05629–01

PRE–CHECK

1. DIAGNOSIS SYSTEM

(a) Description for Euro–OBD

- When troubleshooting Euro–OBD vehicles, the only difference from the usual troubleshooting procedure is that you connect the vehicle to the OBD scan tool complying with ISO 15031–4 or hand–held tester, and read off various data output from the vehicle's ECM.
- Euro–OBD regulations require that the vehicle's on–board computer lights up the Check Engine Warning Light (Malfunction Indicator Lamp)/CHK ENG (MIL) on the instrument panel when the computer detects a malfunction in the emission control system/components or in the powertrain control components which affect vehicle emissions, or a malfunction in the computer. In addition to CHK ENG (MIL) lighting up when a malfunction is detected, the applicable Diagnostic Trouble Codes (DTCs) prescribed by ISO15031–6 are recorded in the ECM memory (See page 05–301).

If the malfunction code is not detected in 3 consecutive trips, CHK ENG (MIL) goes off automatically but the DTCs remain recorded in the ECM memory.

- To check the DTCs, connect the OBD scan tool or hand–held tester to the Data Link Connector 3 (DLC3) on the vehicle. The OBD scan tool or hand–held tester also enables you to erase the DTCs and check freezed frame data and various forms of engine data (For operating instructions, see the OBD scan tool's instruction book.).
- DTCs include ISO controlled codes and manufacturer controlled codes. ISO controlled codes must be set as prescribed by the ISO, while manufacturer controlled codes can be set freely by the manufacturer within the prescribed limits (See DTC chart on page 05–301).

- The diagnosis system operates in normal mode during normal vehicle use. It also has a check mode for technicians to simulate malfunction symptoms and troubleshoot. Most DTCs use 2 trip detection logic* to prevent erroneous detection, and ensure thorough malfunction detection. By switching the ECM to check mode when troubleshooting, the technician can cause the CHK ENG (MIL) to light up for a malfunction that is only detected once or momentarily (Hand–held tester only) (See step 2).
- *2 trip detection logic:
  When a malfunction is first detected, the malfunction code is temporarily stored in the ECM memory (1st trip). If the same malfunction is detected again during the second drive test, this second detection causes the CHK ENG (MIL) to light up (2nd trip) (However, the ignition switch must be turned OFF between the 1st trip and the 2nd trip.).
- Freeze frame data:
  Freeze frame data records the engine condition when a misfire (DTCs P0300 – P0306) or fuel trim malfunction (DTCs P0171, P0172, P0174 and P0175) or other malfunction (first malfunction only), is detected.
  Because freeze frame data records the engine conditions (fuel system, calculated load, engine coolant temperature, fuel trim, engine speed, vehicle speed, etc.) when the malfunction is detected. When troubleshooting, it is useful to determine whether the vehicle was running or stopped, the engine was warmed up or not, the air–fuel ratio was lean or rich, etc. at the time of the malfunction.

Priorities for troubleshooting. If troubleshooting priorities for multiple DTCs are given in the applicable DTC chart, these should be followed.

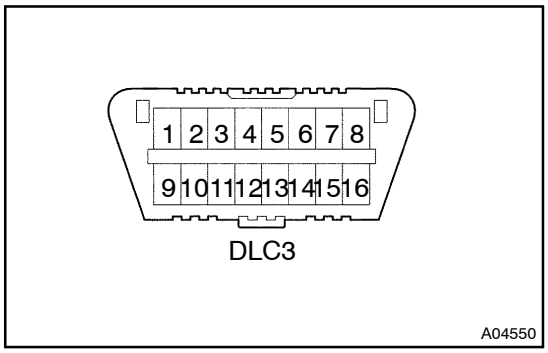
If no instructions are given, troubleshoot DTCs according to the following priorities.

(1) DTCs other than fuel trim malfunction (DTCs P0171 and P0172) and misfire (DTCs P0300 – P0306).
(2) Fuel trim malfunction (DTCs P0171, P0172, P0174 and P0175).
(3) Misfire (DTCs P0300 – P0306).

