BLACK SMOKE EMITTED

HINT:
Specified values in the following troubleshooting flowchart are for reference only. Variations in the Data List result values may occur depending on the measuring conditions or the vehicle's age. Do not judge the vehicle to be normal even when the Data List values indicate a standard level. There are possibly some concealed factors of the malfunction.

INSPECTION PROCEDURE

1 READ OUTPUT DTC (RELATED TO ENGINE)

(a) Connect the intelligent tester II to the DLC3.
(b) Turn the ignition switch ON and turn the intelligent tester II ON.
(c) Enter the following menus: Powertrain / Engine / DTC.
(d) Read the DTCs.
Result:

Display (DTC Output)	Proceed to
Other than engine–related DTCs (see page 05–477)	A
DTCs related to the engine (see page 05–477)	B

B → **REPAIR OR REPLACE ENGINE CONTROL SYSTEM ACCORDING TO DTC OUTPUT (See page 05–477)**

A

2 READ DATA LIST (INJECTION VOLUME)

(a) Connect the intelligent tester II to the DLC3.
(b) Start the engine and turn the intelligent tester II ON.
(c) Enter the following menus: Powertrain / Engine / Data List / Injection Volume and Injection Feedback Vol #1, #2, #3 and #4.
(d) Read the values.
Standard:

Item	Engine Speed*	Reference Value
Injection Volume	Idling (No engine load)	3 to 12 mm^3
Injection Feedback Vol #1	Idling (No engine load)	–3 to 3 mm^3
Injection Feedback Vol #2	Idling (No engine load)	–3 to 3 mm^3
Injection Feedback Vol #3	Idling (No engine load)	–3 to 3 mm^3
Injection Feedback Vol #4	Idling (No engine load)	–3 to 3 mm^3

HINT:
*: If no idling conditions are specified, the shift lever should be in the neutral position, the A/C switch and all accessory switches should be OFF.

NG → **Go to step 12**

OK

3 PERFORM ENGINE RPM ACCELERATION

HINT:
If the exhaust gas contains excessive black smoke, perform the following operations.
(a) Accelerate the engine speed up to the maximum RPM with no load 20 times.
(b) Check the volume of black smoke in the exhaust gas.
Result:

Result	Proceed to
Black smoke faded away	OK
Black smoke remains in the exhaust gas	NG

HINT:
Soot deposits in the exhaust system can be a source of excessive black smoke.

NG → **Go to step 4**

OK

END

4 CHECK AIR INTAKE SYSTEM AND EXHAUST SYSTEM

(a) Remove the air cleaner filter.
(b) Inspect the EGR valve operation.
(1) Start the engine and warm it up.
(2) Check that clicking sounds are heard from the EGR valve when the vacuum hose is disconnected from EGR valve with the engine in an idling condition.
(c) Inspect the throttle valve operation.
(1) Start the engine.
(2) Check if the throttle valve fully opens when accelerating the engine speed.

HINT:
While revving up, the EGR valve is fully closed and the throttle valve is fully opened. If the systems are normal, the volume of black smoke will decrease.
OK: EGR valve and throttle valve operate normally.

NG → **Go to step 5**

OK

CHECK AND REPAIR LOCATIONS WHERE MALFUNCTIONS EXIST

5 READ DATA LIST (MASS AIR FLOW RATE)

HINT:
DTC P0100/31 is set if there is an open or short malfunction in the MAF meter (1 trip detection logic).
(a) Disconnect the throttle control motor connector.
(b) Disconnect the E–VRV connector for EGR.
(c) Connect the intelligent tester II to the DLC3.
(d) Start the engine and turn the intelligent tester II ON.
(e) Enter the following menus: Powertrain / Engine / Data List / MAF.
(f) Read the values.
Result:

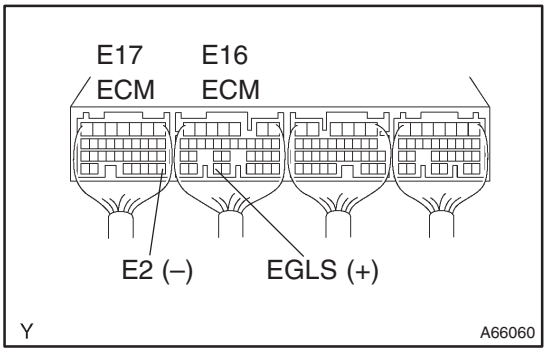
Engine Speed Condition	Air Flow Rate
750 rpm	5 to 12 gm/s

NG → **REPLACE MASS AIR FLOW METER**

OK

6 CHECK ECM (EGLS VOLTAGE)

HINT:
The lifting amount of the EGR valve can be checked using the output of the EGR position sensor.



