

TOYOTA

1HD-FE ENGINE

**REPAIR MANUAL FOR
EMISSION CONTROL**

Jan., 1995

FOREWORD

This repair manual has been prepared to provide information covering general service repairs for the Emission Control System of the 1HD-FT engine.

Applicable models: HDJ80 series

For service of the 1HD-FT engine, refer to the following repair manual.

Manual Name	Pub. No.
• 1HD-FT Engine Repair Manual	RM437E

All information in this manual is based on the latest product information at the time of publication. However, specifications and procedures are subject to change without notice.

TOYOTA MOTOR CORPORATION

TOYOTA 1HD-FE ENGINE EMISSION CONTROL REPAIR MANUAL

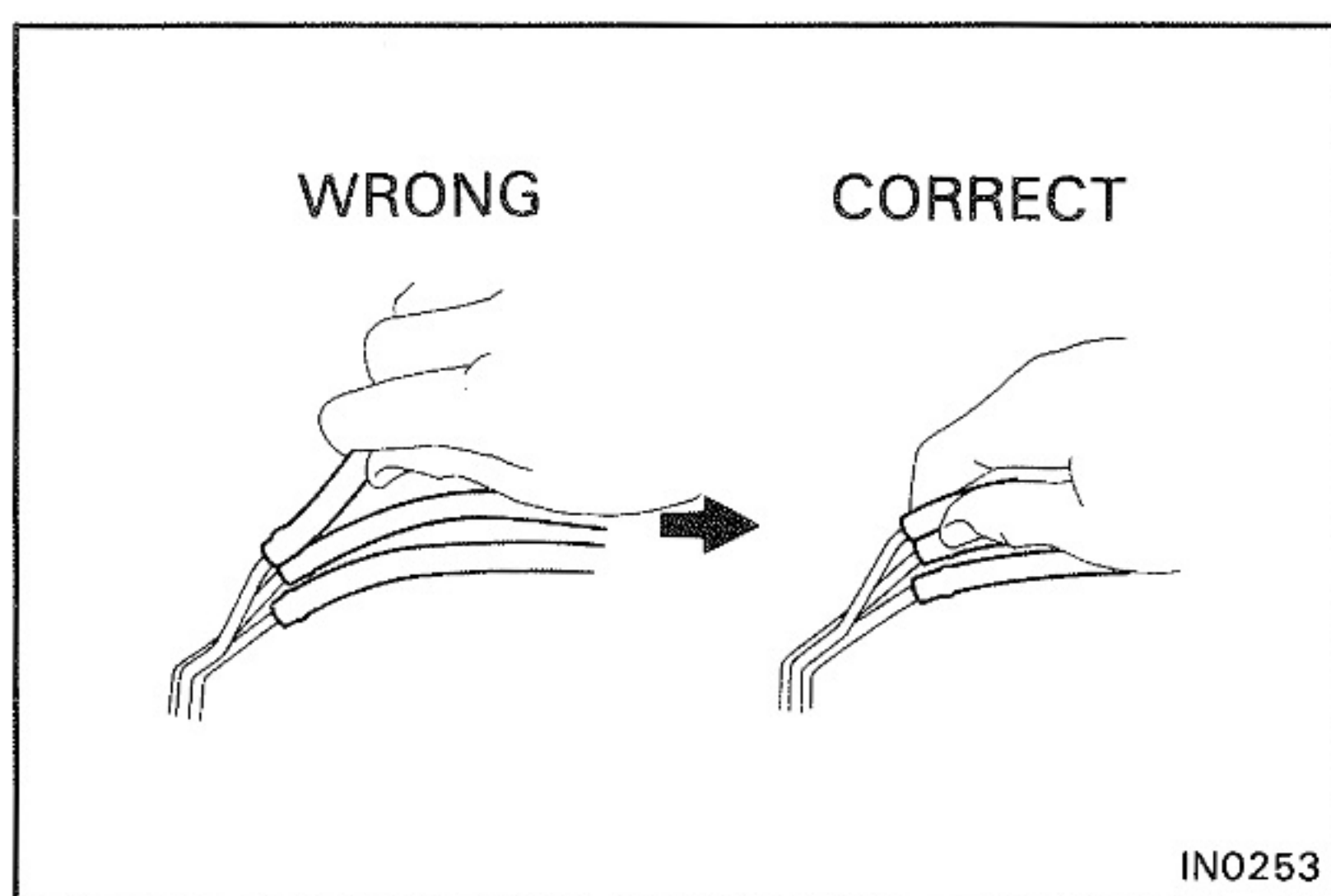
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INTRODUCTION

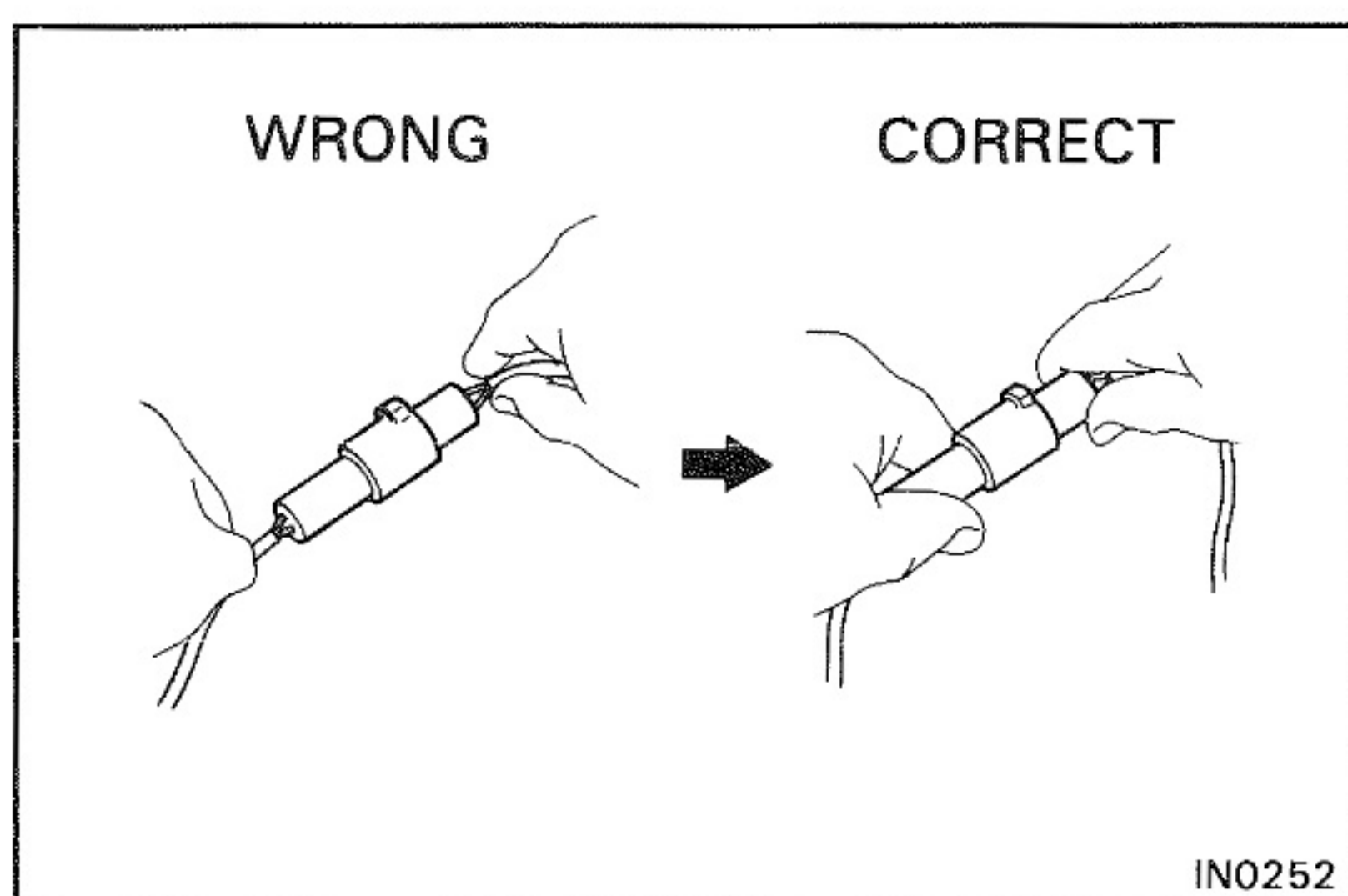
GENERAL PRECAUTIONS 1-2
ABBREVIATIONS USED IN THIS
MANUAL 1-3

GENERAL PRECAUTIONS

1. **KNOW THE IMPORTANCE OF PERIODIC MAINTENANCE.**
 - (a) Every service item in the periodic maintenance list must be performed.
 - (b) Failing to do even one item can cause the engine to run poorly and increase exhaust emissions.
2. **LISTEN TO THE CUSTOMERS COMMENTS CAREFULLY.**
Always determine exactly what the customer's complaint is, if any, and verify it before proceeding with repairs.
3. **DETERMINE IF YOU HAVE AN ENGINE OR EMISSION CONTROL SYSTEM PROBLEM.**
Engine problems are usually not caused by the emission control systems.
4. **CHECK HOSE AND WIRING CONNECTORS FIRST.**
The most frequent cause of problems is simply a bad wiring or vacuum hoses connection. Always make sure that all connections are secure and correct.
5. **OBSERVE THE FOLLOWING PRECAUTIONS TO AVOID DAMAGING THE PARTS:**
 - (a) Be careful not to drop electrical components, such as sensors or relays. If they are dropped on a hard floor, they should be replaced and not reused.

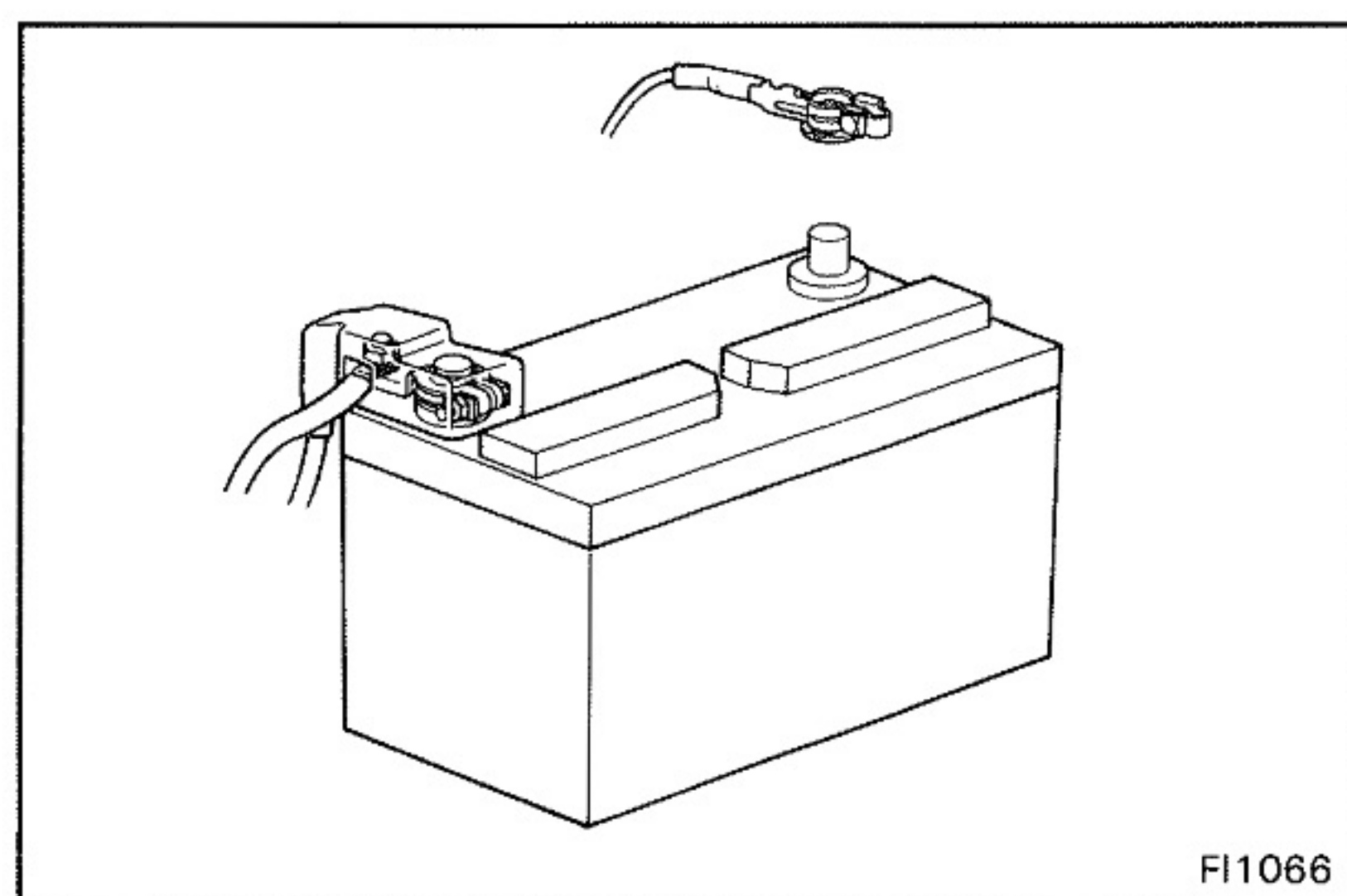
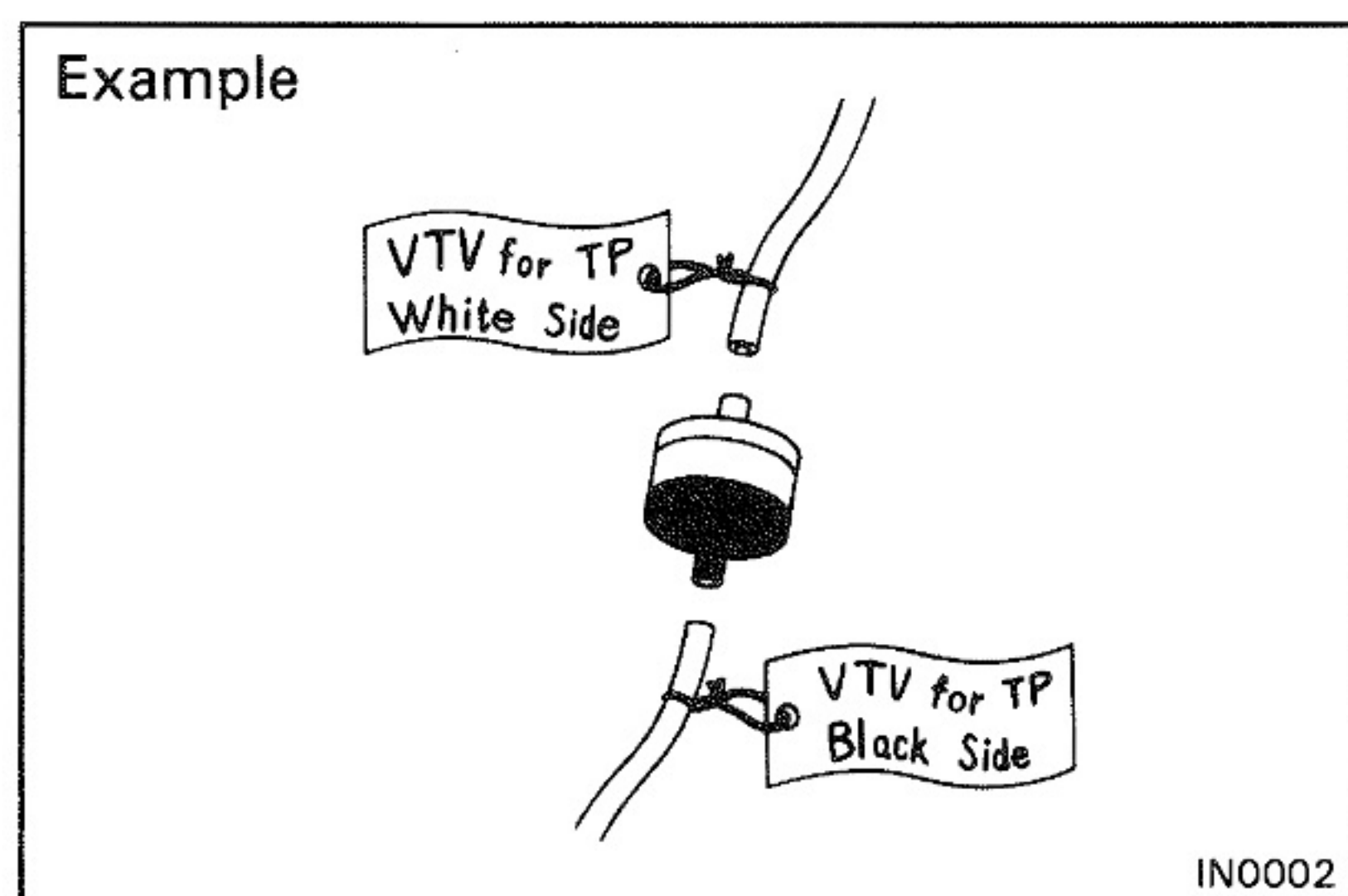


- (b) When disconnecting vacuum hoses, pull on the end of the hose, not the middle.



- (c) When separating electrical connectors, pull on the connector itself, not the wires.

- (d) When steam cleaning an engine, protect the air filter, VSV and EVRV from water.
- (e) Never use an impact wrench to remove or install temp. sensors.
- (f) When checking continuity at the wire connector, insert the tester probe carefully to prevent terminals from bending.
- (g) When using a vacuum gauge, never force the hose onto a connector that is too large. Use a step-down adapter instead. Once the hose has been stretched, it may leak.



6. TAG HOSES BEFORE DISCONNECTING THEM:

- (a) When disconnecting vacuum hoses, use tags to identify how they should be reconnected.
- (b) After completing a job, double check that the vacuum hoses are properly connected. A label under the hood shows the proper layout.

