valve, a speed sensor, a computer, and a specially calibrated distributor. In addition, the 2T-C engine has a mixture control valve to admit additional air to intake manifold during certain conditions of deceleration. All engines use a throttle positioner.

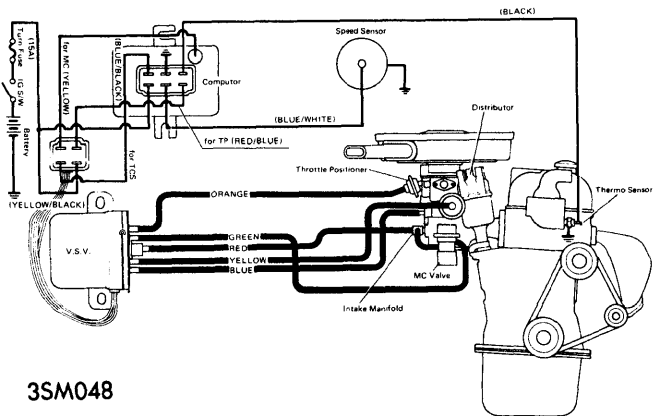


3SM047 SYSTEM SCHEMATIC (3K-C ENGINE)

**Thermo-Sensor** — Unit is a thermistor which possesses qualities of low resistance at high temperatures, and high resistance at low temperatures.

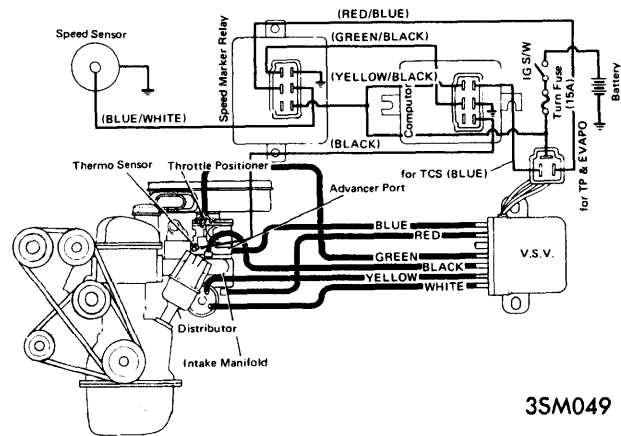
**Speed-Sensor** — Consists of a magnet driven by speedometer cable and an on-off reed switch. The switch is actuated by a magnetic field of the magnet. Reed switch produces 6 pulses (18R-C engine except Celica and F engine) and 4 pulses (all other engines) for each revolution of speedometer cable. These pulses are fed to either the speed marker relay or computer.

**Vacuum Switching Valve** — Unit contains electromagnetic coil which is controlled by the computer or speed marker. When this coil is energized, valve is turned on, and vacuum advance is not allowed. On F engines, vacuum retards ignition timing. On 2T-C engines, vacuum switching valve also operates mixture control valve. Throttle positioner (not directly a part of T.C.S. system) is also controlled by vacuum switching valve.



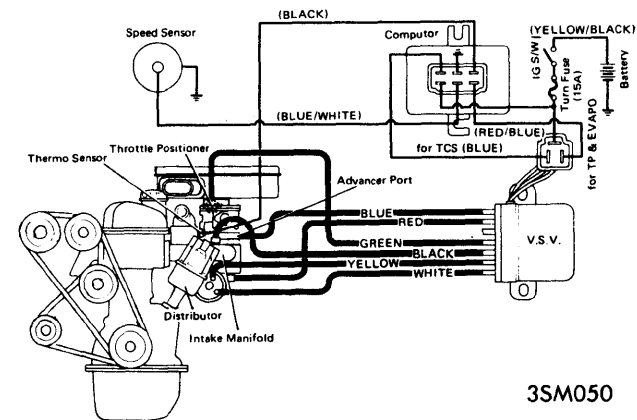
3SM048

SYSTEM SCHEMATIC (2T-C ENGINE)



3SM049

SYSTEM SCHEMATIC (4M ENGINE, CORONA MK II)



3SM050

SYSTEM SCHEMATIC (4M ENGINE, CROWN)

**Throttle Positioner** — Consists of a diaphragm type vacuum actuator which is linked to carburetor throttle linkage. Actuator is controlled by vacuum switching valve and prevents complete throttle closing under certain deceleration conditions.