(b) Description for M–OBD

- When troubleshoot Multiplex OBD (M–OBD) vehicles, the only difference from the usual troubleshooting procedure is that you connect the vehicle to the hand–held tester, and read off various data output from the vehicle's ECM.
- The vehicle's on–board computer indicates the check engine light (CHK ENG) on the instrument panel when the computer detects a malfunction in the computer itself or in drive system components. In addition to an indication of the CHK ENG when a malfunction is detected, the applicable Diagnostic Trouble Codes (DTCs) are recorded in the ECM memory (See page 05–301). When the malfunction does not reoccur, the CHK ENG is indicated until the ignition switch is turned off, and then the CHK ENG is not indicated when the ignition switch is turned on but the DTCs remain recorded in the ECM memory.
- To check the DTCs, connect the hand–held tester to Data Link Connector 3 (DLC3) on the vehicle. or read the number of blinks of the check engine warning light when TC and CG terminals on the DLC3 are connected. The hand–held tester also enables you to erase the DTCs and activate the several actuators and check freezed frame data and various forms of engine data. (For operating instructions, see the hand–held tester instruction book.)
- The diagnosis system operates in the normal mode during normal vehicle use. It also has a check (test) mode for technicians to simulate malfunction symptoms and troubleshoot. Most DTCs use 2 trip detection logic* to prevent erroneous detection, and ensure thorough malfunction detection. By switching the ECM to the check (test) mode using hand–held tester when troubleshooting, the technician can cause the CHK ENG on the light up for a malfunction that is only detected once or momentarily (Hand–held tester only) (See step 2).
- * 2 trip detection logic
  When a logic malfunction is fist detected, the malfunction is temporally stored in the ECM memory. If the same malfunction is detected again during the second drive test, this second detection cases the CHK ENG to light up.
  The 2 trip repeats the same mode for 2 times (However, the ignition switch must be turned OFF between the 1st trip and 2nd trip).

- Freeze frame data:
  Freeze frame data records the engine condition when malfunction is detected.
  Because freeze frame data records the engine conditions (fuel system, calculator load, water temperature, fuel trim, engine speed, vehicle speed, etc.) when the malfunction is detected. When troubleshooting, it is useful for determining whether the vehicle was running or stopped, the engine was warmed up or not, the air–fuel ratio was lean or rich, etc. at the time of the malfunction.



(c) Check the DLC3.
The vehicle's ECM uses the ISO 9141–2 (Euro–OBD)/ISO 14230 (M–OBD) communication protocol. The terminal arrangement of DLC3 complies with ISO 15031–3 and matches the ISO 9141–2/ISO 14230 format.

Terminal No.	Connection/Voltage or Resistance	Condition
7	Bus + Line/Pulse generation	During transmission
4	Chassis Ground ⇔ Body Ground/1 Ω or less	Always
5	Signal Ground – Body Ground/1 Ω or less	Always
16	Battery Positive ⇔ Body Ground/9 – 14 V	Always

HINT:
If your display shows UNABLE TO CONNECT TO VEHICLE when you have connected the cable of the hand–held tester to the DLC3, turned the ignition switch ON and operated the scan tool, there is a problem on the vehicle side or tool side.
If communication is normal when the tool is connected to another vehicle, inspect the DLC3 on the original vehicle.
If communication is still not possible when the tool is connected to another vehicle, the problem is probably in the tool itself, so consult the Service Department listed in the tool's instruction manual.

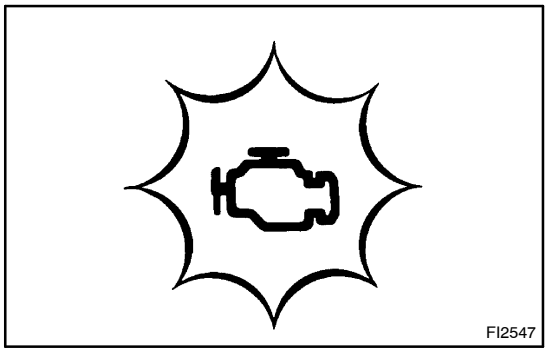
2. INSPECT DIAGNOSIS (Normal Mode)

(a) Check the DTC using hand–held tester.