7. USE GENUINE PARTS.

8. PERFORM WORK SAFELY.

- (a) If the vehicle is to be jacked up only at the front or rear end, be sure to block the wheels.
- (b) After the vehicle is jacked up always support it on stands. It is extremely dangerous to do any work on the vehicle raised on a jack alone, even for a small job that can be finished quickly.
- (c) Disconnect the cable from the negative (—) terminal of the battery to make work safer when replacing electrical parts or working on parts near an electrical source.

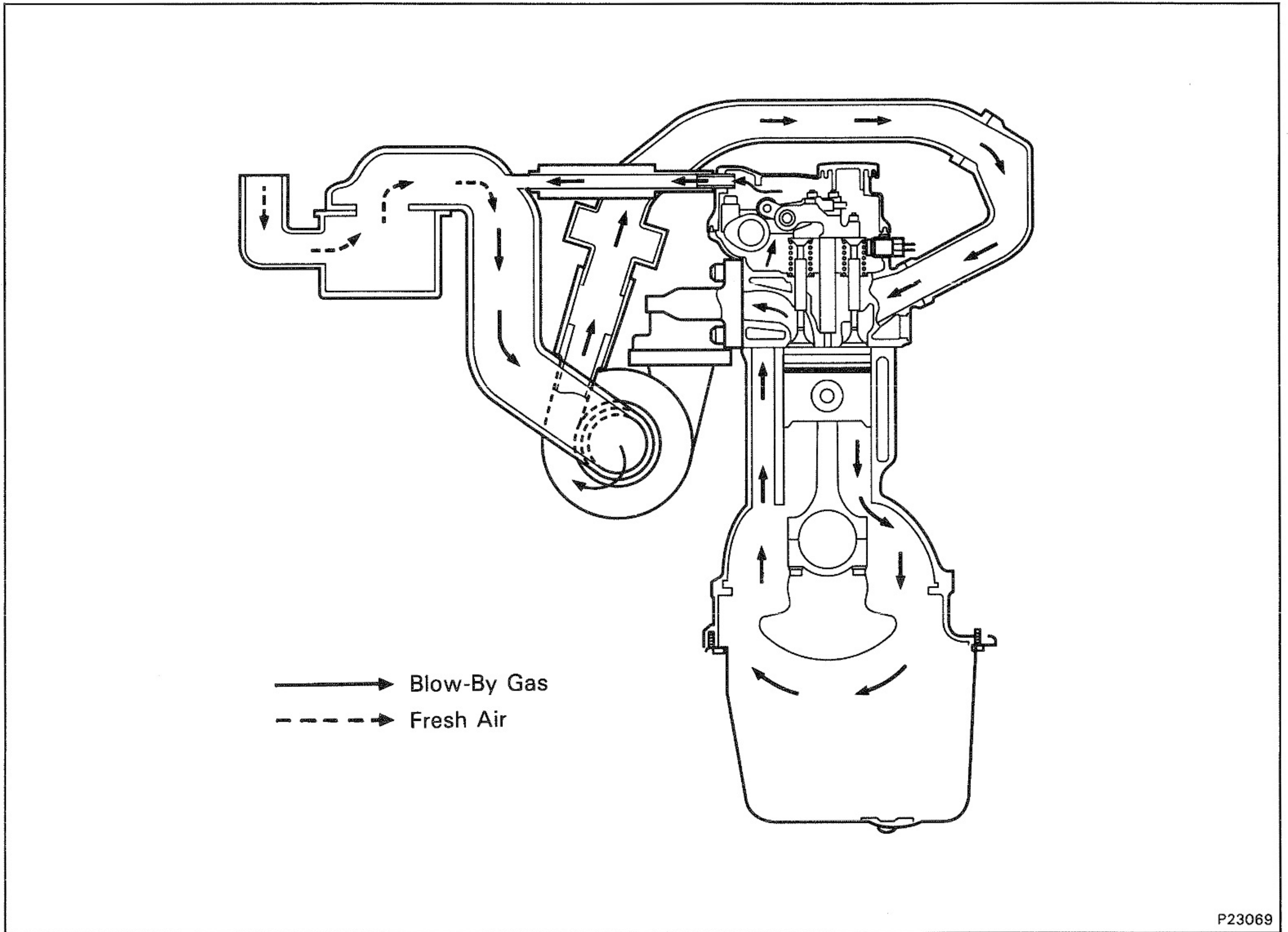
ABBREVIATIONS USED IN THIS MANUAL

A/C	Air Conditioner
ACSD	Automatic Cold Start Device
Approx.	Approximately
BACS	Boost Altitude Compensational Stopper
DC	Direct Current
ECU	Electronic Control Unit
EGR	Exhaust Gas Recirculation
EVTV	Electronic Vacuum Regulating Valve
FL	Fusible Link
LHD	Left-Hand Drive
PCV	Positive Crankcase Ventilation
PS	Power Steering
RHD	Right-Hand Drive
SICS	Starting Injection Control System
SST	Special Service Tool
STD	Standard
TDC	Top Dead Center
VSV	Vacuum Switching Valve
w/	With
w/o	Without

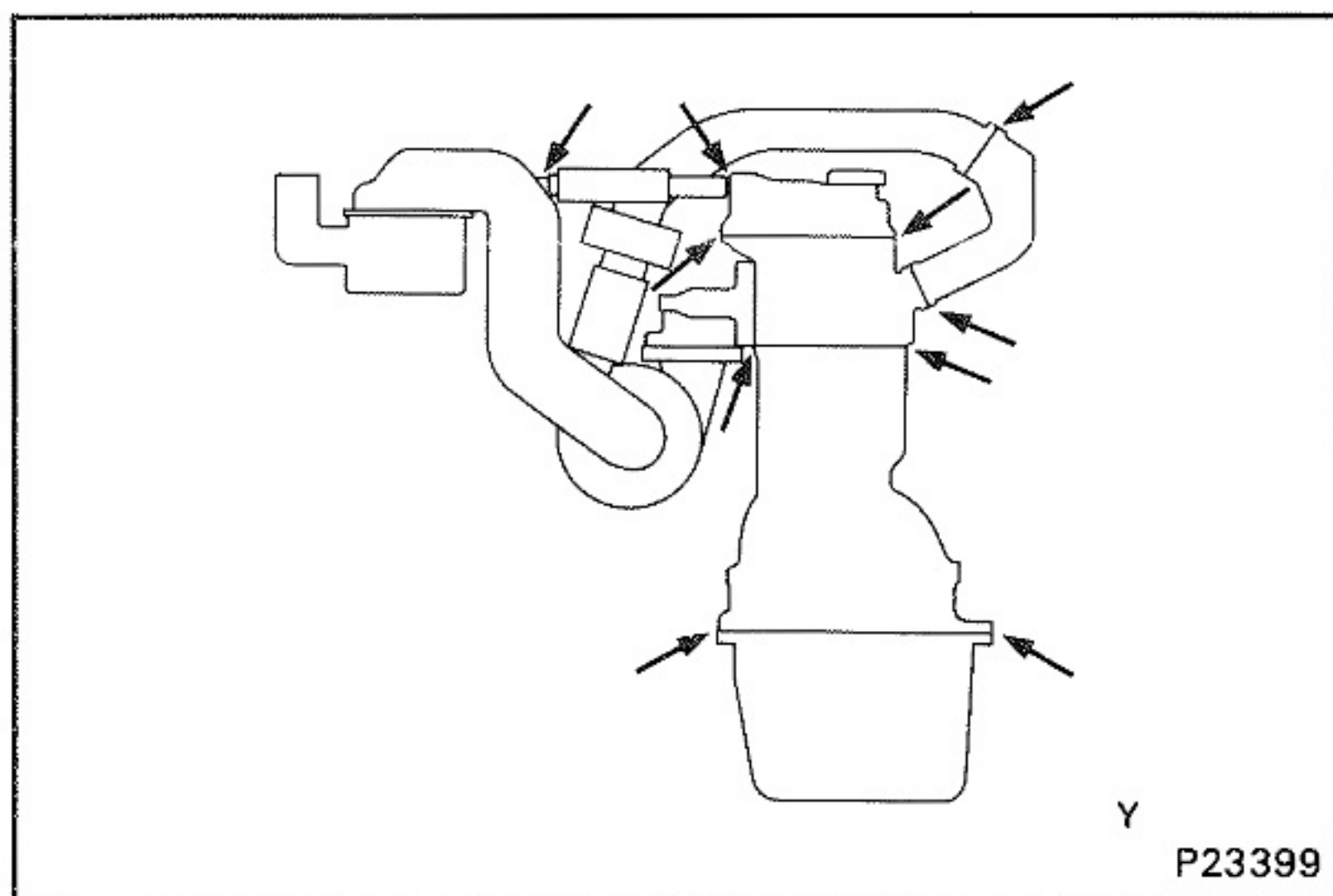
EMISSION CONTROL SYSTEMS

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POSITIVE CRANKCASE VENTILATION (PCV) SYSTEM



To reduce HC emission, crankcase blow-by gas (HC) is routed to the intake manifold for combustion in the cylinders.

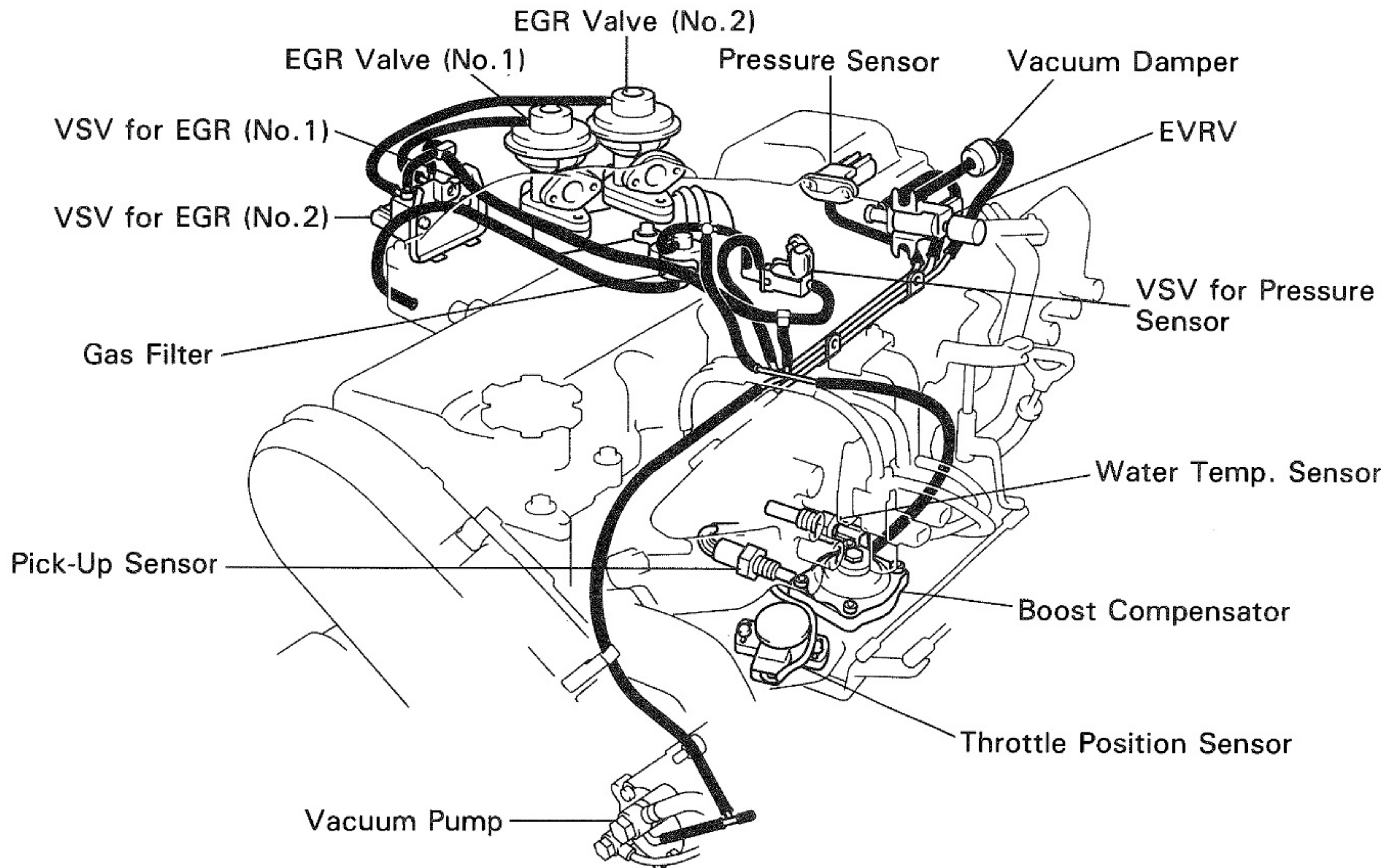


INSPECTION OF PCV HOSE AND CONNECTIONS

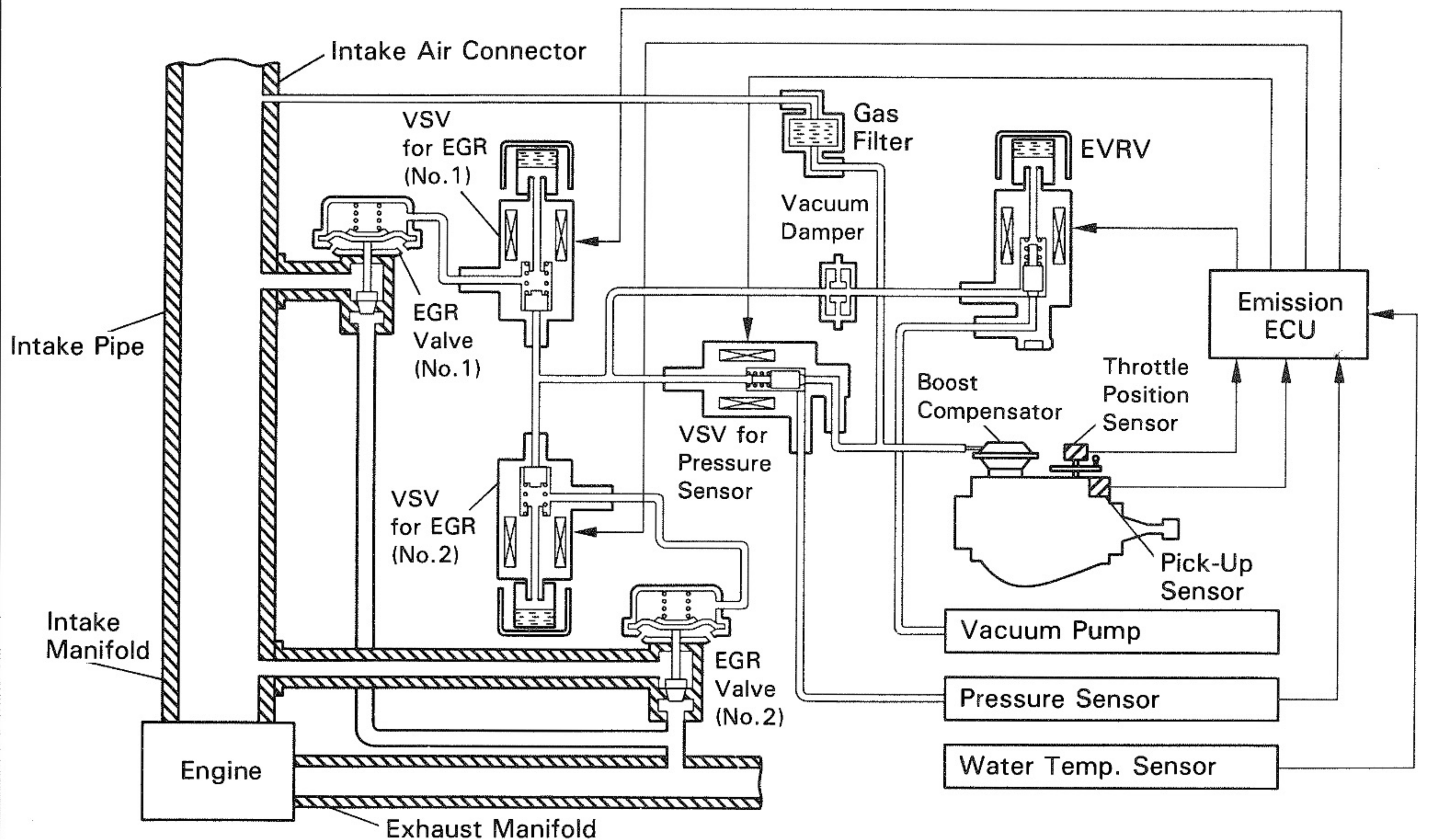
VISUALLY INSPECT HOSE AND CONNECTIONS

Check for cracks, leaks or damage.