**Mixture Control Valve (2T-C Engine Only)** — Valve allows fresh air to pass into intake manifold during deceleration from high or intermediate speeds. Valve serves to control air/fuel ratio during these periods.

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**Speed Marker Relay (18R-C engine, Except Celica)** – Used in conjunction with computer, this solid state device is activated by pulses from speed sensor. Used to control vacuum switching valve, pulses are fed to computer.

**Computer** – Solid state device which controls the activation of vacuum switching valve. On 18R-C engines, except Celica, computer is used in conjunction with a speed marker relay.

### OPERATION

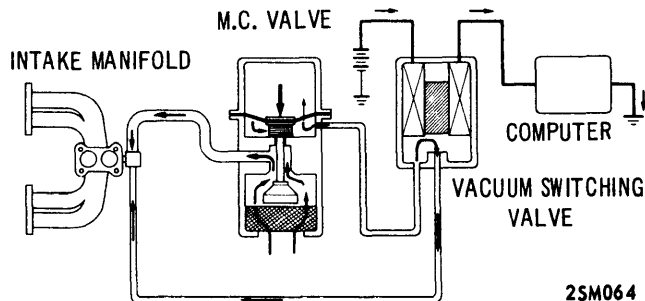
1) When engine coolant temperature is between 140-212°F and vehicle speed is under 36 MPH (3K-C engine), 41 MPH (2T-C & F engines), or 62 MPH (18R-C and 4M engines) temperature and speed sensors close circuits to computer or speed marker relay. In turn, circuit to vacuum switching valve coil is closed and coil is energized. This turns on vacuum switching valve.

2) On Land Cruiser models (F engine), vacuum switching valve allows vacuum to act on distributor retard diaphragm and ignition is thus retarded.

3) On all other engines, when vacuum switching valve is turned on, it cuts off all vacuum to vacuum advance unit of distributor. Only centrifugal advance is then provided.

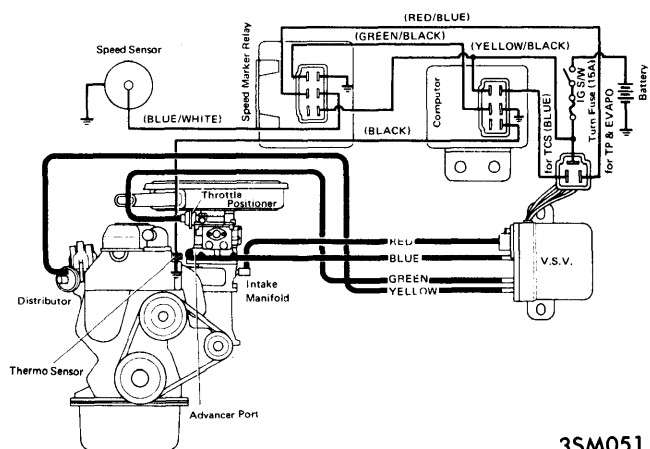
4) Throttle positioner is also controlled, through speed sensor, by vacuum switching valve. At intermediate or high speeds, valve allows atmospheric air to diaphragm of throttle positioner. This sets throttle positioner lever so that when throttle is released, throttle valve contacts positioner and holds throttle in a slightly opened position.

ditional vacuum created causes control valve to open momentarily and allows fresh air to be drawn through mixture control valve and into intake manifold.