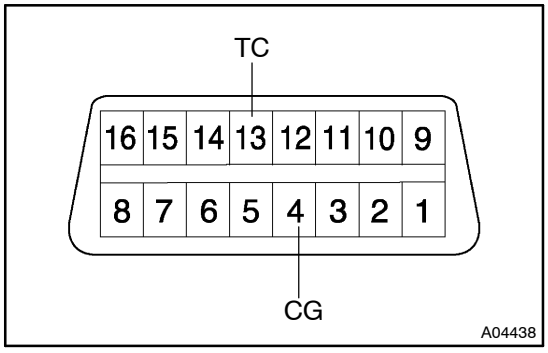
NOTICE:

Hand–held tester only:

When the diagnosis system is switched from the normal mode to the check mode, it erases all DTCs and freezed frame data recorded in the normal mode. So before switching modes, always check the DTCs and freezed frame data, and note them down.

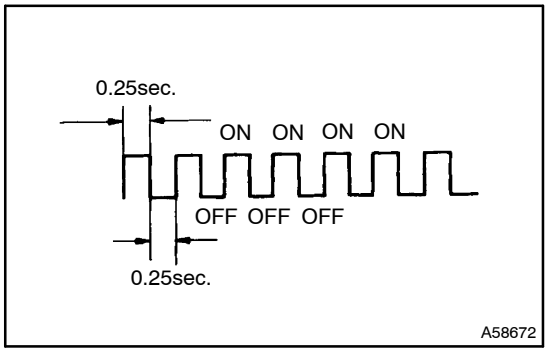


(1) The CHK ENG (MIL) comes on when the ignition switch is turned ON and the engine is not running.
(2) Prepare the hand–held tester.
(3) Connect the hand–held tester to the DLC3.
(4) Turn the ignition switch ON and push the hand–held tester main switch ON.
(5) Use the hand–held tester to check the DTCs and freezed frame data, note them down (For operating instructions, see the hand–held tester instruction book.).
(6) See page to confirm the details of the DTCs.

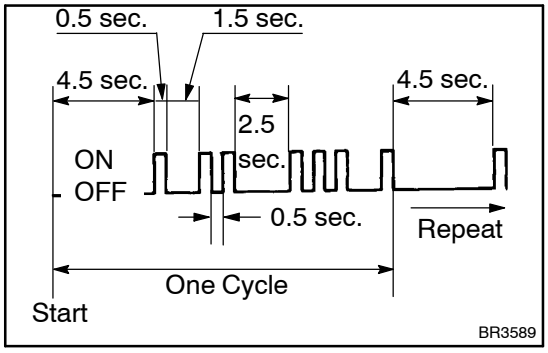


(b) Check the DTC when not using hand–held tester (M–OBD).
(1) Turn the ignition switch ON.
(2) Using SST, connect terminals 13 (TC) and 4 (CG) of the DLC3.

SST 09843–18040



(3) Read the DTC from the CHK ENG (MIL).
As an example, the blinking patterns for codes, normal, 12 and 31 are as shown in the illustration.



(4) Check the details of the malfunction using the DTC chart on page .

(5) After completing the check, disconnect terminals 13 (TC) and 4 (CG) and turn off the display.

HINT:
In the event of 2 or more malfunction cords, the indication will begin from the smaller numbered cord and continue in order to the larger.

(6) Push the function key of the steering switch until EFI will be displayed on the instrument panel.

(7) Read the DTC on the instrument panel.

HINT:
If a CHK ENG (MIL) is not indicated, check the DLC3 circuit.

NOTICE:

- **When simulating symptoms with a hand–held tester to check the DTCs, use the normal mode. For code on the DTC chart subject to ”2 trip detection logic”, perform the following either action.**
- **Turn the ignition switch OFF after the symptom is simulated the first time. Then repeat the simulation process again. When the problem has been simulated twice, the CHK ENG (MIL) is indicated on the instrument panel and the DTCs are recorded in the engine ECU.**
- **Check the 1st trip DTC using Mode 7 for ISO 15031 (Continuous Test Results of Euro–OBD function in hand–held tester).**

(c) Clear the DTC.
The DTCs and frozen frame data will be erased by either actions.

(1) Operating the hand–held tester to erase the codes. (See the hand–held tester’s instruction book for operating instructions.)

(2) Disconnecting the battery terminals or E.F.I. fuse and ETCS fuse more than 30 second.

NOTICE:
If the hand–held tester switches the ECM from the normal mode to the check mode or vice–versa, or if the ignition switch is turned from ON to ACC or OFF during the check mode, the DTCs and frozen frame data will be erased.

3. INSPECT DIAGNOSIS (Check (Test) Mode)

HINT:

Hand–held tester only:

Compared to the normal mode, the check mode has an increased sensitivity to detect malfunctions.