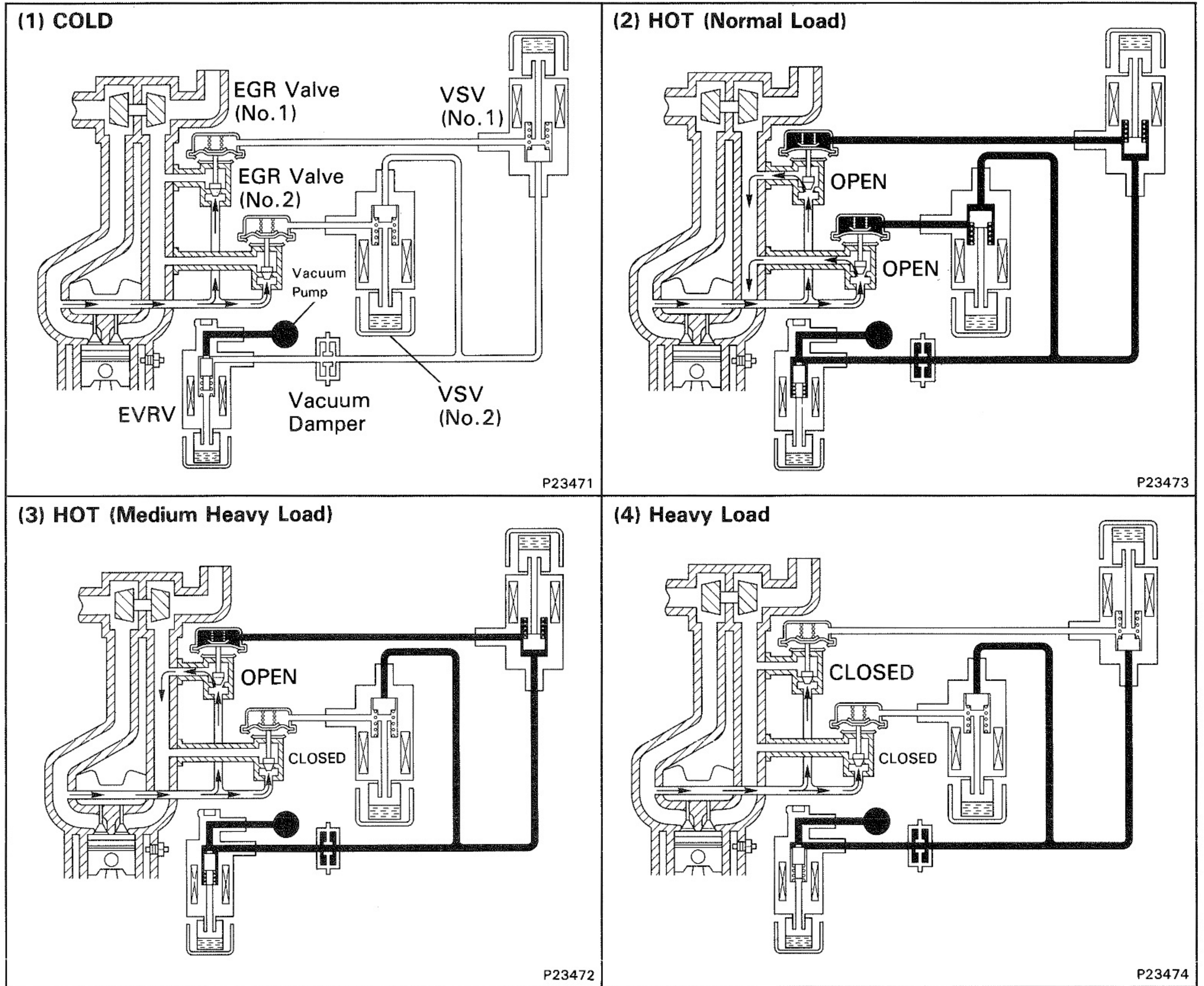
EXHAUST GAS RECIRCULATION (EGR) SYSTEM



P23046



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To reduce NO_x emission, part of the exhaust gas is recirculated through the EGR valve to the intake manifold in order to lower the maximum combustion temperature.

Coolant Temperature	Engine Speed	Driving Condition	EVRV	VSV (No.1)	VSV (No.2)	Exhaust Gas
Below 30°C (86°F)	—	(1) —	—	—	—	Not recirculated
Above 50°C (122°F)	Idling	—	OPEN	OPEN	OPEN	Recirculated
	Above 1,000 rpm	(2) Normal Load	OPEN	OPEN	OPEN	Recirculated
		(3) Medium Heavy Load	OPEN	OPEN	CLOSED	Recirculated
		(4) Heavy Load	OPEN	CLOSED	CLOSED	Not recirculated

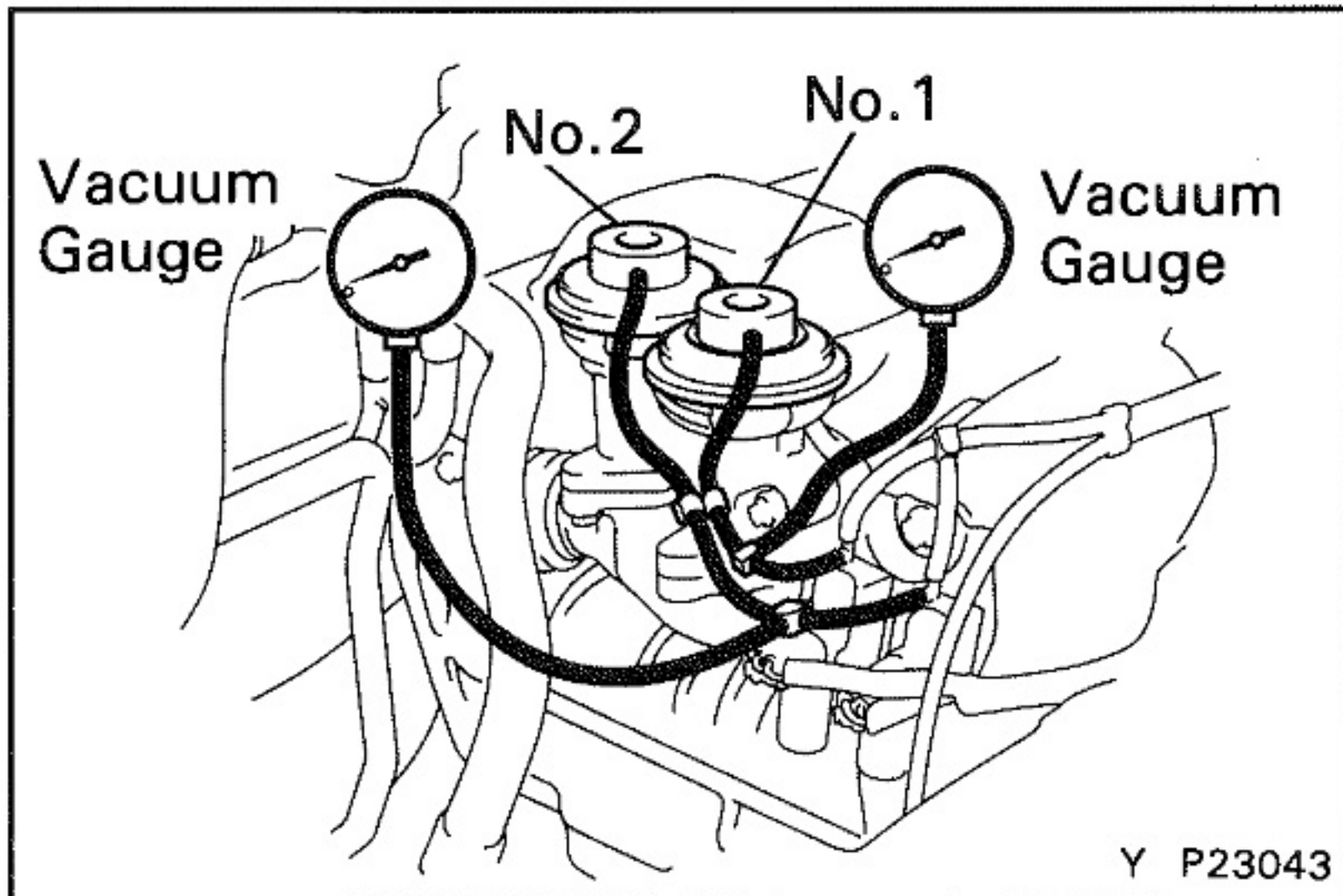
Remarks:

- * 1 The EVRV maintains vacuum from the vacuum pump at a constant value in spite of atmospheric pressure change.
- * 2 The emission ECU senses the accelerator opening angle to detect a driving condition.
- * 3 The EVRV and VSV are controlled by the emission ECU. When the VSV is closed, air is led into the EGR valve diaphragm through its air filter and EGR valve closes the port, so the exhaust gas is not recirculated. When the VSV is open, the emission ECU controls the EVRV to maintain vacuum to the EGR valve diaphragm at optimum value by mixing air and constant vacuum from the vacuum pump.

INSPECTION OF EGR SYSTEM

HINT: In a malfunction where the EGR system is always on, black smoke or white smoke may be output from the exhaust pipe. If this occurs, inspect the EGR system also.

NOTICE: Always stop the engine when installing or removing the vacuum gauges, or removing the vacuum hoses.

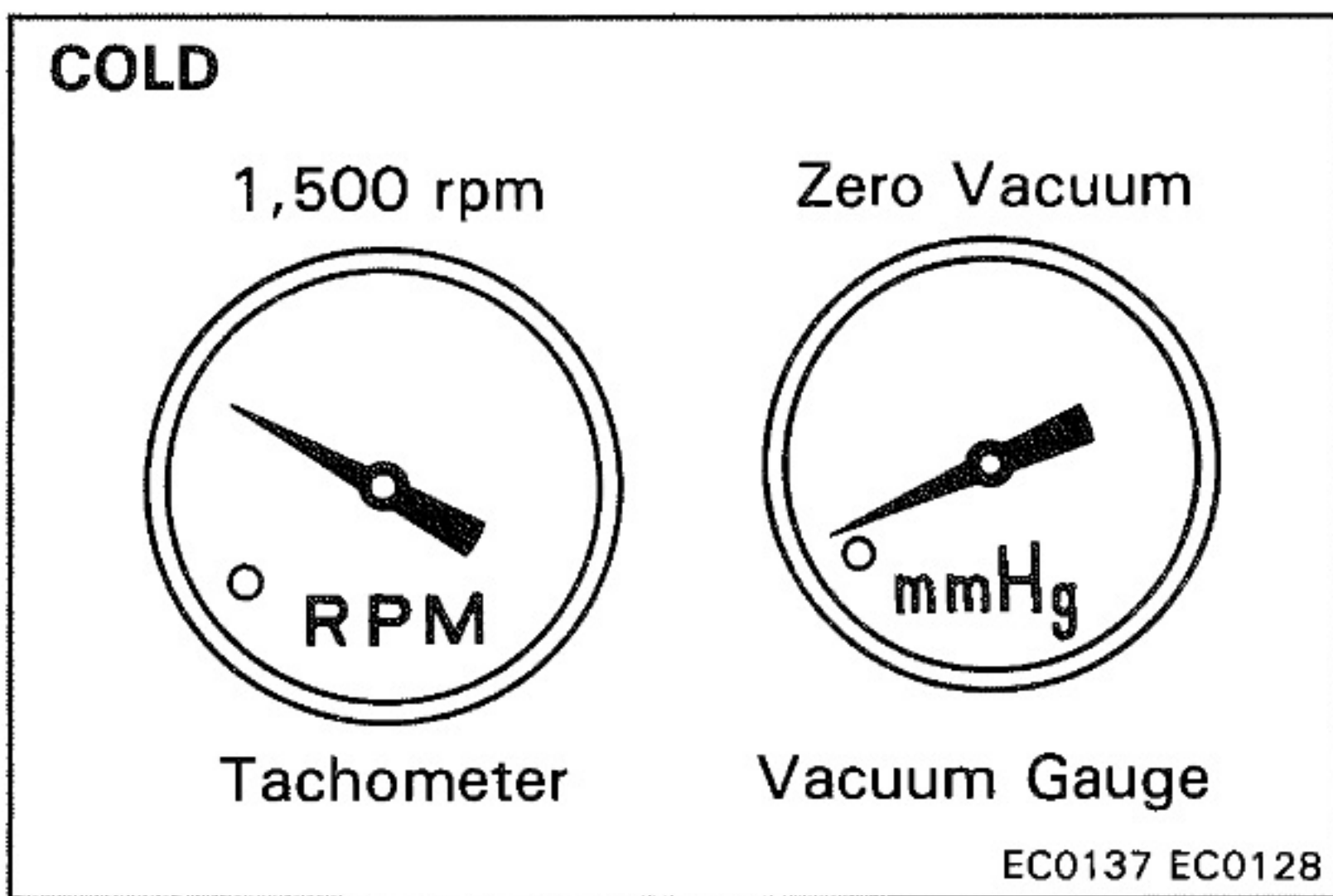


1. INSTALL VACUUM GAUGES

Using 3-way connectors, connect 2 vacuum gauges to the hose between the EGR valve and VSV (No.1 & No.2).

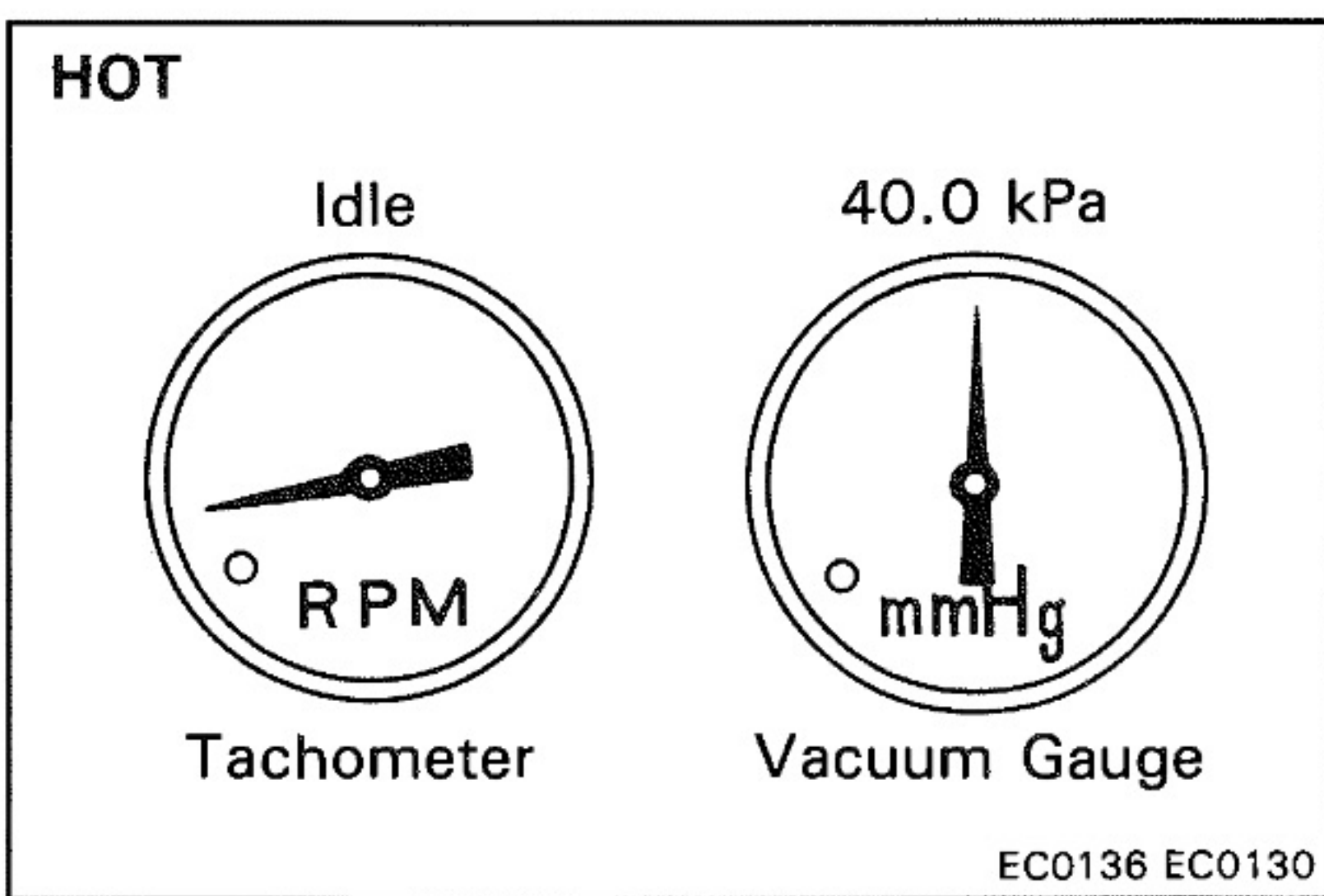
2. INSPECT SEATING OF EGR VALVE

Start the engine and check that the engine starts and runs at idle.



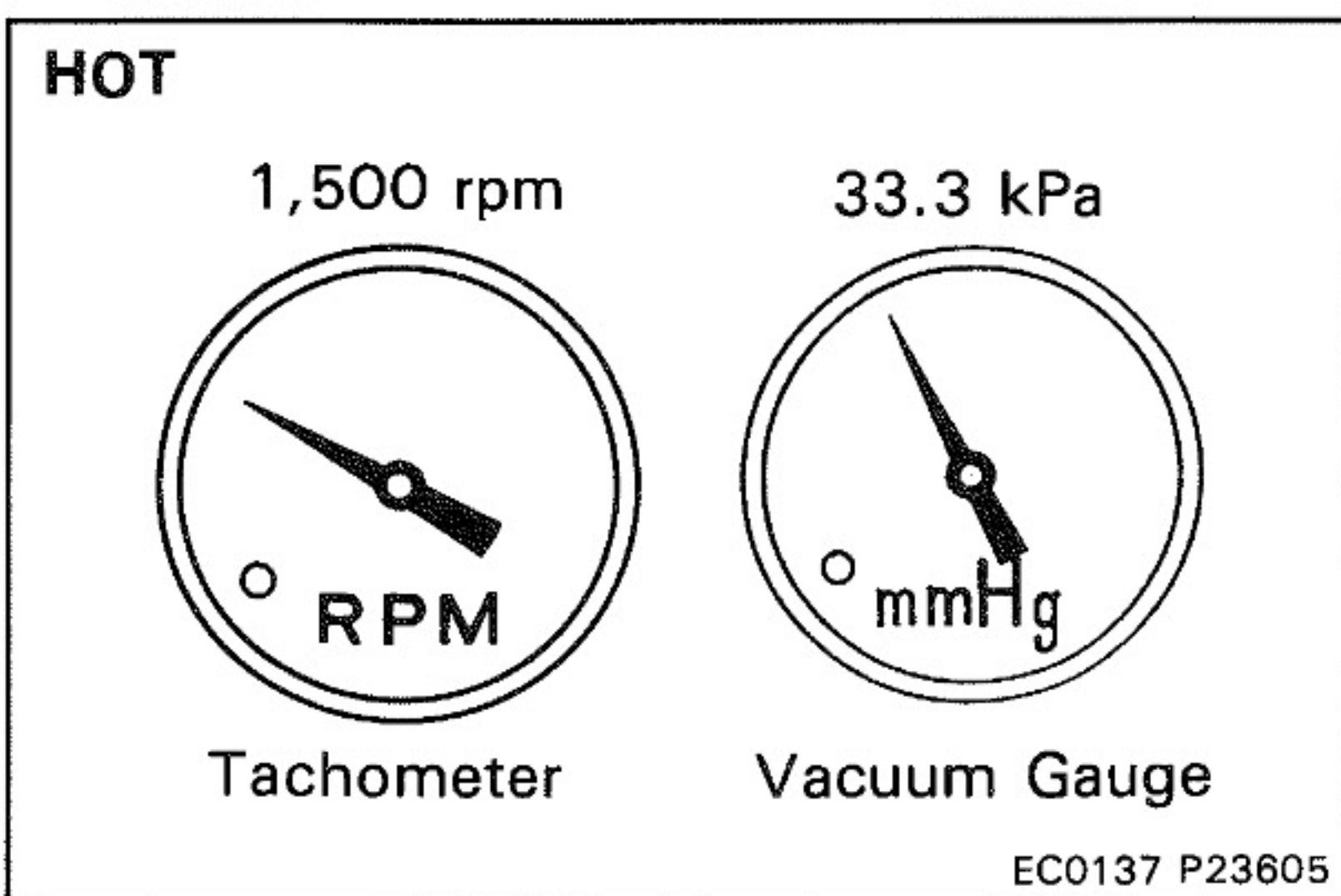
3. INSPECT COLD ENGINE CONDITION

- (a) The coolant temperature should be below 30°C (86°F).
- (b) Check that the vacuum gauge indicates zero at 1,500 rpm.