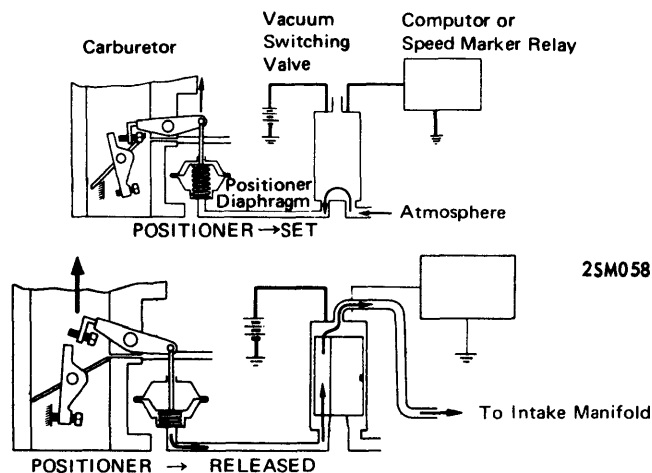
25M064

### MIXTURE CONTROL VALVE OPERATION



3SM051

### SYSTEM SCHEMATIC (18R-C ENGINE, EXC. CELICA)

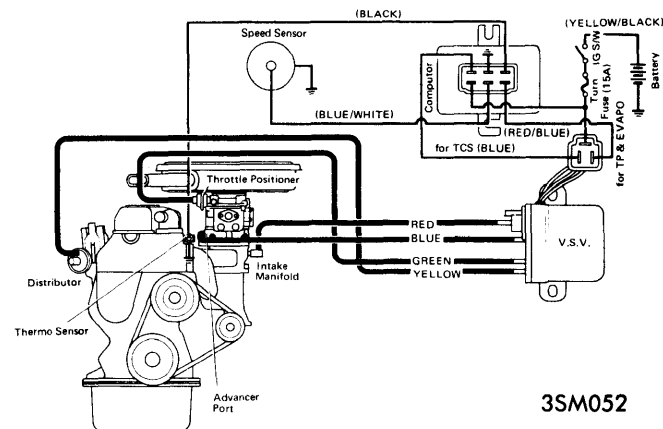


25M058

### THROTTLE POSITIONER

5) When vehicle speed decreases to about 10 MPH, vacuum switching valve, because of signals from speed sensor, allows vacuum to diaphragm of throttle positioner. This releases throttle positioner lever from its set position and allows throttle valve to return to normal idling position.

6) A mixture control valve is provided on 2T-C engines only. When idling or at low speed, speed sensor signals computer to cut off vacuum to switching valve and no vacuum is allowed to mixture control valve. During normal running at intermediate and high speed, vacuum switching valve receives signals from speed sensor which allows vacuum to reach mixture control diaphragm. This vacuum is not high enough to activate the valve at this time. When throttle is released suddenly, ad-



3SM052

### SYSTEM SCHEMATIC (18R-C ENGINE, CELICA)

### TESTING

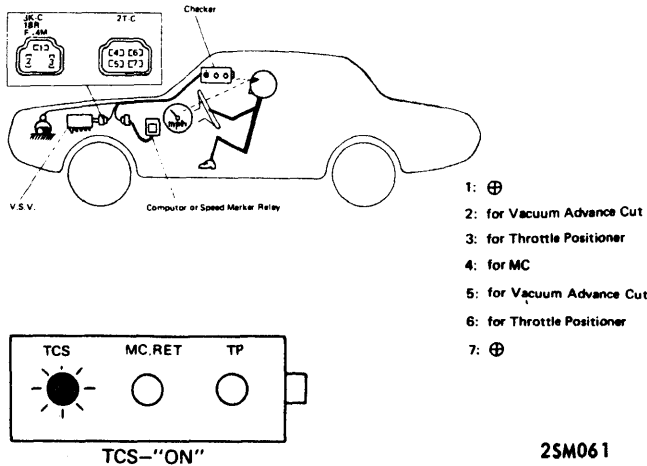
**T.C.S. Vacuum System** – Disconnect vacuum sensing hose from distributor and connect vacuum gauge in its place. Vacuum gauge must be placed so that it may be read by driver. Road test vehicle, place on a dynamometer or raise

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## 1972-73 TOYOTA TRANSMISSION CONTROLLED SPARK (Cont.)