(a) Turn the ignition switch ON.
(b) Measure the voltage of the ECM connectors.
Standard:

Tester Connection	Condition	Specified Condition
E16–33 (EGLS) – E17–28 (E2)	Ignition switch ON	A (0.3 to 1.3 V)

(c) Turn the ignition switch ON.
(d) Start the engine and warm it up.
(e) Measure the voltage of the ECM connector.
Standard:

Tester Connection	Condition	Specified Condition
E16–33 (EGLS) – E17–28 (E2)	Idling: 750 rpm	A + (1.91 to 2.70 V)

HINT:
Idle the engine, turn the A/C switch OFF and move the shift lever to N. After the engine warms up, the engine should have no lode.

NG → **REPLACE EGR VALVE ASSY** (**See page 10–20**)

OK

7	CHECK TURBOCHARGING PRESSURE (See page 13–1)

Standard: Turbocharging pressure is within standard range.

NG	REPLACE TURBOCHARGER SUB–ASSY (See page 13–10)

OK

8	READ DATA LIST (COMMON RAIL PRESSURE, INJECTION VOLUME, M–INJ/PILOT ON, PILOT–INJECTION, REVISED INJECTION VOLUME)

(a) Connect the intelligent tester II to the DLC3.
(b) Start the engine and turn the intelligent tester II ON.
(c) Enter the following menus: Powertrain / Engine / Data List.
(d) Select the following menu items in order and read the values.
- Fuel Press
- Injection Volume
- Main Injection
- Pilot 1 Injection, Pilot 2 Injection
- Injection Feedback Vol #1, #2, #3 and #4

Reference:

Item	Engine Speed*	Reference Value
Fuel Press	Idling	3,0000 to 40,000 kPa
Fuel Press	2,000 rpm (No engine load)	35,000 to 50,000 kPa
Fuel Press	3,000 rpm (No engine load)	50,000 to 80,000 kPa
Injection Volume	Idling	3 to 12 mm^3
Injection Volume	2,000 rpm (No engine load)	5 to 12 mm^3
Injection Volume	3,000 rpm (No engine load)	7 to 14 mm^3
Main Injection	Idling	330 to 1,000 μs
Pilot 1 Injection, Pilot 2 Injection	Idling	330 to 570 μs
Injection Feedback Vol #1	Idling	–3 to 3 mm^3
Injection Feedback Vol #2	Idling	–3 to 3 mm^3
Injection Feedback Vol #3	Idling	–3 to 3 mm^3
Injection Feedback Vol #4	Idling	–3 to 3 mm^3

HINT:
*: If no idling conditions are specified, the shift lever should be in the neutral position, the A/C switch and all accessory switches should be OFF.

Result:

Result	Proceed to
Within reference value	A
One of Injection Feedback Vol #1 to #4 indicates outside reference value	B
Other result	C

B	REPLACE INJECTOR (See page 11–52)

C	Go to step 12

A

9	INSPECT CYLINDER COMPRESSION PRESSURE (See Pub. No. RM990E, page 14–186)

Standard: Cylinder compression pressure is within standard range.

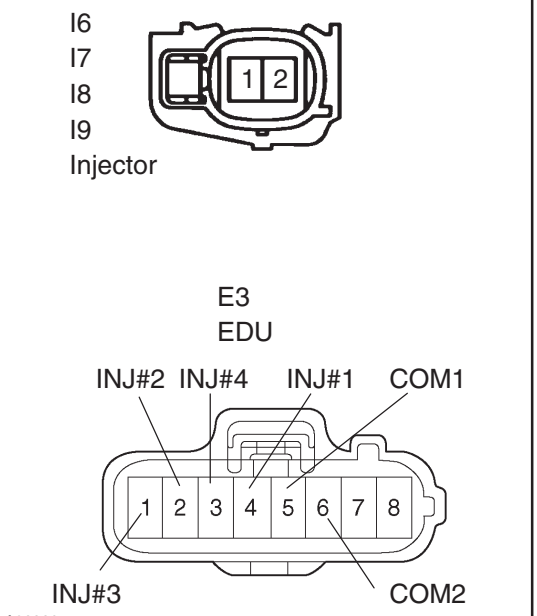
NG → **CHECK AND REPAIR ENGINE**

OK

10	CHECK WIRE HARNESS (INJECTOR – EDU)

HINT:
DTC P0200/97 is set if there is an open or short malfunction in the EDU circuit (1 trip detection logic).