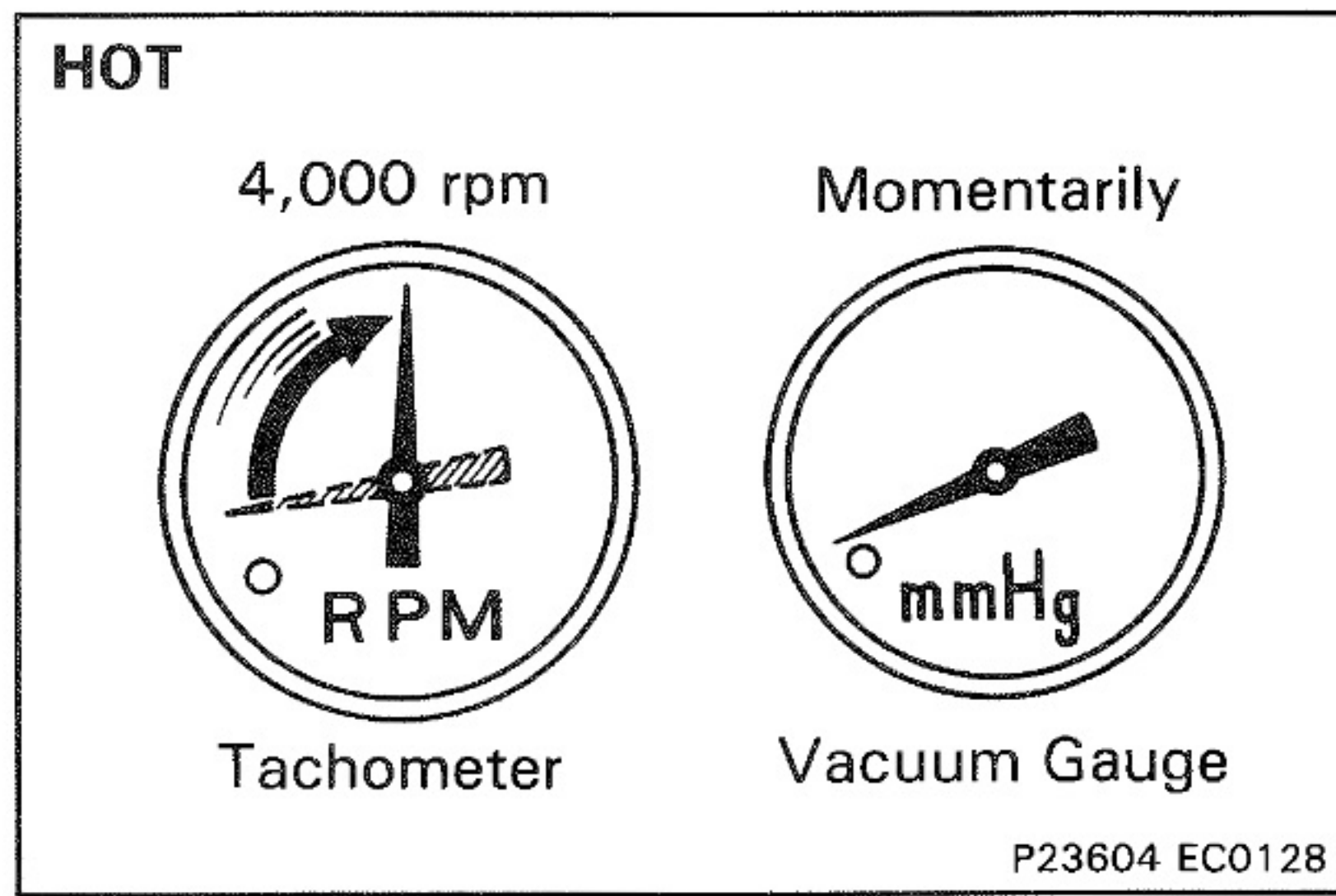


4. INSPECT HOT ENGINE CONDITION

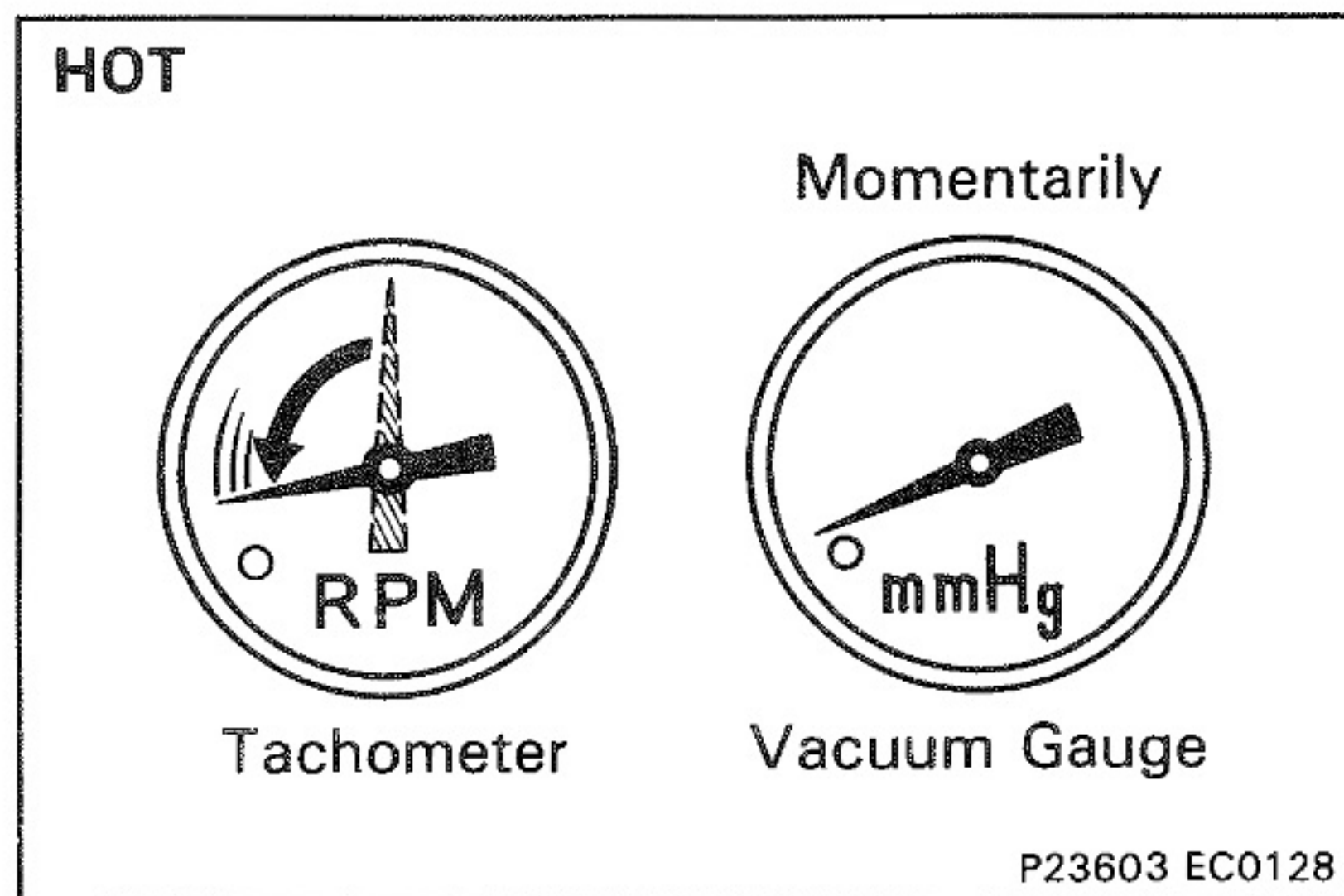
- (a) Warm up the engine. The coolant temperature should be above 50°C (122°F).
- (b) Check that the vacuum gauge indicates about 40.0 kPa (300 mmHg, 11.81 in.Hg) at idle.



- (c) Check that the vacuum gauge indicates about 33.3 kPa (250 mmHg, 9.84 in.Hg) at 1,500 rpm.



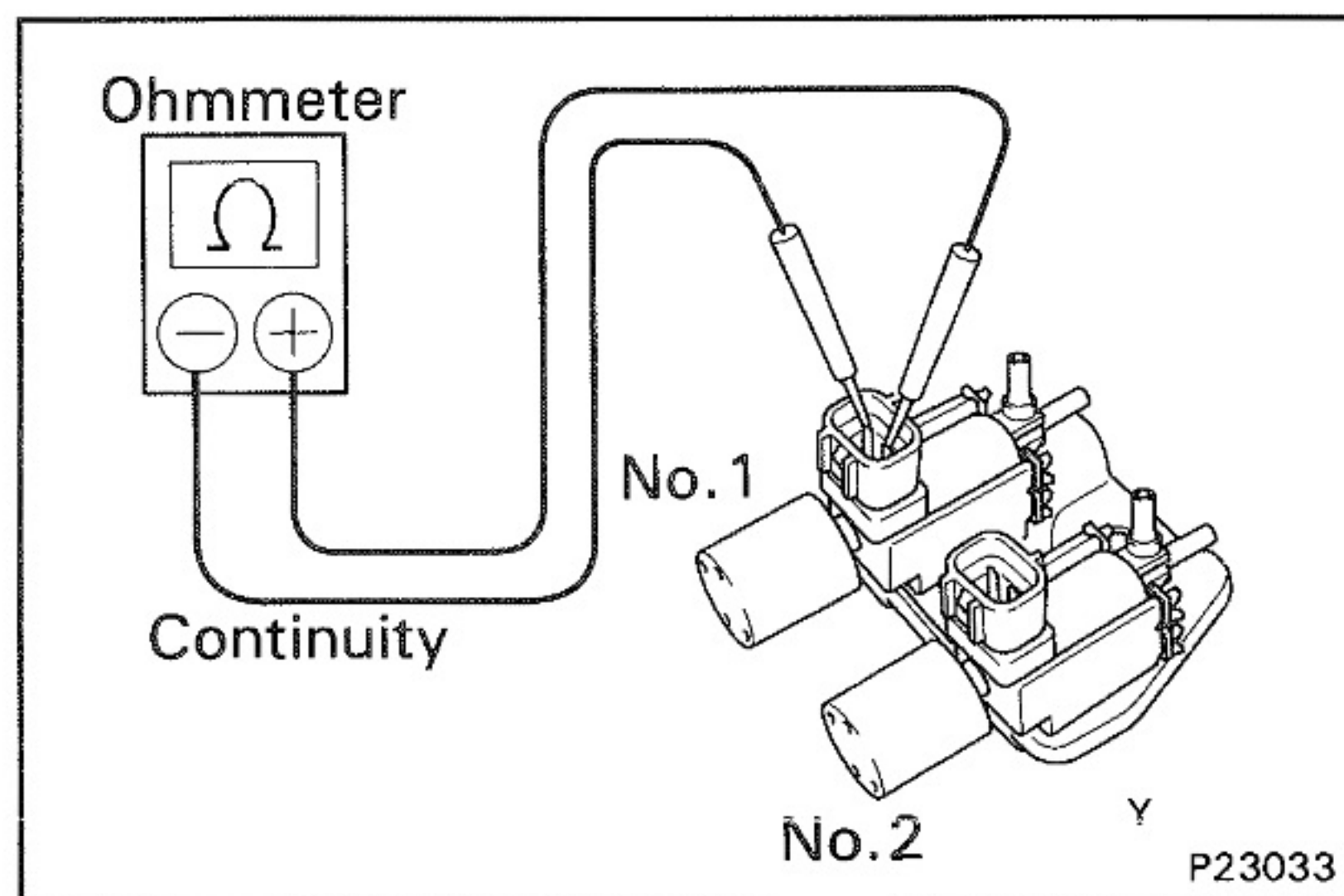
- (d) When the adjusting lever of the injection pump is quickly pushed to the full open, check that the vacuum gauge indicator drops momentarily while the engine speed increases from idle to 4,000 rpm.



- (e) When the adjusting lever of the injection pump is released, check that the vacuum gauge indicator drops momentarily while the engine speed decreases from 4,000 rpm to idle.

IF NO PROBLEM IS FOUND WITH THIS INSPECTION, SYSTEM IS NORMAL; OTHERWISE INSPECT EACH PART

5. REMOVE VACUUM GAUGES



INSPECTION OF VSV

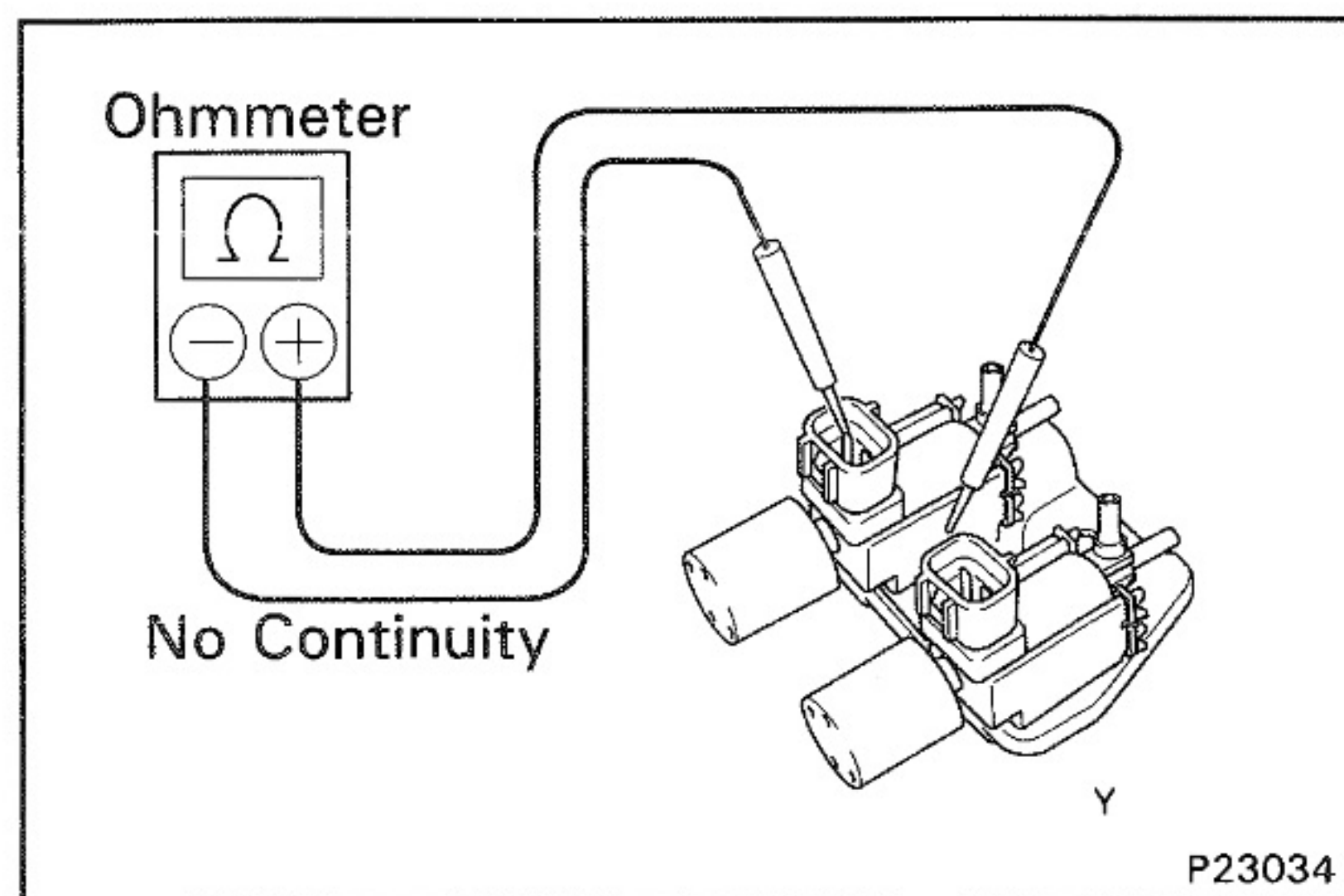
HINT: Perform the same inspection for the VSV (No.2) as for the VSV (No.1).

1. INSPECT VSV FOR OPEN CIRCUIT

Using an ohmmeter, check that there is continuity between the terminals.