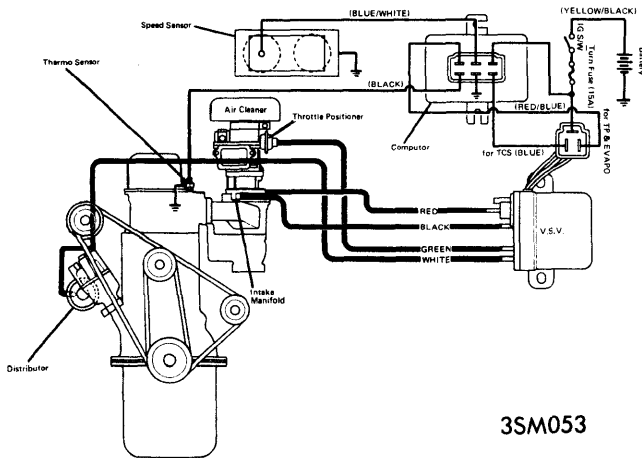
rear wheels. Then bring vehicle (speedometer) to various speeds of T.C.S. operation. Observe vacuum gauge readings. Maximum vacuum readings indicate "OFF" condition of T.C.S.

**T.C.S. Electrical Circuits** – Test requires special Toyota T.C.S. tester. It provides checks on electrical circuits to various sensors. Even if electrical check shows circuits to be in good condition, it is necessary to verify that vacuum components and distributor are functioning properly. To check electrical circuits, proceed as follows:



T.C.S. ELECTRICAL CIRCUIT CHECKER

1) Pull off vacuum switching valve connector and plug in checker connector in its place. Attach ground connector to vehicle body and place checker on instrument panel.



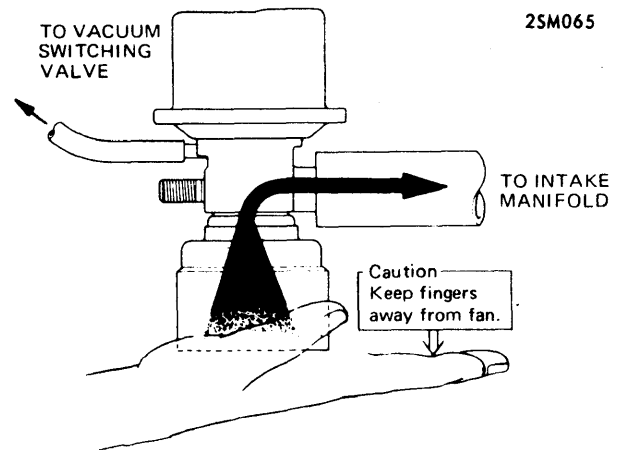
SYSTEM SCHEMATIC (F ENGINE)

2) Turn ignition switch on and push button on side of checker. All three lamps will light if the checker is in normal operating condition.

3) Running tests on T.C.S. system must be done at T.C.S. operating speeds and temperatures. To achieve speeds required for tests, either road test, place vehicle on a dynamometer, or raise up rear wheels. T.C.S. system is on whenever "TCS" indicator lamp on checker lights up.

4) On 2T-C engine only, the same procedures and checking instrument can be used to test electrical functioning of throttle positioner and mixture control valve. See illustration of circuit tester.

**Mixture Control Valve (2T-C Engine Only)** – 1) With vehicle on dynamometer or rear wheels raised, bring vehicle speed (speedometer) to intermediate or high speed. When mixture control system is on, release throttle for sudden engine deceleration. Momentary vacuum should be felt by placing hand at bottom of control valve when system is on. See illustration.

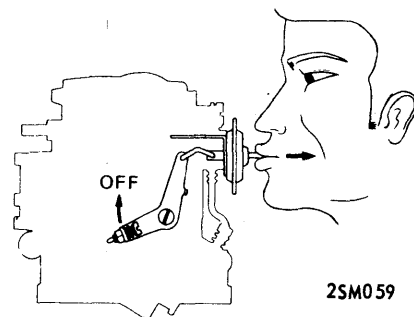


MIXTURE CONTROL VALVE INSPECTION

2) With engine idling, disconnect mixture control valve vacuum sensing hose. Place hand at bottom of valve. If vacuum can be felt, mixture control valve must be replaced.