Wire Harness Side



(a) Disconnect the I6, I7, I8 and I9 injector connectors.
(b) Disconnect the E3 EDU connector.
(c) Measure the resistance of the wire harness side connectors.

Standard:

Tester Connection	Specified Condition
I6–2 – E3–4 (INJ#1)	Below 1 Ω
I7–2 – E3–2 (INJ#2)	Below 1 Ω
I8–2 – E3–1 (INJ#3)	Below 1 Ω
I9–2 – E3–3 (INJ#4)	Below 1 Ω
I6–1 – E3–5 (COM1)	Below 1 Ω
I7–1 – E3–6 (COM2)	Below 1 Ω
I8–1 – E3–6 (COM2)	Below 1 Ω
I9–1 – E3–5 (COM1)	Below 1 Ω
I6–2 or E3–4 (INJ#1) – Body ground	10 kΩ or higher
I7–2 or E3–2 (INJ#2) – Body ground	10 kΩ or higher
I8–2 or E3–1 (INJ#3) – Body ground	10 kΩ or higher
I9–2 or E3–3 (INJ#4) – Body ground	10 kΩ or higher
I6–1 or E3–5 (COM1) – Body ground	10 kΩ or higher
I7–1 or E3–6 (COM2) – Body ground	10 kΩ or higher
I8–1 or E3–6 (COM2) – Body ground	10 kΩ or higher
I9–1 or E3–5 (COM1) – Body ground	10 kΩ or higher

NG → **REPAIR OR REPLACE HARNESS OR CONNECTOR**

OK

11 PERFORM ACTIVE TEST (INJECTOR CUT)

(a) Connect the intelligent tester II to the DLC3.
(b) Start the engine and turn the intelligent tester II ON.
(c) Enter the following menus: Powertrain / Engine / Active Test / Injector cut #1, #2, #3 and #4.
(d) Check the engine idling condition while the fuel injection of each cylinder is cut using the intelligent tester II.

Result:

Engine Idling Condition	Proceed to
Becomes unstable	A
Does not change	B

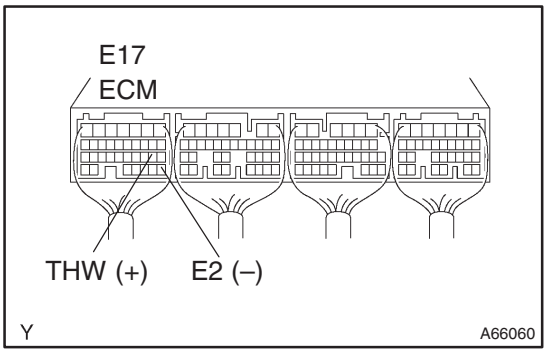
HINT:
Replace the injector mounted on the cylinder that causes rough idling.

B → **REPLACE INJECTOR (See page 11–52)**

A

REPLACE INJECTOR DRIVER

12 CHECK ECM (THW VOLTAGE)



(a) Start the engine.
(b) Measure the voltage of the ECM connector.

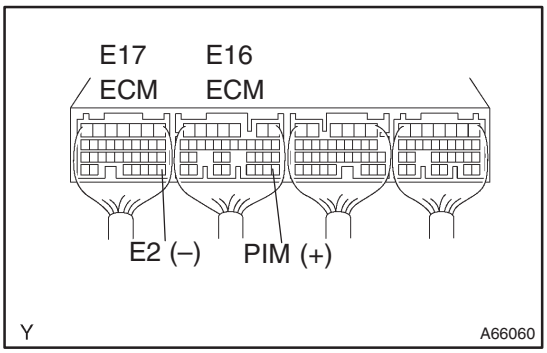
Standard:

Tester Connection	Condition	Specified Condition
E17–19 (THW) – E17–28 (E2)	Idling, engine coolant temperature between 60°C and 120°C (140°F and 248°F)	0.2 to 1.0 V

NG → **Go to step 18**

OK

13 CHECK ECM (PIM VOLTAGE)



(a) Turn the ignition switch ON.
(b) Measure the voltage of the ECM connectors.
Standard:

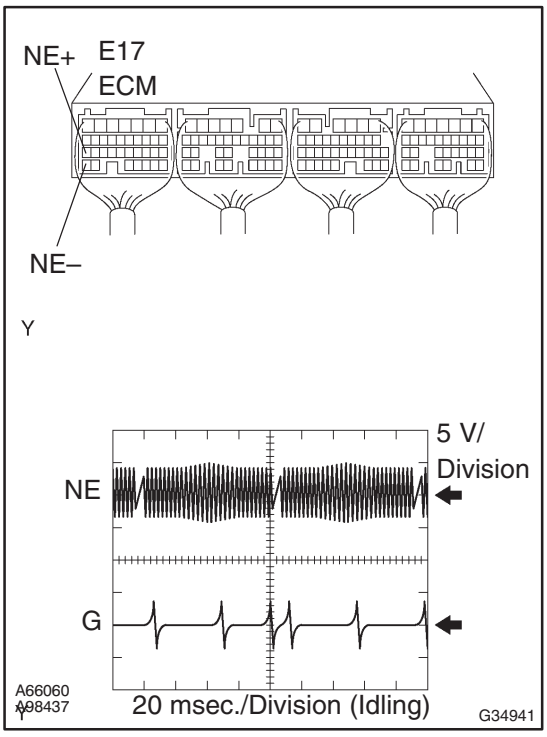
Tester Connection	Condition	Specified Condition
E16–28 (PIM) – E17–28 (E2)	Applied negative pressure of 40 kPa (300 mmHg, 11.8 in.Hg)	1.3 to 1.9 V
E16–28 (PIM) – E17–28 (E2)	Same as atmospheric pressure	2.4 to 3.1 V
E16–28 (PIM) – E17–28 (E2)	Applied positive pressure of 170 kPa (1,275 mmHg, 190.5 in.Hg)	3.7 to 4.3 V

HINT:
Even when the voltage output from the manifold absolute pressure sensor is within the standard level, there may be a problem in the sensor caused by age deterioration.

NG → **Go to step 19**

OK

14 CHECK ECM (NE SIGNAL)



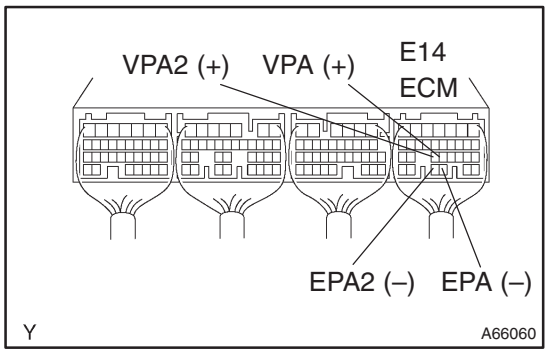
(a) While idling the engine, check the waveform of the ECM connector using an oscilloscope.
Standard:

Tester Connection	Specified Condition
E17–27 (NE+) – E17–34 (NE–)	Correct waveform is shown

NG → **Go to step 20**

OK

15 CHECK ECM (VPA, VPA2 VOLTAGE)



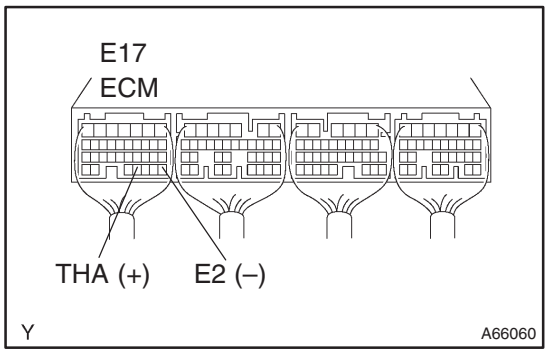
(a) Turn the ignition switch ON.
(b) Measure the voltage of the ECM connector.
Standard:

Tester Condition	Accelerator Pedal Condition	Specified Condition
E14–22 (VPA) – E14–28 (EPA)	Released	0.6 to 1.0 V
E14–22 (VPA) – E14–28 (EPA)	Depressed	2.9 to 4.2 V
E14–23 (VPA2) – E14–29 (EPA2)	Released	1.4 to 1.8 V
E14–23 (VPA2) – E14–29 (EPA2)	Depressed	3.7 to 5.0 V

NG → **Go to step 21**

OK

16 CHECK ECM (THA VOLTAGE)



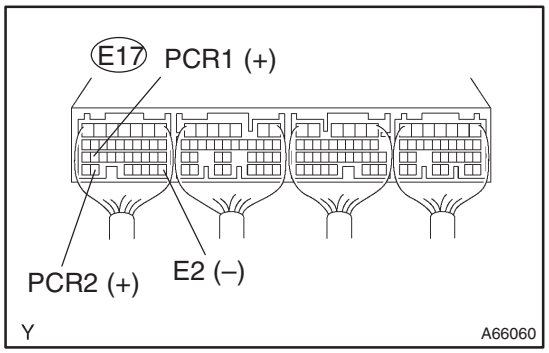
(a) Start the engine.
(b) Measure the voltage of the ECM connector.
Standard:

Tester Connection	Condition	Specified Condition
E17–31 (THA) – E17–28 (E2)	Idling, intake air temperature at 20°C (68°F)	0.5 to 3.4 V

NG → **Go to step 22**

OK

17 CHECK ECM (PCR1, PCR2 VOLTAGE)



(a) Start the engine.
(b) Measure the voltage of the ECM connector.
Standard:

Tester Connection	Condition	Specified Condition
E17–26 (PCR1) – E17–28 (E2)	Idling	1.7 to 2.2 V
E17–33 (PCR2) – E17–28 (E2)	Idling	1.2 to 1.6 V

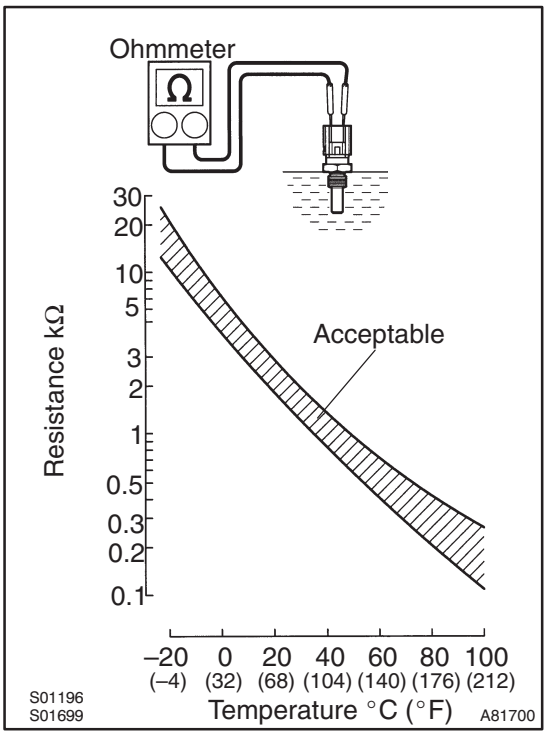
NG → **Go to step 23**

OK

REPLACE ECM (See Pub. No. RM990E, page 10–34)

NOTICE:
After replacing the ECM, allow for ECM learning start the engine and idle it until it is fully warmed up.

18 INSPECT ENGINE COOLANT TEMPERATURE SENSOR



(a) Remove the sensor.
(b) Measure the resistance of the sensor.
Standard:

Tester Connection	Condition	Specified Condition
1 – 2	20°C (68°F)	2.32 to 2.59 kΩ
1 – 2	80°C (140°F)	0.310 to 0.326 kΩ