Resistance: 37 – 44 Ω at 20°C (68°F)

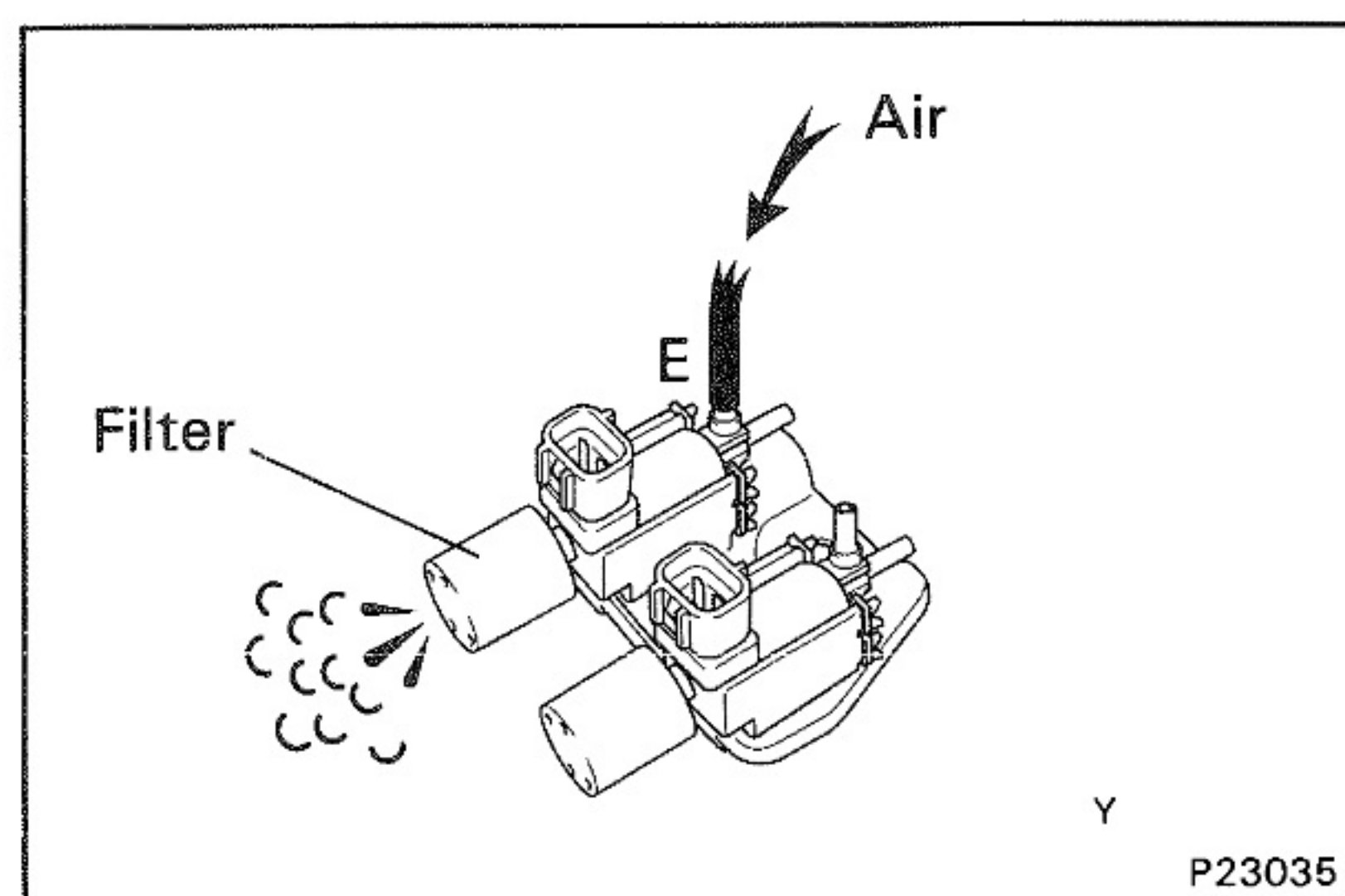
If there is no continuity, replace the VSV.



2. INSPECT VSV FOR GROUND

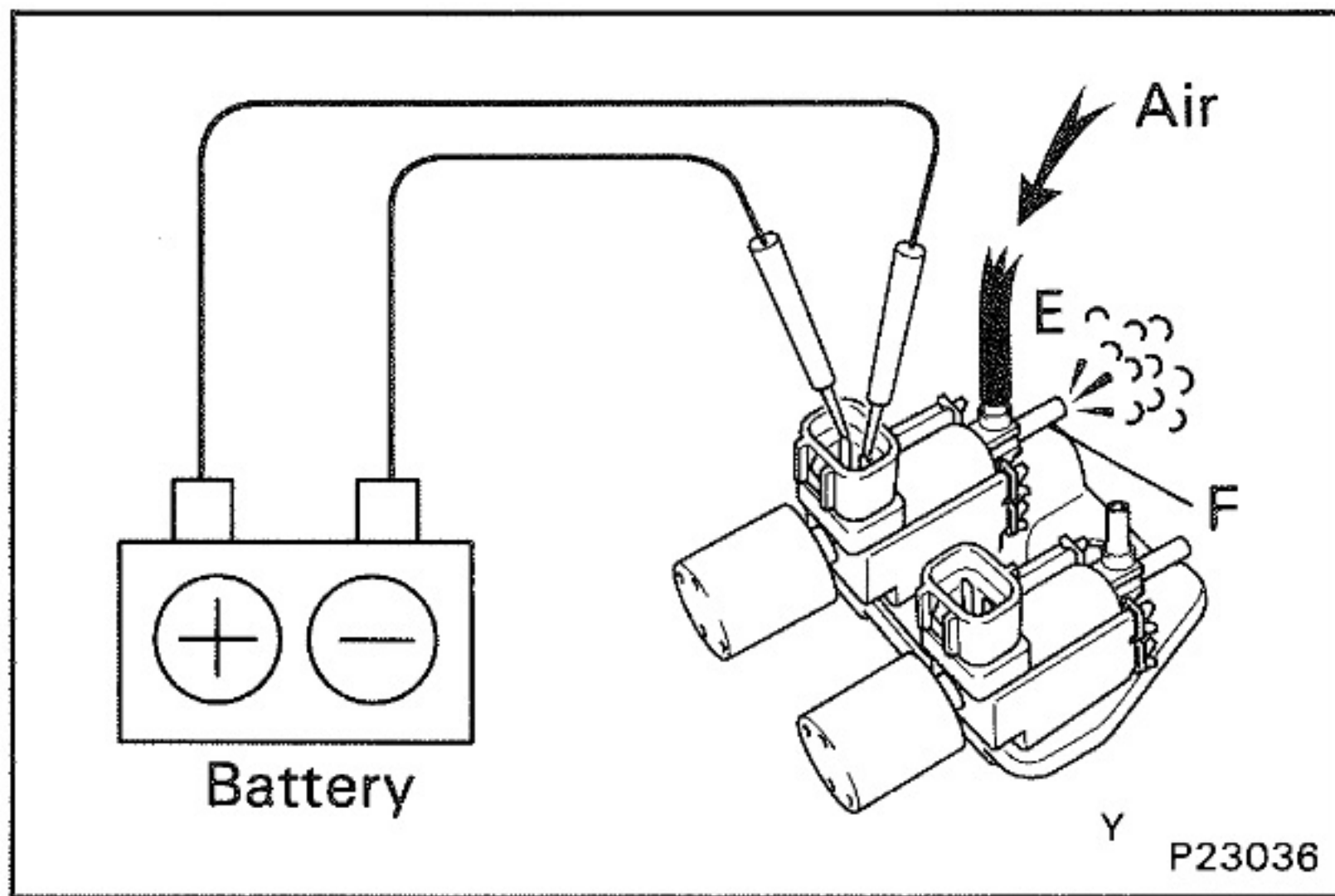
Using an ohmmeter, check that there is no continuity between each terminal and the body.

If there is continuity, replace the VSV.

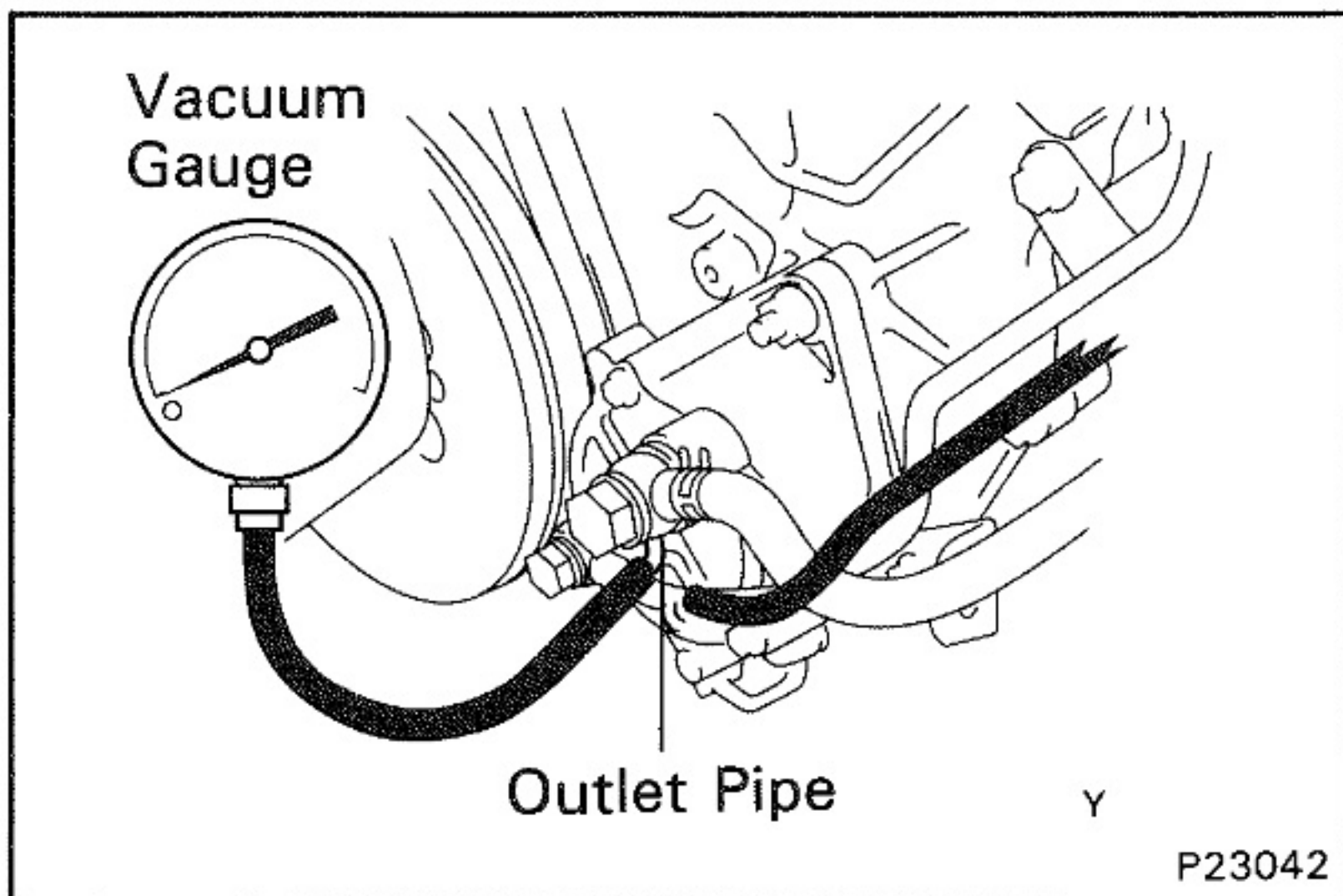


3. INSPECT VSV OPERATION

- (a) Check that air flows from port E to the filter.



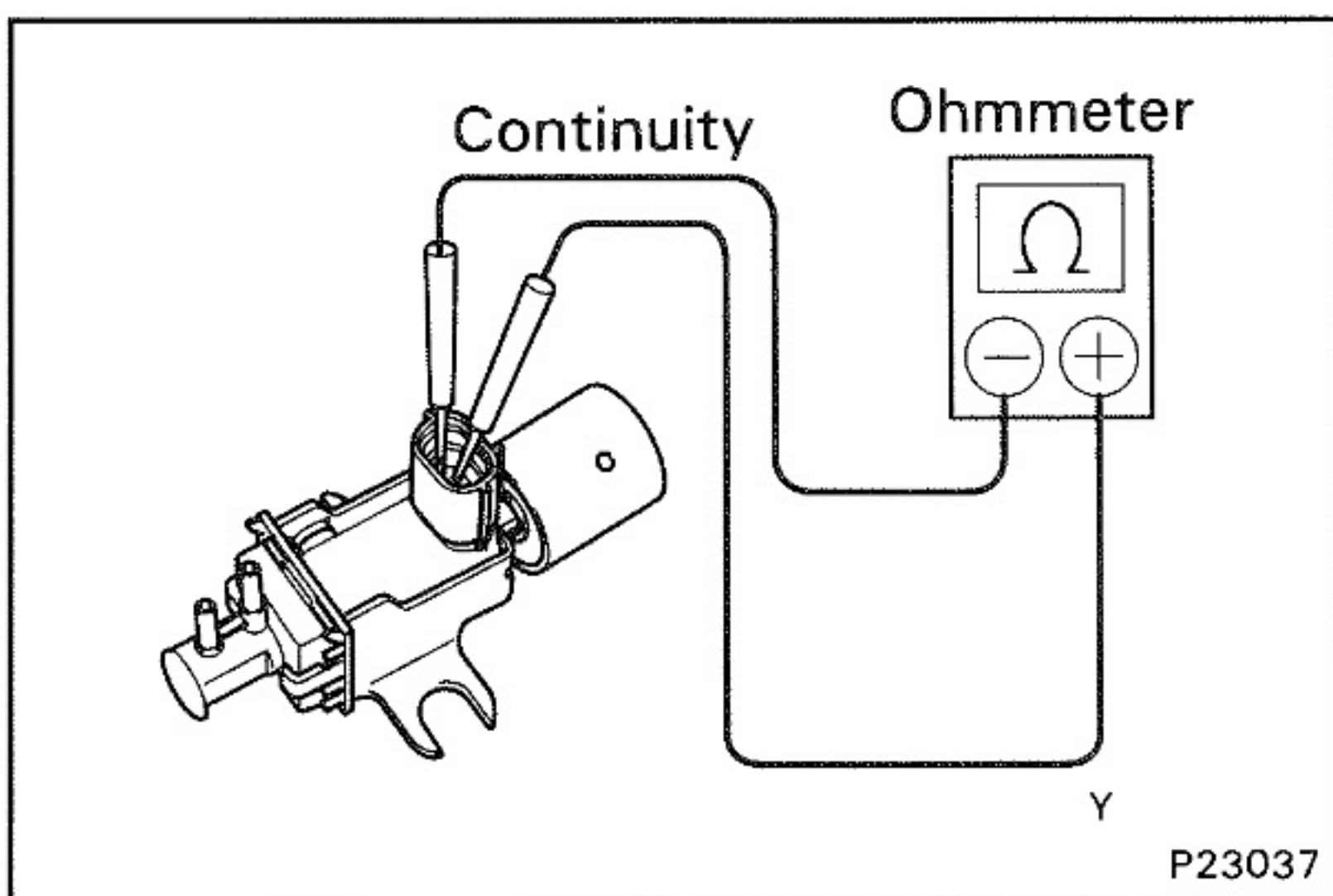
- (b) Apply battery voltage across the terminals.
- (c) Check that air flows from ports E to F.
If operation is not as specified, replace the VSV.



INSPECTION OF VACUUM PUMP

INSPECT OUTPUT VACUUM WITH VACUUM GAUGE

- (a) Connect a vacuum gauge to the outlet pipe.
- (b) Warm up the engine and check that the vacuum gauge indicates above 46.7 kPa (350 mmHg, 13.78 in.Hg).
If a problem is found, repair the vacuum pump.



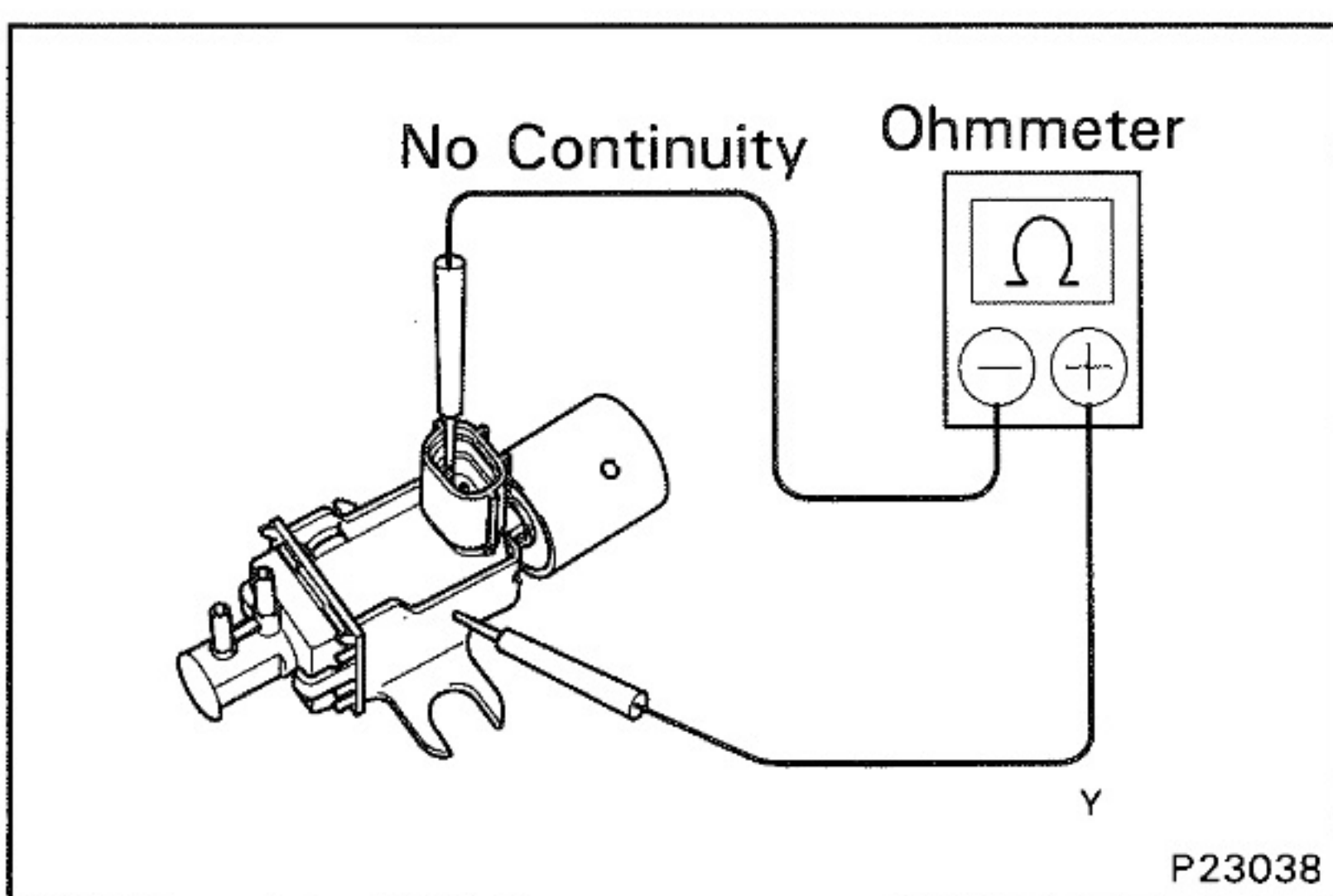
INSPECTION OF EVRV

1. INSPECT EVRV FOR OPEN CIRCUIT

Using an ohmmeter, measure the resistance between the terminals as shown.