**Throttle Positioner** – 1) With vehicle on a dynamometer, rear wheels raised, or road testing vehicle, raise vehicle speed slowly. Throttle positioner should turn on at about 15 MPH. Raise vehicle speed to above 25 MPH and then let engine decelerate to about 10 MPH. Throttle positioner should turn off.

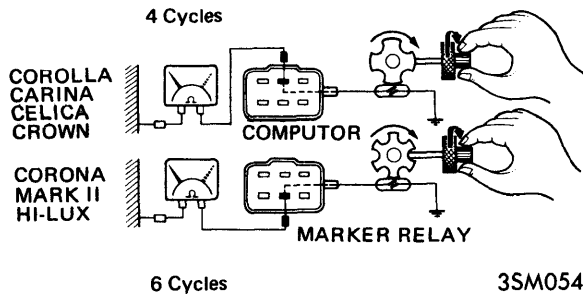
2) Disconnect throttle positioner hose from vacuum switching valve. Throttle positioner linkage should turn off (not contacting throttle lever) when hose to throttle positioner diaphragm is sucked. See illustration.



CHECKING THROTTLE POSITIONER

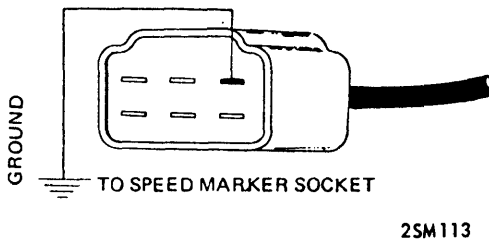
## 1972-73 TOYOTA TRANSMISSION CONTROLLED SPARK (Cont.)

**Speed Sensor** — Disconnect speedometer cable at transmission. Disconnect computer or speed marker connector and connect ohmmeter as shown in illustration. Turn cable by hand and count number of on-off cycles per each revolution of speedometer cable. If number of cycles is not correct (see illustration) replace speedometer. **NOTE** — On Land Cruiser models, connections should be as shown for Corolla, Carina, etc. but reading should be six cycles.



**SPEED SENSOR TEST**

**Speed Marker (18R-C Engine, Except Celica)** — If all other components of system operate correctly, but complete system fails to function, stop engine, disconnect speed marker connector and ground terminal as shown in illustration. Start engine, raise engine speed to 2000 RPM. If T.C.S. system turns off, speed marker is defective and must be replaced.

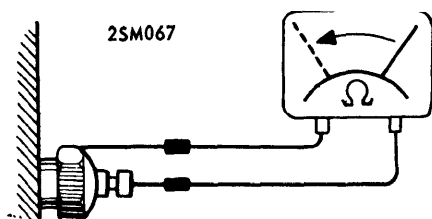


**SPEED MARKER CONNECTOR**

**Computer** — If all other components operate correctly, but complete system does not function correctly, then computer unit is defective and must be replaced.

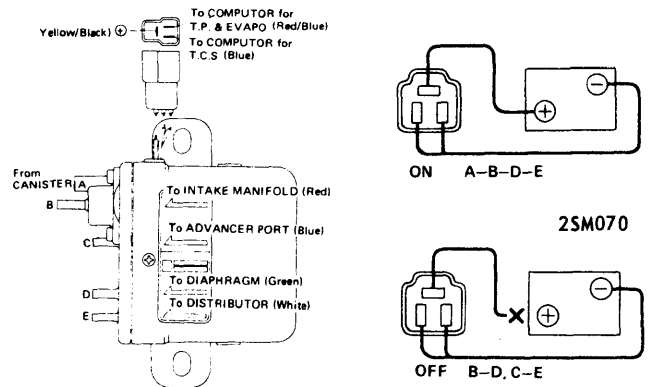
**CAUTION** — Running engine at high speed with rear axle housing raised (wheels off ground) is hard on differential gears, propeller shaft, and is also dangerous. Extreme care should be used and efforts should be made to complete tests in shortest time possible.