Furthermore, the same diagnostic items which are detected in the normal mode can also be detected in the check (test) mode.

(a) Check the DTC.

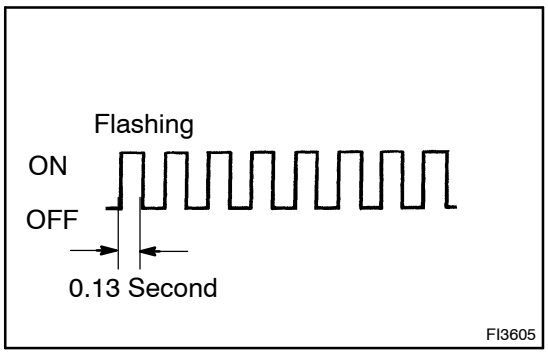
(1) Initial conditions
- Battery voltage 11 V or more
- Throttle valve fully closed
- Transmission in P or N position
- A/C switched OFF

(2) Turn the ignition switch OFF.

(3) Prepare the hand–held tester.

(4) Connect the hand–held tester to the DLC3.

(5) Turn the ignition switch ON and push the hand–held tester main switch ON.



(6) Switch the hand–held tester from the normal mode to the check (test) mode.

(7) Check if the CHK ENG (MIL) blinks.

NOTICE:

If the hand–held tester switches the ECM from the normal mode to the check mode or vice–versa, or if the ignition switch is turned from ON to ACC or OFF during the check mode, the DTCs and freezed frame data will be erased.

(8) Start the engine.

(9) Simulate the conditions of the malfunction described by the customer.

NOTICE:

Leave the ignition switch ON until you have checked the DTCs, etc.

(10) After simulating the malfunction conditions, use the hand–held tester diagnosis selector to check the DTCs and freezed frame data, etc.

HINT:

Take care not to turn the ignition switch OFF. Turning the ignition switch OFF switches the diagnosis system from the check (test) mode to the normal mode. so all DTCs, etc. are erased.

(11) After checking the DTC, inspect the applicable circuit.

4. FAIL–SAFE CHART

If any of the following codes is recorded, the ECM enters fail–safe mode.

DTC No.	Fail–Safe Operation	Fail–Safe Deactivation Conditions
P0100/31	Ignition timing fixed at 10°BTDC	Returned to normal condition
P0110/24	Intake air temp. is fixed at 20°C(68°F)	Returned to normal condition
P0115/22	Engine coolant temp. is fixed at 80°C(176°F)	Returned to normal condition
P0141/27 P1135/21 P1155/28	The heater circuit in witch an abnormality is detected is turned off	Ignition switch OFF
P0325/52 P0330/55	Max. timing retardation	Ignition switch OFF
P1300/14 P1305/15 P1310/15 P1315/14 P1320/14 P1325/15	Fuel cut	Returned to normal condition

5. CHECK FOR INTERMITTENT PROBLEMS

Hand–held tester only:

By putting the vehicle's ECM in the check mode, 1 trip detection logic is possible instead of 2 trip detection logic and sensitivity to detect open circuits is increased. This makes it easier to detect intermittent problems.

(1) Clear the DTC (See step 2.)
(2) Set the check mode (See step 2.)
(3) Perform a simulation test (See page 01–21).
(4) Check the connector and terminal (See page 01–31).
(5) Handle the connector (See page 01–31).

6. ENGINE OPERATING CONDITION

NOTICE:

The values given below for "Normal Condition" are representative values, so a vehicle may still be normal even if its value varies differ from those listed here. So do not decide whether a part is faulty or not solely according to the "Normal Condition" here.

(a) CARB mandated signals.