Resistance: 11 — 13 Ω at 20°C (68°F)

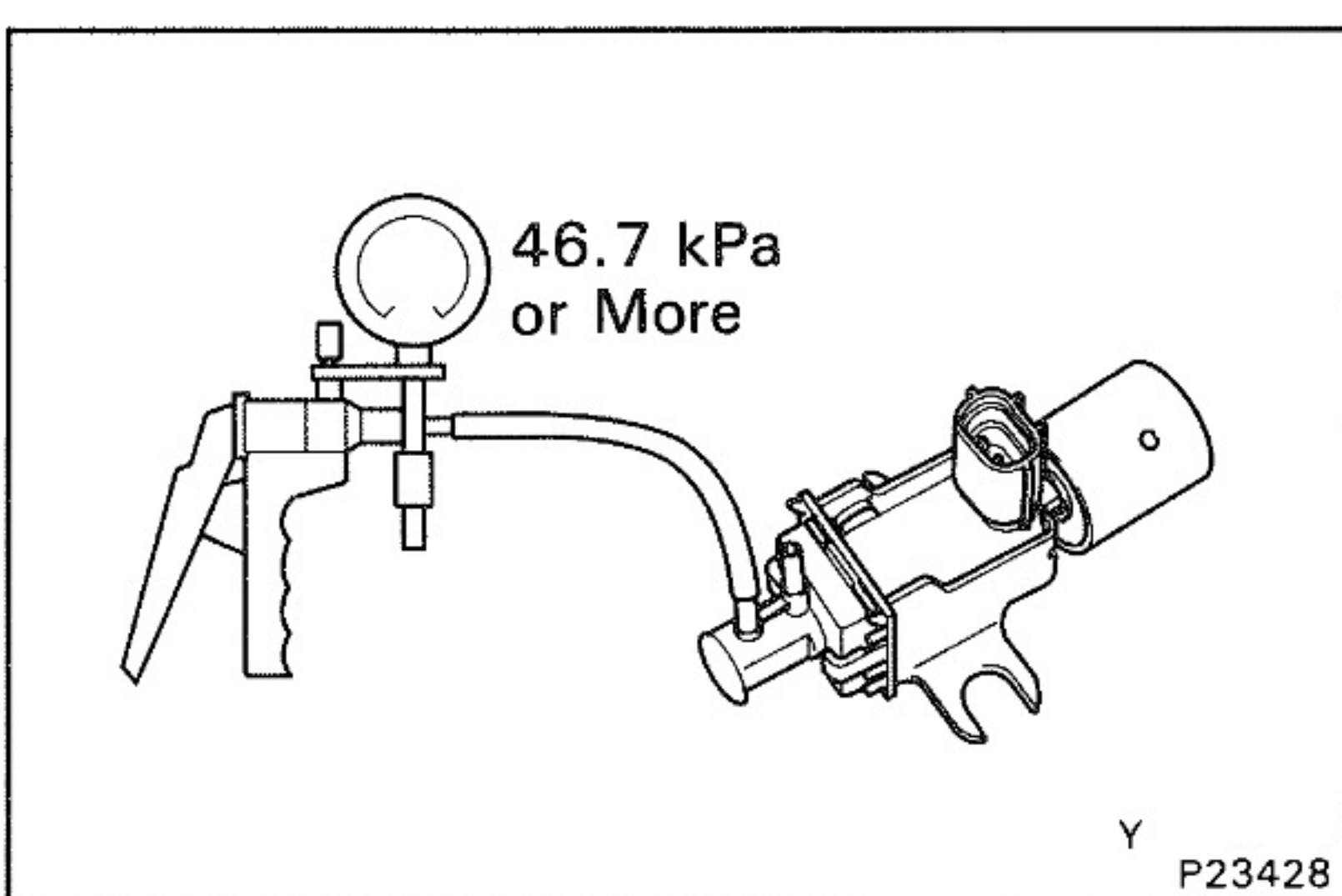
If the resistance is not within specification, replace the EVRV.



2. INSPECT EVRV FOR GROUND

Using an ohmmeter, check that there is no continuity between the terminals and the EVRV body.

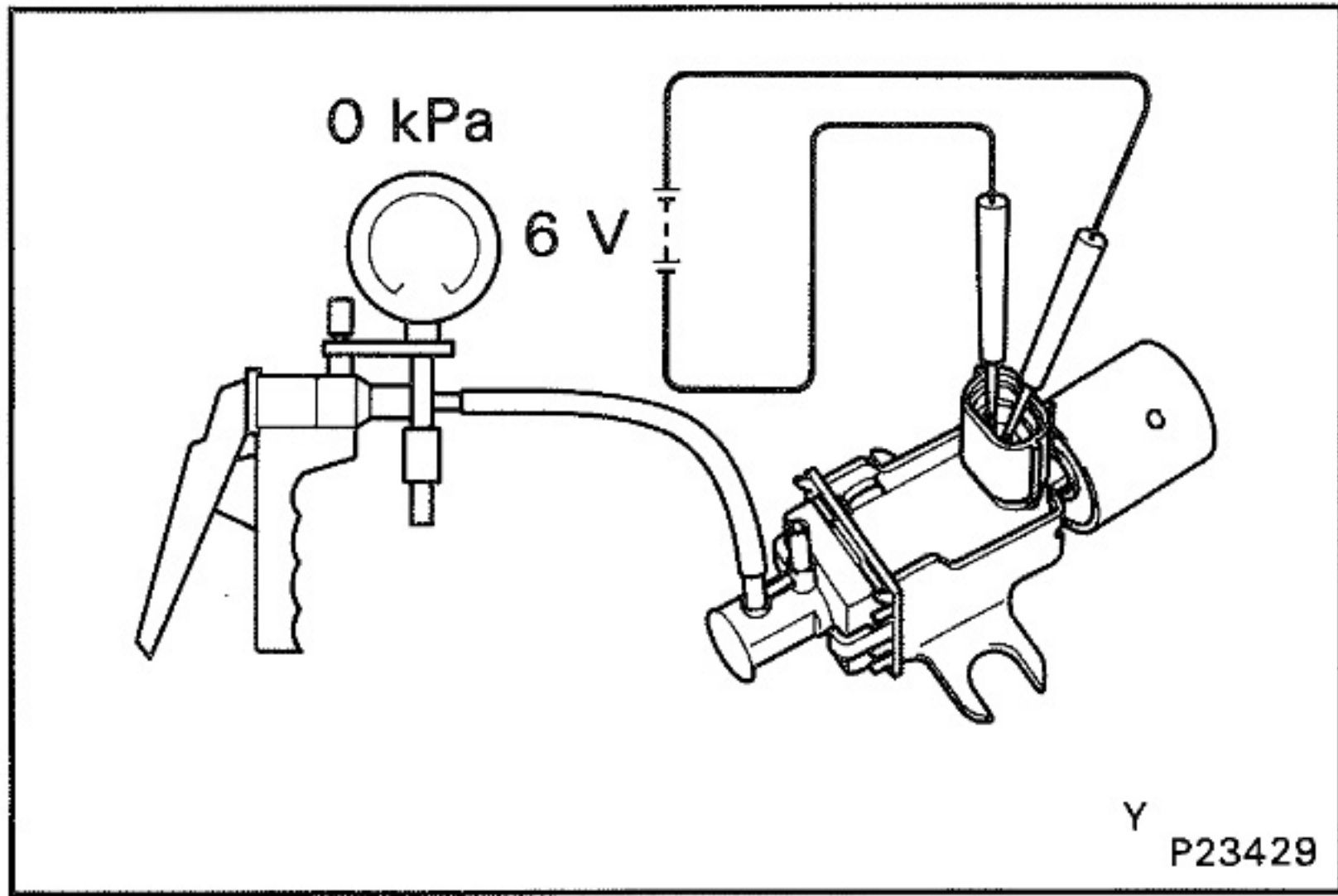
If there is continuity, replace the EVRV.



3. INSPECT EVRV FOR AIR TIGHTNESS

Check that when vacuum is applied to the vacuum outlet port shown, the needle of vacuum pump indicates an increase of 46.7 kPa (350 mmHg, 13.78 in.Hg) or more.

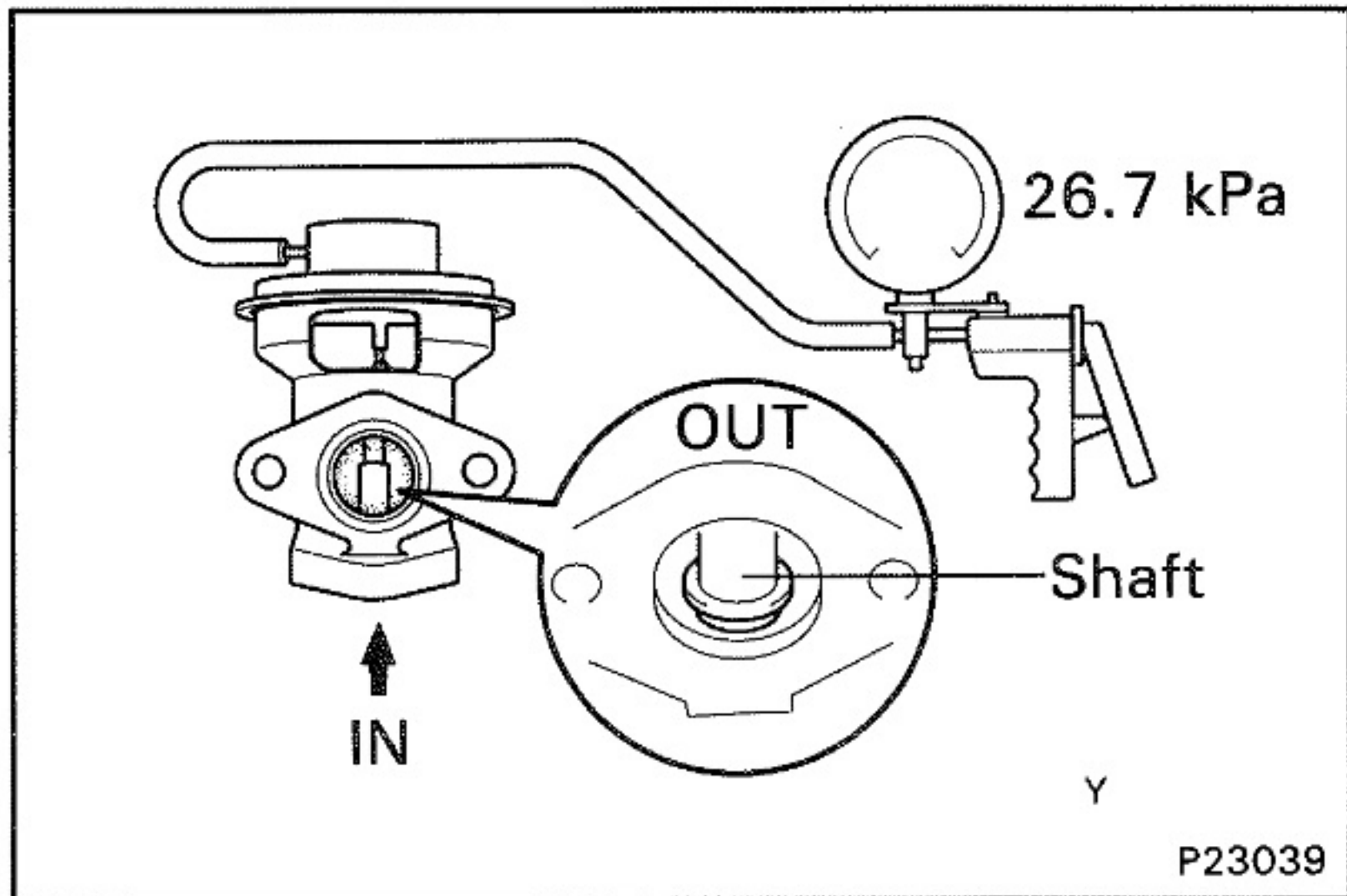
If a problem is found, replace the EVRV.



4. INSPECT EVRV OPERATION

- (a) Apply about 6 V of DC power to the terminals.
- (b) Check that when vacuum is applied to the vacuum outlet port shown, the need does not move.

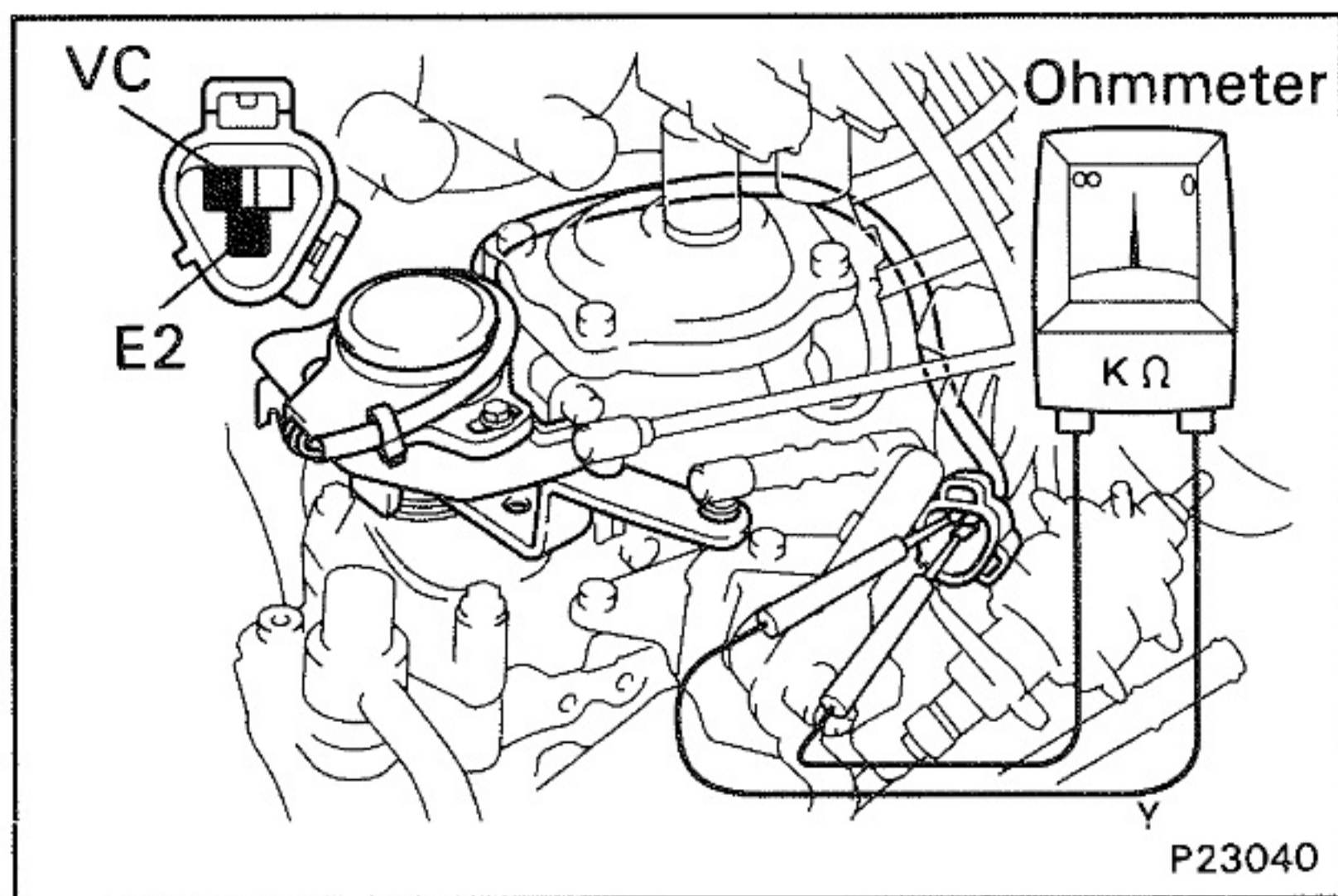
If operation is not as specified, replace the EVRV.



INSPECTION OF EGR VALVE

1. REMOVE EGR VALVE
2. INSPECT EGR VALVE

- (a) When a vacuum of 26.7 kPa (200 mmHg, 7.87 in.Hg) is applied to the diaphragm chamber, check that the shaft rises up and that air flows from IN to OUT.
- (b) Maintain the above conditions, and check again that there are no leaks.
- (c) Check the valve for sticking and heavy carbon deposits. If a problem is found, replace it.