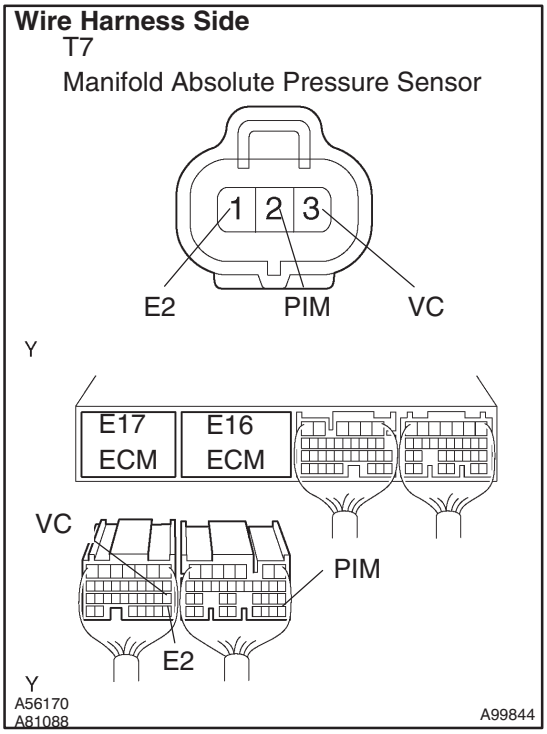
NOTICE:
If checking the ECT sensor in water, keep the terminals dry. After the check, wipe the sensor dry.
HINT:
Alternative procedure: Connect an ohmmeter to the installed ECT sensor and read the resistance. Use an infrared thermometer to measure the engine temperature in the immediate vicinity of the sensor. Compare these values against the resistance/temperature graph. Change the engine temperature (warm up or allow to cool down) and repeat the test.

NG → **REPLACE ENGINE COOLANT TEMPERATURE SENSOR**

OK

REPAIR OR REPLACE HARNESS OR CONNECTOR

19 CHECK WIRE HARNESS (MANIFOLD ABSOLUTE PRESSURE SENSOR – ECM)



(a) Disconnect the T7 sensor connector.
(b) Disconnect the E16 and E17 ECM connectors.
(c) Measure the resistance of the wire harness side connectors.
Standard:

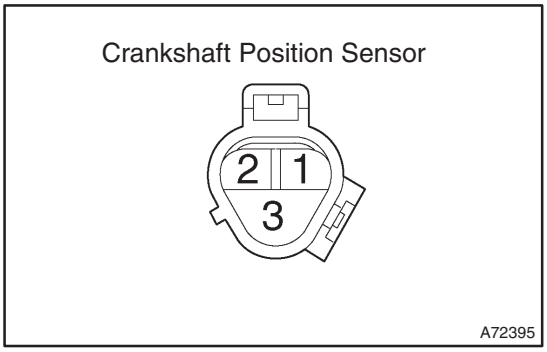
Tester Connection	Specified Condition
T7–2 (PIM) – E16–28 (PIM)	Below 1 Ω
T7–3 (VC) – E17–18 (VC)	Below 1 Ω
T7–1 (E2) – E17–28 (E2)	Below 1 Ω
T7–2 (PIM) or E16–28 (PIM) – Body ground	10 kΩ higher
T7–3 (VC) or E17–18 (VC) – Body ground	10 kΩ higher
T7–1 (E2) or E17–28 (E2) – Body ground	10 kΩ higher

NG → **REPAIR OR REPLACE HARNESS OR CONNECTOR**

OK

REPLACE MANIFOLD ABSOLUTE PRESSURE SENSOR

20 INSPECT CRANKSHAFT POSITION SENSOR



(a) Disconnect the C3 connector.
(b) Measure the resistance of the sensor.

Standard:

Tester Connection	Condition	Specified Condition
1 – 2	Cold	1,630 to 2,740 Ω
1 – 2	Hot	2,065 to 3,225 Ω

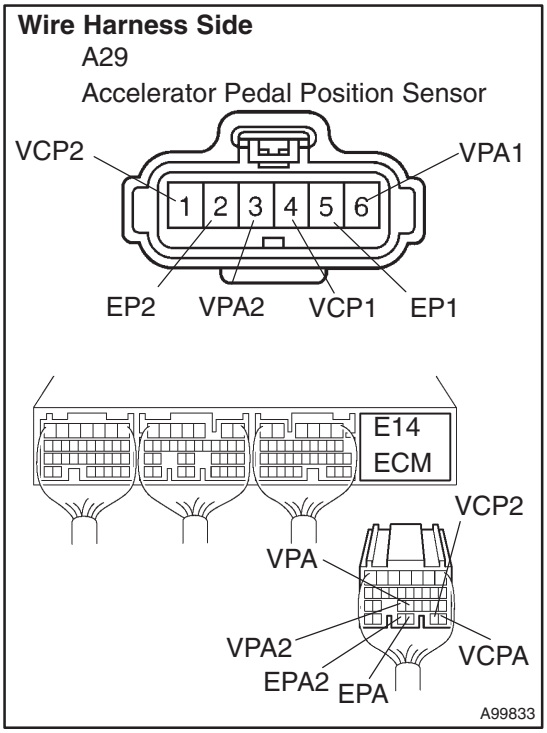
NOTICE:
In the chart above, the terms "cold" and "hot" refer to the temperature of the coils. "Cold" means approximately –10 to 50°C (14 to 122°F). "Hot" means approximately 50 to 100°C (122 to 212°F).