Hand–held Tester Display	Measurement Item	Normal Condition*
FUEL SYS #1	Fuel System Bank 1 OPEN: Air–fuel ratio feedback stopped CLOSED: Air–fuel ratio feedback operating	Idling after warming up: CLOSED
FUEL SYS #2	Fuel System Bank 2 OPEN: Air–fuel ratio feedback stopped CLOSED: Air–fuel ratio feedback operating	Idling after warming up: CLOSED
CALC LOAD	Calculator Load: Current intake air volume as a proportion of max. intake air volume	Idling: 13.1 – 18.7 % Racing without load (2,500rpm): 11.7 – 17.3 %
COOLANT TEMP	Engine Coolant Temp. Sensor Value	After warming up: 80 – 95°C(176 – 203°F)
SHORT FT #1	Short–term Fuel Trim Bank 1	0 ±20 %
LONG FT #1	Long–term Fuel Trim Bank 1	0 ±20 %
SHORT FT #2	Short–term Fuel Trim Bank 2	0 ±20 %
LONG FT #2	Long–term Fuel Trim Bank 2	0 ±20 %
ENGINE SPD	Engine Speed	Idling: 550 –650rpm
VEHICLE SPD	Vehicle Speed	Vehicle stopped: 0 km/h (0 mph)
IGN ADVANCE	Ignition Advance: Ignition Timing of Cylinder No.1	Idling: BTDC 10 – 25.0°
INTAKE AIR	Intake Air Temp. Sensor Value	Equivalent to Ambient Temp.
MAF	Air Flow Rate Through Mass Air Flow Meter	Idling: 3.3 – 4.7 gm/sec. Racing without load (2,500 rpm): 10.4 – 15.4 gm/sec.

Hand–held Tester Display	Measurement Item	Normal Condition*
THROTTLE POS	Voltage Output of Throttle Position Sensor Calculated as a percentage: 0 V → 0 %, 5 V → 100 %	Throttle valve fully closed: 8 – 20 % Throttle valve fully open: 64 – 96 %
O2FT B1 S1	Oxygen Sensor Fuel Trim Bank 1 Sensor 1 (Same as SHORT FT #1)	0 ± 20 %
O2S B1 S2	Voltage Output of Oxygen Sensor Bank 1 Sensor 2	Driving 50 km/h (31 mph): 0.05 – 0.95 V
O2FT B2 S1	Oxygen Sensor Fuel Trim Bank 2 Sensor 1 (Same as SHORT FT #2)	0 ± 20 %
A/FS B1 S1	Voltage Output of A/F Sensor Bank 1 Sensor 1	Idling: 2.8 – 3.8 V
A/FS B2 S1	Voltage Output of A/F Sensor Bank 2 Sensor 1	Idling: 2.8 – 3.8 V
A/FFT B1 S1	A/F Sensor Fuel Trim Bank 1 Sensor 1 (Same as SHORT FT #1)	0 ± 20 %
A/FFT B2 S1	A/F Sensor Fuel Trim Bank 2 Sensor 1 (Same as SHORT FT #1)	0 ± 20 %

*: If no conditions are specifically stated for ”Idling”, it means the shift lever is at N or P position, the A/C switch is OFF and all accessory switches are OFF.

(b) TOYOTA Enhanced Signals.

Hand–held Tester Display	Measurement Item	Normal Condition*
MISFIRE RPM	Engine RPM for first misfire range	Misfire 0: 0 rpm
MISFIRE LOAD	Engine load for first misfire range	Misfire 0: 0 g/r
INJECTOR	Fuel injection time for cylinder No.1	Idling: 1.6 – 2.9 ms
STARTER SIG	Starter Signal	Cranking: ON
CTP SIG	Closed Throttle Position Signal	Throttle fully closed: ON
A/C SIG	A/C Switch Signal	A/C ON: ON
PNP SW	Park/Neutral Position Switch Signal	P or N position: ON
ELCTRCL LOAD SIG	Electrical Load Signal	Defogger switch ON: ON
STOP LIGHT SW	Stop Light Switch Signal	Stop light switch ON: ON
PS OIL PRESS SW	Power Steering Oil Pressure Switch Signal	Turn steering wheel: ON
FC IDL	Fuel Cut Idle: Fuel cut when throttle valve fully closed, during deceleration	Fuel cut operating: ON
FC TAU	Fuel Cut TAU: Fuel cut during very light load	Fuel cut operating: ON
CYL#1 – CYL#6	Abnormal revolution variation for each cylinder	0 %
IGNITION	Total number of ignition for every 1,000 revolutions	0 – 3,000
INTAKE CTRL VSV	Intake Air Control Valve VSV Signal	VSV operating: ON
A/C CUT SIG	A/C Cut Signal	A/C S/W OFF: ON
FUEL PUMP	Fuel Pump Signal	Idling: ON
EVAP (PURGE) VSV	EVAP VSV Signal	VSV operating: Above 30 %
VAPOR PRESS VSV	Vapor Pressure VSV Signal	VSV operating: ON
THROTTLE POS #2	Throttle position sensor No. 2 output voltage	Throttle fully closed: 2.0 – 2.9 V Throttle fully open: 4.6 – 5.0 V
ACCEL POS	Accelerator pedal position sensor No. 1 output voltage	Accelerator released: 0.5 – 1.1 V Accelerator depressed: 3.0 – 4.6 V
ACCEL POS #2	Accelerator pedal position sensor No. 2 output voltage	Accelerator released: 0.9 – 2.3 V Accelerator depressed: 3.4 – 5.0 V
THROTTLE TARGET POS	Target position of throttle valve	idling: 0.4 – 1.0 V
THROTTLE OPEN DUTY	Throttle motor opening duty ratio	Throttle fully closed: 0 % When accelerator pedal is depressed, duty ratio is increased
THROTTLE CLOSE DUTY	Throttle motor closed duty ratio	Throttle fully closed: 0 % When accelerator pedal is quick released, duty ratio is increased
THROTTLE MOTOR CTL	Whether or not throttle motor control is permitted	idling: ON