**Thermo-Sensor** — Connect ohmmeter to terminal of sensor and to body of sensor. At coolant temperature of 70-85°F (before starting engine) resistance should measure 15,000 to 30,000 ohms. At coolant temperature of 180°F (after engine warm up) resistance should measure about 2,000 ohms.

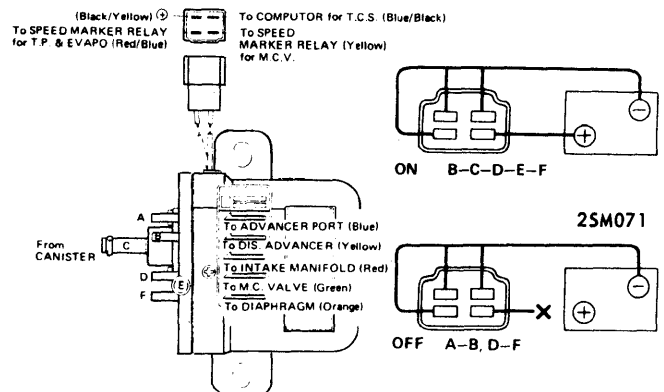


**CHECKING THERMO SENSOR**

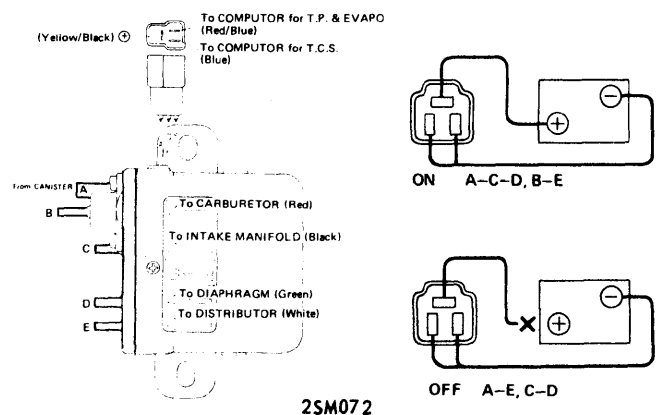
**Vacuum Switching Valve Vacuum Passage Test** — Connect a 12 volt power supply to connector of vacuum switching valve as shown in illustrations. Each of the passages indicated directly under electrical hookup illustrations ("ON") should be clear to each other. Disconnect power supply. Only those passages indicated directly under electrical hookup illustrations ("OFF") should be clear to each other. To test, blow air or smoke through various passages. If defective, replace vacuum switching valve.



**VACUUM PASSAGE TEST (3K-C & 18R-C)**



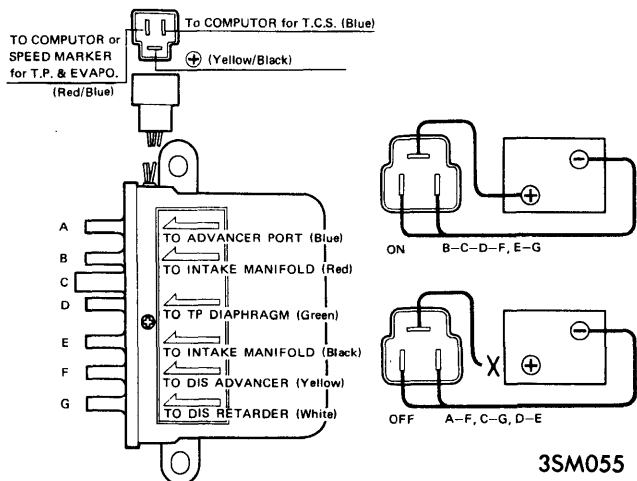
**VACUUM PASSAGE TEST (2T-C)**



**VACUUM PASSAGE TEST (F)**

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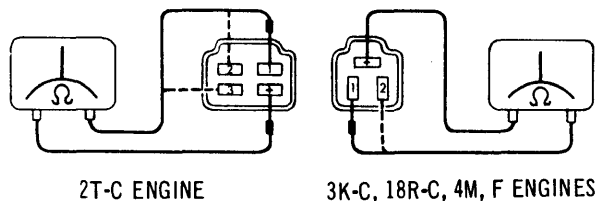
## 1972-73 TOYOTA TRANSMISSION CONTROLLED SPARK (Cont.)