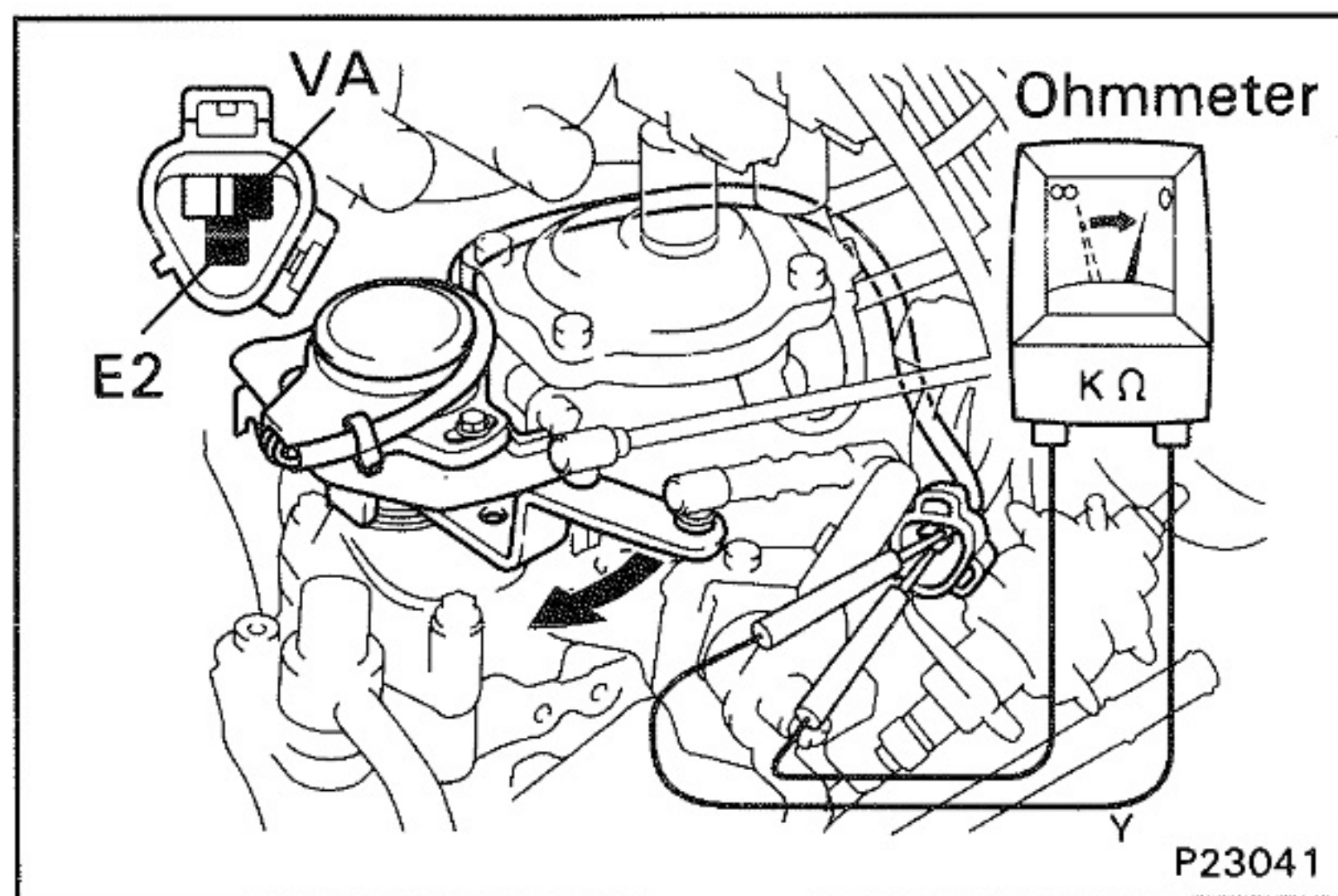


3. REINSTALL EGR VALVE WITH NEW GASKET

INSPECTION OF THROTTLE POSITION SENSOR

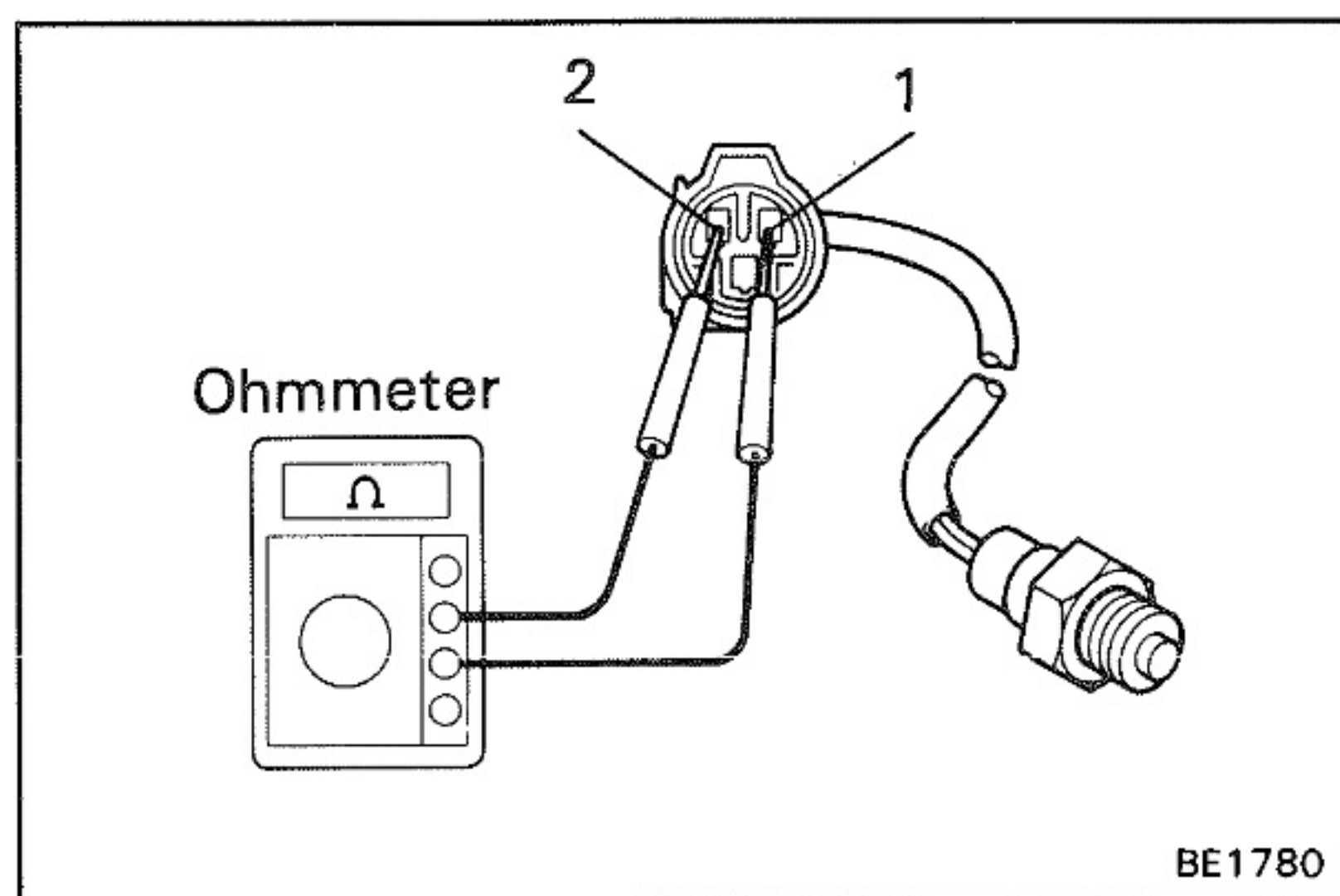
- (a) Using an ohmmeter, measure the resistance between VC and E2 terminals.

Resistance: 1.84 – 3.42 kΩ at 20°C (68°F)



- (b) Check the decrease in resistance between VA and E2 terminals when the adjusting lever is moved from the closed to the open position.

HINT: After removal or replacement of the throttle position sensor, have minute adjustments done at a specially equipped service shop.



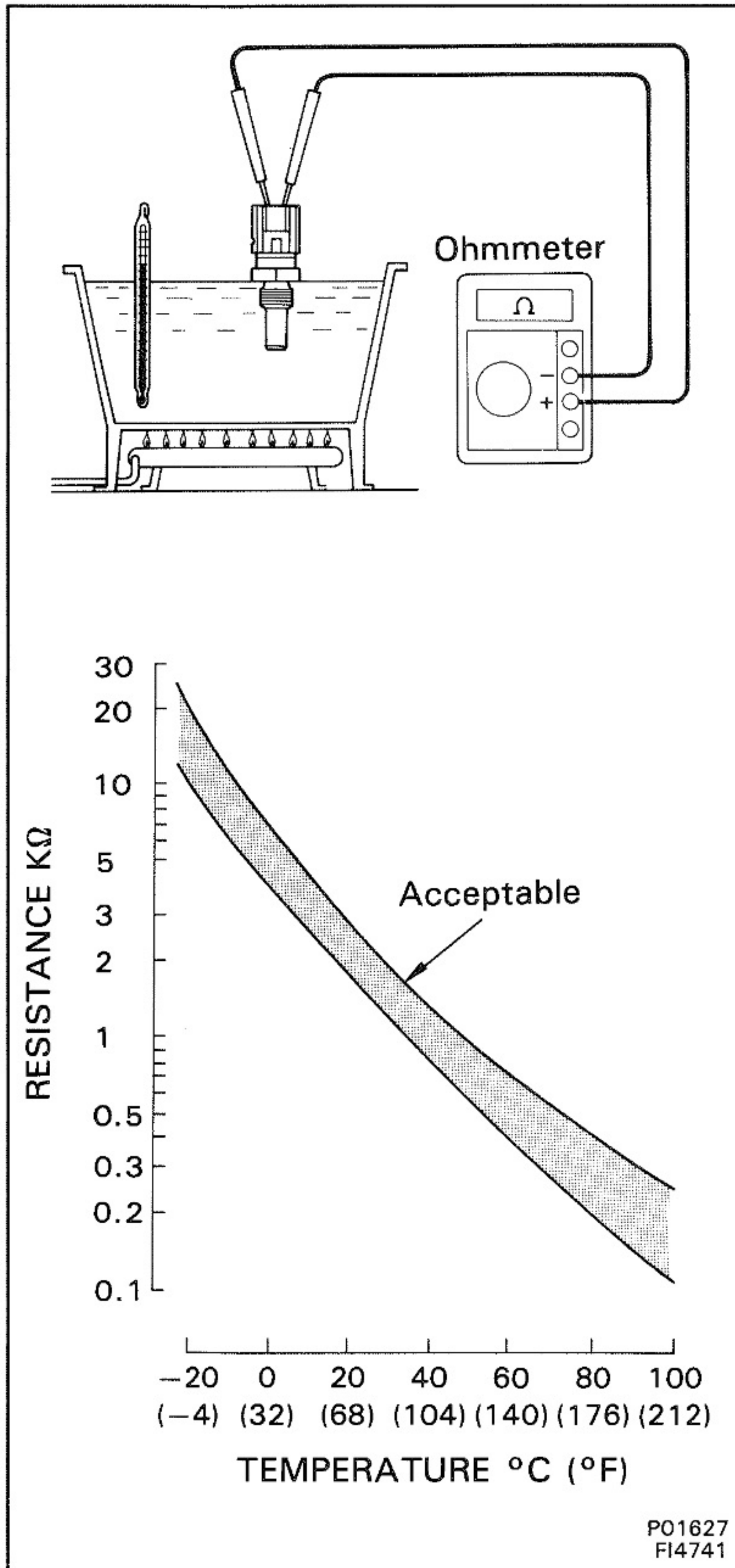
INSPECTION OF PICK-UP SENSOR

INSPECT PICK-UP SENSOR RESISTANCE

Measure the resistance between terminals 1 and 2.

Resistance: Approx. 730 Ω

If resistance value is not as specified, replace the sensor.



INSPECTION OF WATER TEMPERATURE SENSOR

1. REMOVE WATER TEMPERATURE SENSOR

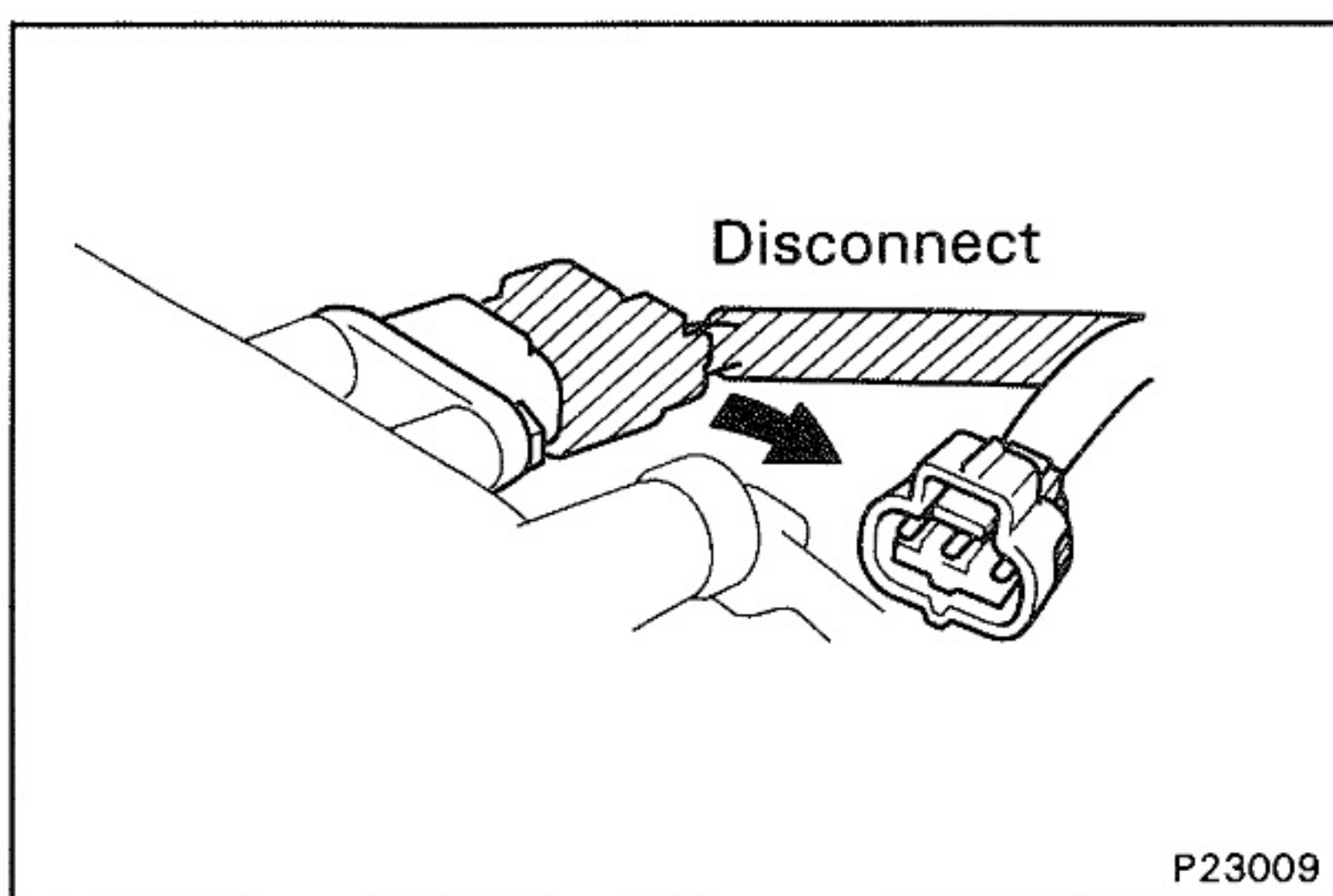
2. INSPECT WATER TEMPERATURE SENSOR

Using an ohmmeter, measure the resistance between the terminals.

Resistance: Refer to the chart graph

If the resistance is not as specified, replace the sensor.