Hand–held Tester Display	Measurement Item	Normal Condition*
+BM	Whether or not electric throttle control system power is inputted	idling: ON
TOTAL FT B1	Total Fuel Trim Bank 1: Average value for fuel trim system of bank 1	Idling: 0.8 – 1.2
TOTAL FT B2	Total Fuel Trim Bank 1: Average value for fuel trim system of bank 2	Idling: 0.8 – 1.2

*: If no conditions are specifically stated for "Idling", it means the shift lever is at N or P position, the A/C switch is OFF and all accessory switches are OFF.

BASIC INSPECTION

When the malfunction code is not confirmed in the DTC check, troubleshooting should be carried out in the order for all possible circuits to be considered as the causes of the problems. In many cases, by carrying out the basic engine check shown in the following flow chart, the location causing the problem can be found quickly and efficiently. Therefore, using of this check is essential in engine troubleshooting.

1 CHECK BATTERY VOLTAGE

NOTICE:
Carry out this check underthe engine stoppage condition.

	OK	NG
Voltage	11V or more	Less than 11V

NG → **CHARGE OR REPLACE BATTERY**

OK

2 CHECK IF ENGINE IS CRANKED

NG → **PROCEED TO PROBLEM SYMPTOMS TABLE ON PAGE 05–311**

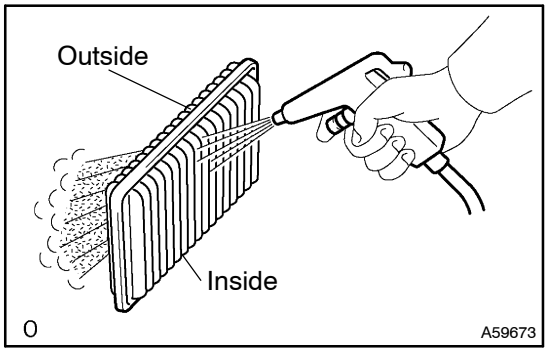
OK

3 CHECK IF ENGINE STARTS

NG → **GO TO STEP 7**

OK

4	CHECK AIR FILER



(a) Visually check that the air filter is not excessively dirty or oily.

NOTICE:
If necessary, clean the filter with compressed air. First blow from inside thoroughly, then blow from outside of filter.

NG → **REPAIR OR REPLACE**

OK

5	CHECK IDLE SPEED (See page 14–137)

NG → **PROCEED TO PROBLEM SYMPTOMS TABLE ON PAGE 05–311**

OK

6	CHECK IGNITION TIMIMG (See page 14–137)

NG → **PROCEED TO PAGE 14–137 AND CONTINUE TO TROUBLESHOOT**

OK

PROCEED TO PROBLEM SYMPTOMS TABLE ON PAGE 05–311

7	CHECK FUEL PRESSURE (See page 11–52)

NG → **PROCEED TO PAGE 11–52 AND CONTINUE TO TROUBLESHOOT**

OK

8	CHECK FOR SPARK(See page 18–5)

NG → **PROCEED TO PAGE 18–5 AND CONTINUE TO TROUBLESHOOT**

OK

PROCEED TO PROBLEM SYMPTOMS TABLE ON PAGE 05–311