VACUUM PASSAGE TEST (4M)

**Vacuum Switching Valve Short-Circuit Test** – Unplug valve connector and with a circuit tester, check for shorting between various terminals and vacuum switching valve body. If any shorting is detected, valve should be replaced.

**Vacuum Switching Valve Open-Circuit Test** – Unplug valve connector and measure resistance between (+) terminal and other terminals using a circuit tester. Replace valve if resistance is not to specified value. See illustration.



Standard Resistance Table

Engine	(+) to 1	(+) to 2	(+) to 3
3K C, 18R-C, F	56.0 ohms	28.0 ohms	—
2T-C	28.0 ohms	56.0 ohms	56.0 ohms
4M	28.0 ohms	28.0 ohms	—

3SM056

VACUUM SWITCHING VALVE OPEN CIRCUIT TEST

### MAINTENANCE

Inspect all hoses, wiring and system components for proper condition and operation every 12,000 miles. In addition to functioning of emission control components, general engine condition and tune-up are important to maintain required emission levels.

**Idle Adjustment** – See *Tune-Up Charts* for specifications on individual car models. With engine at normal operating temperature and vacuum gauge, tachometer and CO meter connected, adjust idle to specified idle RPM with idle speed adjusting screw. Then turn idle mixture screw to obtain maximum vacuum gauge reading. Adjust engine speed to specified RPM using idle speed screw, and again adjust mixture screw to obtain maximum vacuum reading. Now turn idle mixture screw to specified mixture for each engine (see following chart).

#### ① Idle Mixture Setting

Engine	CO% 1972	CO% 1973
3K-C	2-3	1-4
2T-C	2-3	1-4
18R-C	2-3	1-4
4M	1-3	1-3
F	2-3	1-3

① – These are Factory Inspection Standards, which are more severe than those specified by different State regulations. Idle CO may exceed factory standards, but adjustment should be made within State Regulation Values.

**Throttle Positioner Adjustment** – With engine warmed up, pull off thermo-sensor connector and adjust engine idling to specified RPM. See *Tune-Up Charts*. Disconnect vacuum hose from throttle positioner and set throttle positioner to "ON" position. Using throttle positioner adjusting screw, set RPM to speed specified in following chart. Reconnect vacuum hose and thermo-sensor connector.

#### Throttle Positioner Setting (RPM)

Engine	① Manual Trans.	① Auto. Trans.
3K-C	1500	—
2T-C & 18R-C	1400	1400
4M	1300	1200
F	1200	—

① – Set in neutral.

### TROUBLE SHOOTING

**Abnormal Idle Speed** – Faulty carburetor, sticking carburetor linkage or choke valve. Throttle positioner faulty or positioner linkage sticking. Leaking diaphragm. Vacuum switching valve faulty. Vacuum hoses or tubes disconnected or clogged.

**Rough Engine Idle** – Idle speed, idle mixture, ignition timing or valve clearance improperly adjusted. Vacuum hoses or lines disconnected or leaking. Air or fuel leakage caused by loose manifold bolts or carburetor flange attaching nuts. Stuck ventilation valve. Vacuum switching valve faulty.

**Insufficient Engine Braking Effect** – Engine idle speed or throttle positioner improperly adjusted or faulty. Distributor retard and advance diaphragm faulty or leaking. Vacuum hoses or lines clogged or disconnected. Speed sensor, speed marker, computer, T.C.S. circuit, or vacuum switching valve faulty.

**Power Loss at High Speed** – Faulty speed sensor, speed marker, computer, T.C.S. circuit. Faulty mixture control valve.