NG → **REPLACE CRANKSHAFT POSITION SENSOR**

OK

REPAIR OR REPLACE HARNESS OR CONNECTOR

21 CHECK WIRE HARNESS (ACCELERATOR PEDAL POSITION SENSOR – ECM)



(a) Disconnect the A29 sensor connector.
(b) Disconnect the E14 ECM connector.
(c) Measure the resistance of the wire harness side connectors.

Standard:

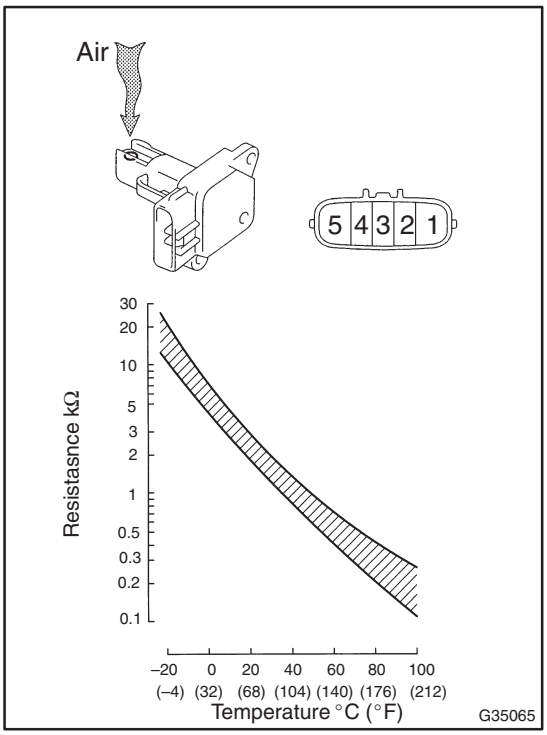
Tester Connection	Specified Condition
A29–1 (VCP2) – E14–27 (VCP2) A29–2 (EP2) – E14–29 (EPA2) A29–3 (VPA2) – E14–23 (VPA2) A29–4 (VCP1) – E14–26 (VCPA) A29–5 (EP1) – E14–28 (EPA) A29–6 (VPA1) – E14–22 (VPA)	Belown 1 Ω
A29–1 (VCP2) or E14–27 (VCP2) – Body ground A29–2 (EP2) or E14–29 (EPA2) – Body ground A29–3 (VPA2) or E14–23 (VPA2) – Body ground A29–4 (VCP1) or E14–26 (VCPA) – Body ground A29–5 (EP1) or E14–28 (EPA) – Body ground A29–6 (VPA1) or E14–22 (VPA) – Body ground	10 kΩ or higher

NG → **REPAIR OR REPLACE HARNESS OR CONNECTOR**

OK

REPLACE ACCELERATOR PEDAL ROD ASSY (See Pub. No. RM990E, page 10–33)

22 INSPECT INTAKE AIR TEMPERATURE SENSOR



(a) Check the IAT sensor.
(1) Remove the MAF meter.
(2) Measure the resistance of the sensor.
Standard:

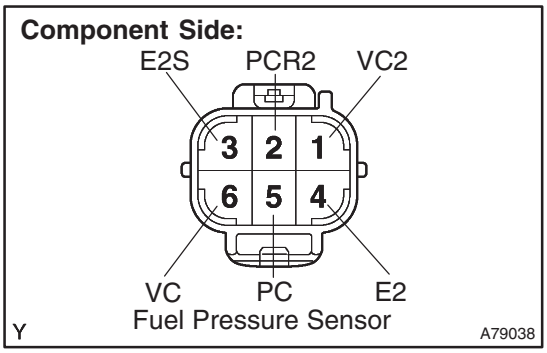
Tester Connection	Condition	Specified Condition
4 – 5	–20°C (–4°F)	13.6 to 18.4 kΩ
4 – 5	20°C (68°F)	2.21 to 2.69 kΩ
4 – 5	60°C (140°F)	0.49 to 0.67 kΩ

NG → **REPLACE MASS AIR FLOW METER**

OK

REPAIR OR REPLACE HARNESS OR CONNECTOR

23 INSPECT COMMON RAIL ASSY (FUEL PRESSURE SENSOR)



(a) Disconnect the I9 fuel pressure sensor connector.
(b) Measure the resistance between each pair of the terminals of the fuel pressure sensor.
Standard:

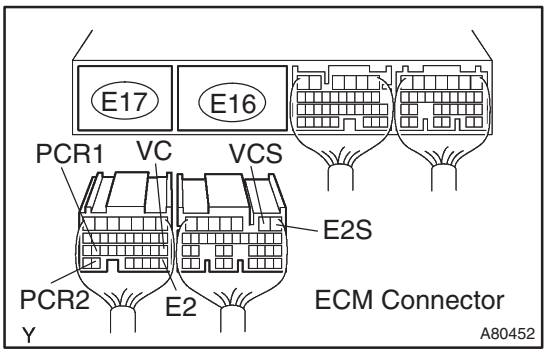
Tester Connection	Specified Condition
PC (I9–5) – E2 (I9–4)	16.4 kΩ or less
PCR2 (I9–2) – E2S (I9–3)	16.4 kΩ or less
PC (I9–5) – VC (I9–6)	3 kΩ or less
PCR2 (I9–2) – VC2 (I9–1)	3 kΩ or less

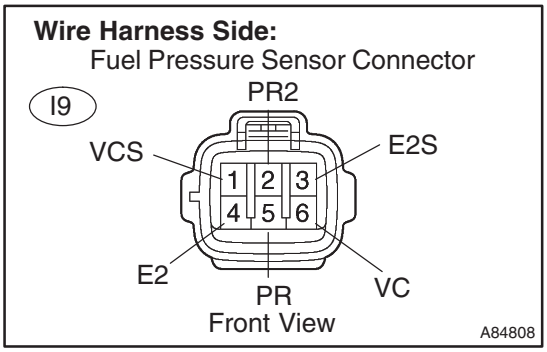
(c) Reconnect the fuel pressure sensor connector.

NG → **REPLACE COMMON RAIL ASSY (See page 11–67)**

OK

24	CHECK WIRE HARNESS (FUEL PRESSURE SENSOR – ECM)





(a) Disconnect the E14 and E17 ECM connectors.
(b) Disconnect the I9 fuel pressure sensor connector.
(c) Check the resistance.

Standard (Check for open):

Tester Connection	Specified Condition
PCR1 (E17–26) – PR (I9–5)	Below 1 Ω
PCR2 (E17–33) – PR2 (I9–2)	
VCS (E16–2) – VCS (I9–1)	
VC (E17–18) – VC (I9–6)	
E2 (E17–28) – E2 (I9–4)	
E2S (E16–1) – E2S (I9–3)	

Standard (Check for short):

Tester Connection	Specified Condition
PCR1 (E17–26) or PR (I9–5) – Body ground	10 kΩ or higher
PCR2 (E17–33) or PR2 (I9–2) – Body ground	
VCS (E16–2) or VCS (I9–1) – Body ground	
VC (E17–18) or VC (I9–6) – Body ground	
E2 (E17–28) or E2 (I9–4) – Body ground	
E2S (E16–1) or E2S (I9–3) – Body ground	

(d) Reconnect the ECM connectors.
(e) Reconnect the fuel pressure sensor connector.

NG → **REPAIR OR REPLACE HARNESS OR CONNECTOR**

OK

25	REPLACE ECM (See Pub. No. RM990E, page 10–34)

NOTICE:
After replacing the ECM, allow for ECM learning start the engine and idle it until it is fully warmed up.

NG → **REPLACE SUPPLY PUMP ASSY (See page 11–63)**

OK

END