3. REINSTALL WATER TEMPERATURE SENSOR



INSPECTION OF PRESSURE SENSOR

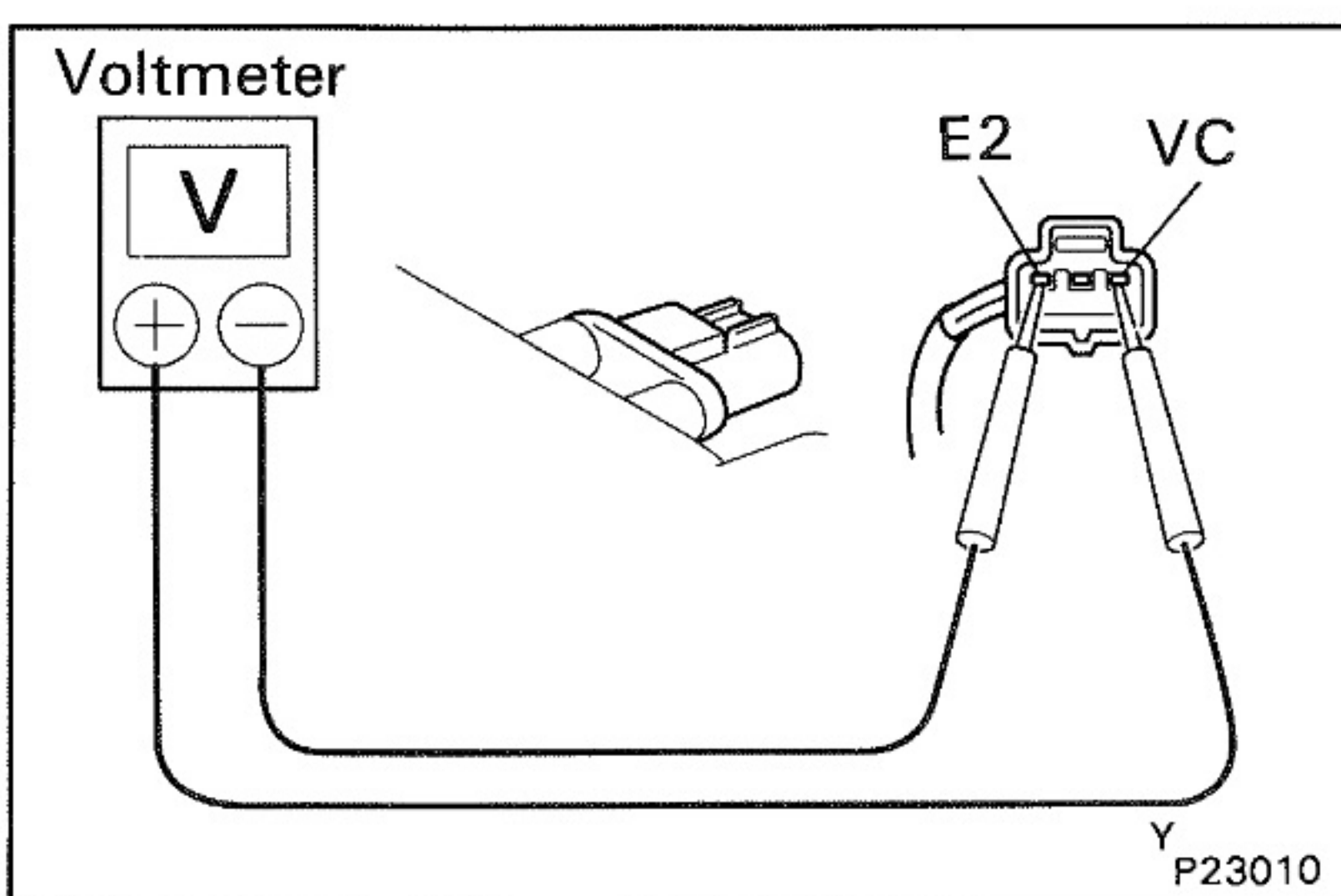
1. INSPECT POWER SOURCE VOLTAGE OF PRESSURE SENSOR

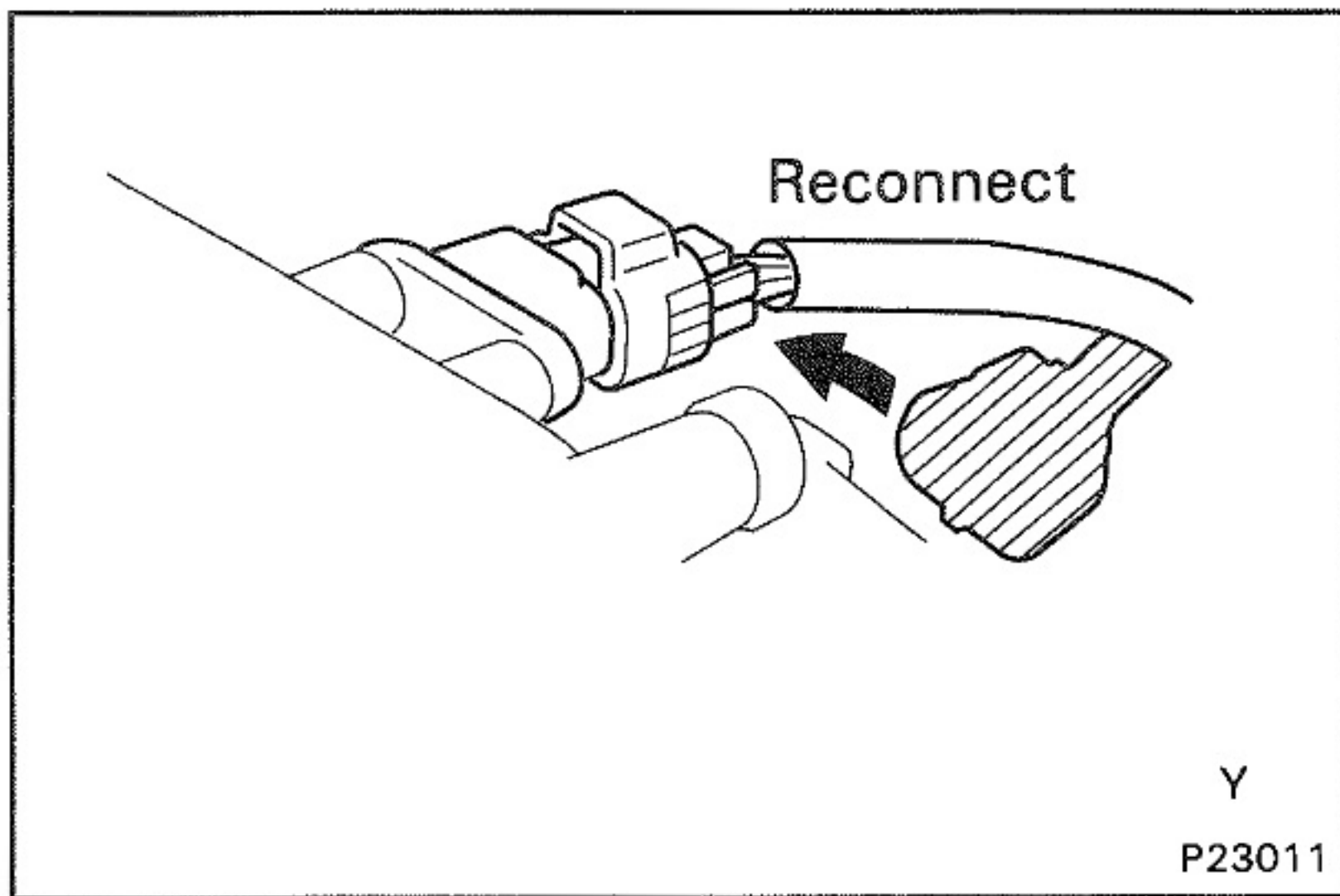
(a) Disconnect the pressure sensor connector.

(b) Turn the ignition switch ON.

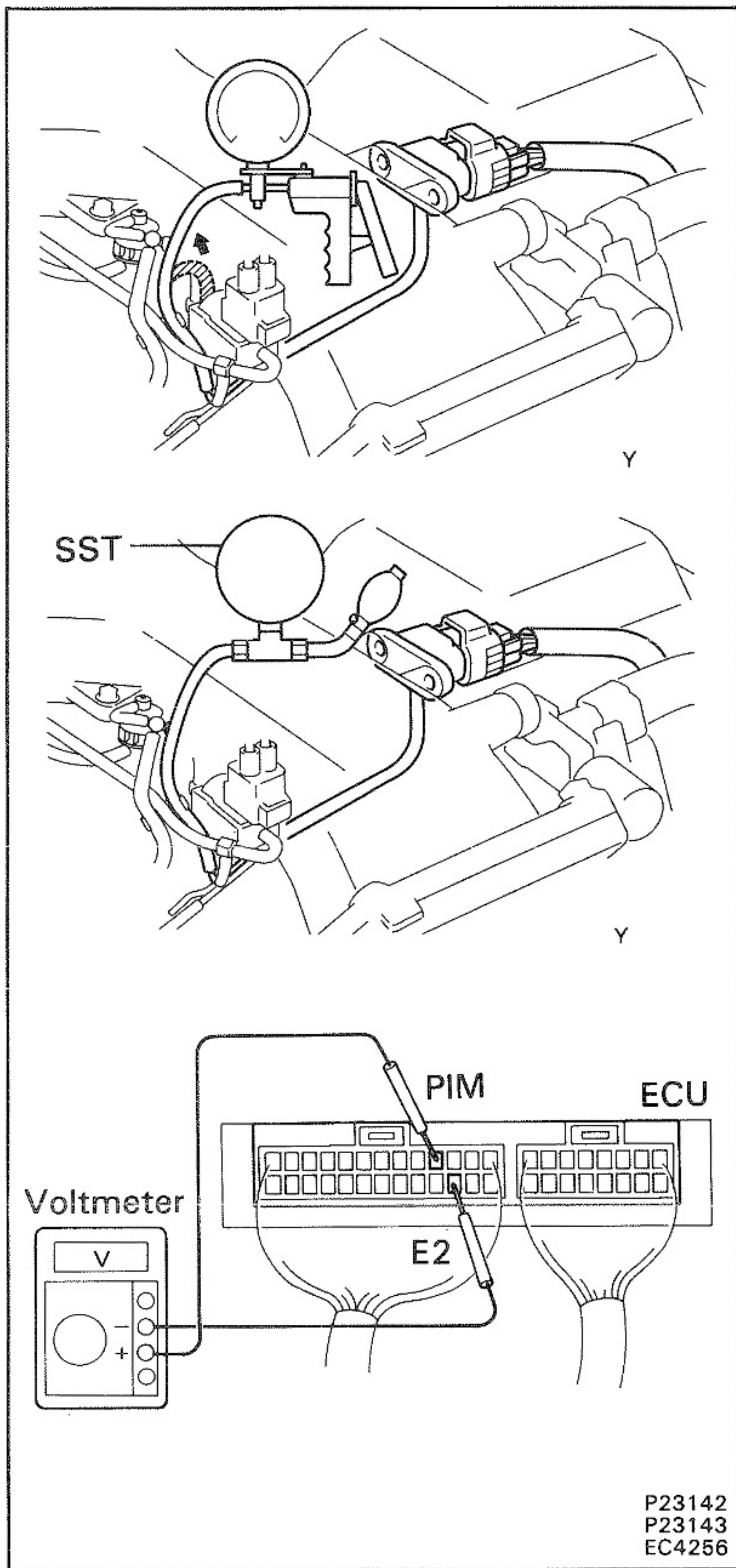
(c) Using a voltmeter, measure the voltage between connector terminals VC and E2 of the wiring harness side.

Voltage: 4.5 — 5.5 V





- (d) Turn the ignition switch OFF.
- (e) Reconnect the pressure sensor connector.



2. INSPECT POWER OUTPUT OF PRESSURE SENSOR

- (a) Turn the ignition switch ON.
- (b) Disconnect the vacuum hose from the VSV side.
- (c) Connect a voltmeter to terminals PIM and E2 of the emission ECU, and measure the output voltage under ambient atmospheric pressure.
- (d) Apply vacuum to the pressure sensor in 13.3 kPa (100 mmHg, 3.94 in.Hg) segments to 40.0 kPa (300 mmHg, 11.81 in.Hg).
- (e) Measure the voltage drop from step (c) above for each segment.

Voltage drop:

Applied vacuum kPa	13.3	26.7	40.0
(mmHg)	(100)	(200)	(300)
(in.Hg)	(3.94)	(7.87)	(11.81)
Voltage drop V	0.3 – 0.5	0.6 – 0.8	0.95 – 1.15

- (f) Using a turbocharger pressure gauge (SST), apply pressure to the pressure sensor in 1.96 kPa (0.20 kgf/cm², 2.84 psi) segments to 9.80 kPa (1.00 kgf/cm², 14.2 psi). SST 09992–00240

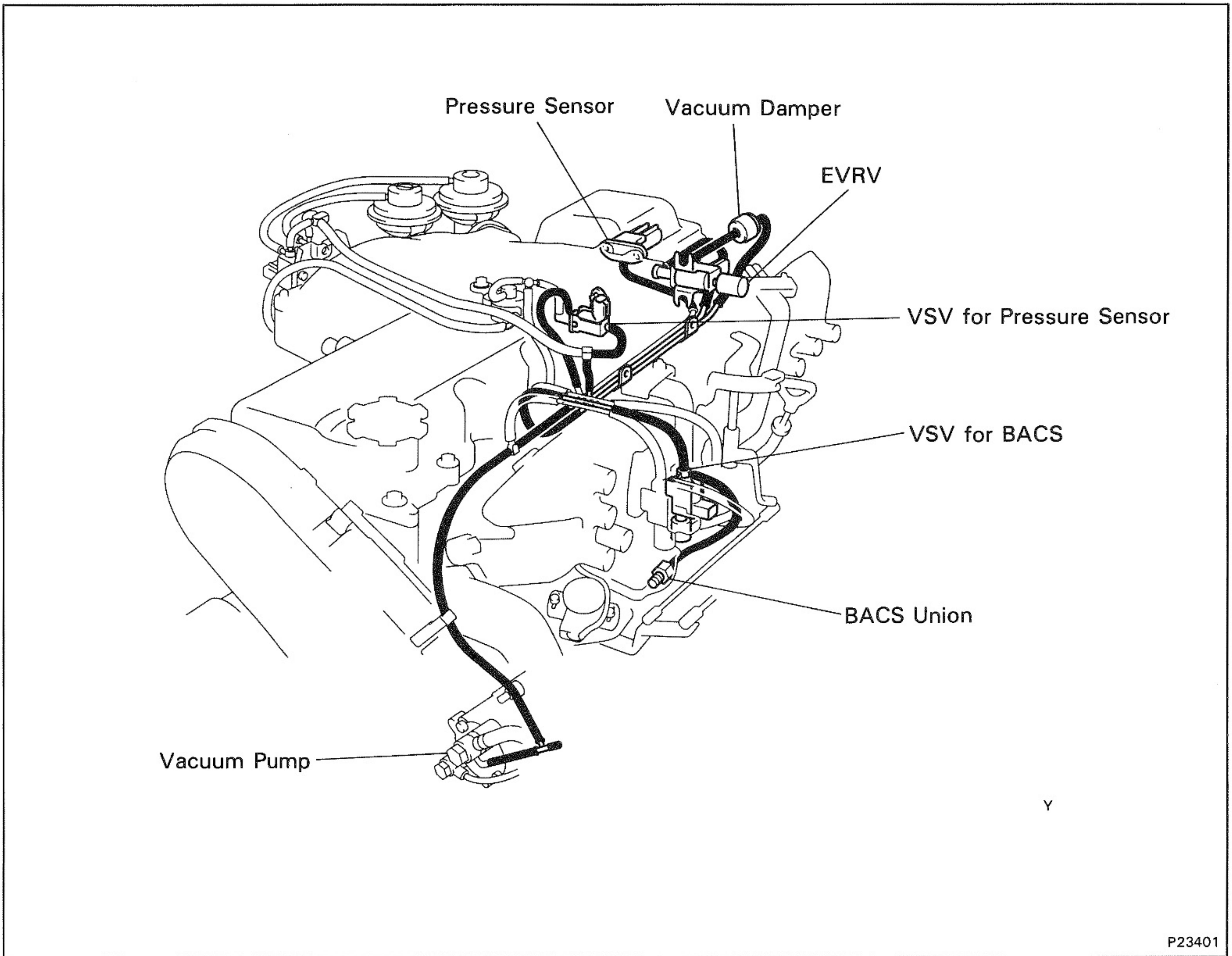
- (g) Measure the voltage up from step (c) above for each segment.

Voltage up:

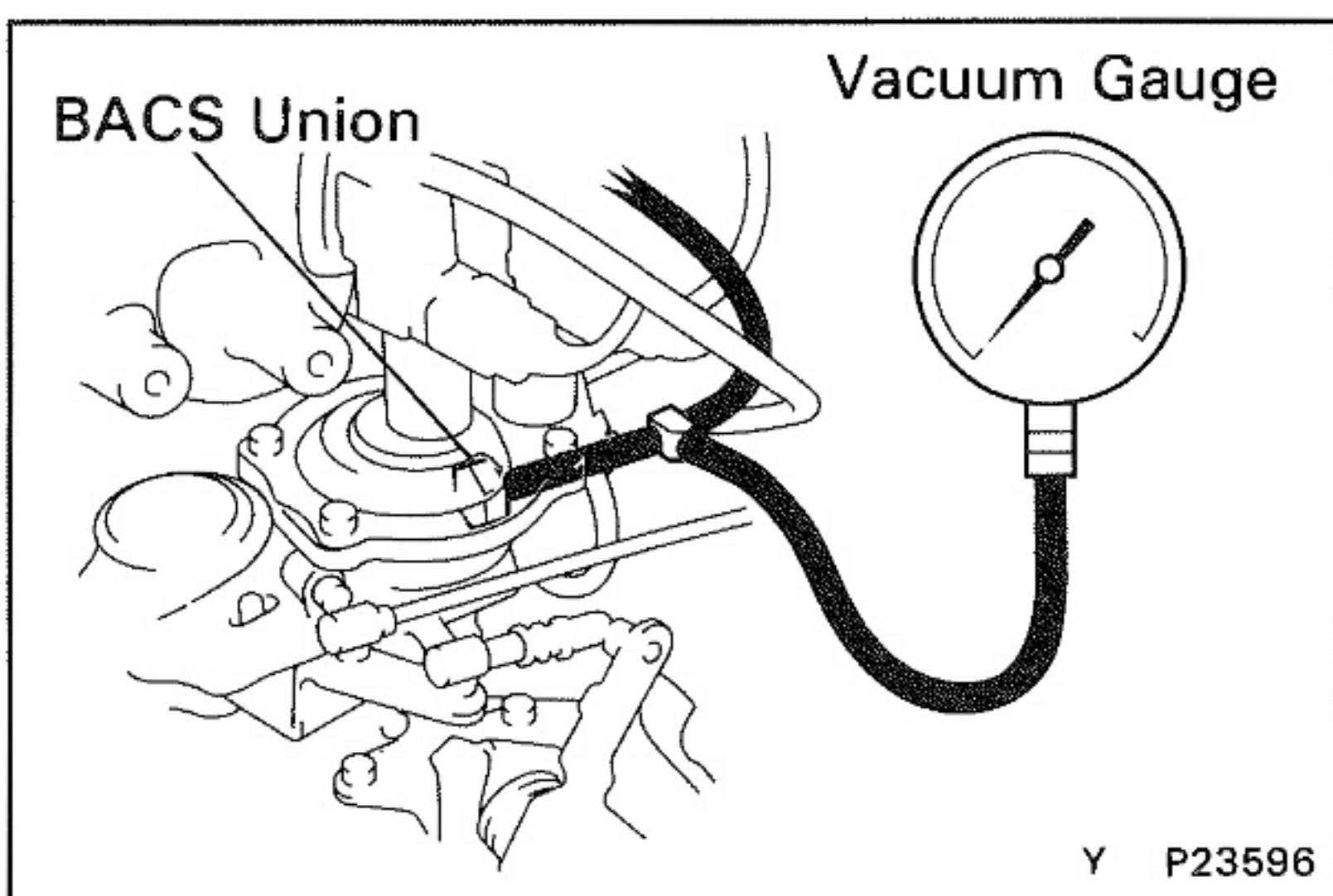
Applied pressure kPa	19.6	39.2	58.9	78.5	98.0
(kgf/cm ²)	(0.20)	(0.40)	(0.60)	(0.80)	(1.00)
(psi)	(2.84)	(5.69)	(8.53)	(11.4)	(14.2)
Voltage up V	0.4–0.7	0.9–1.2	1.4–1.7	2.0–2.3	2.5–2.8

- (h) Reconnect the vacuum hose to the VSV.

BOOST ALTITUDE COMPENSATIONAL STOPPER (BACS) SYSTEM



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INSPECTION OF BACS SYSTEM

1. **INSPECT EGR SYSTEM**
(See page 2-5)

2. **INSTALL VACUUM GAUGE**

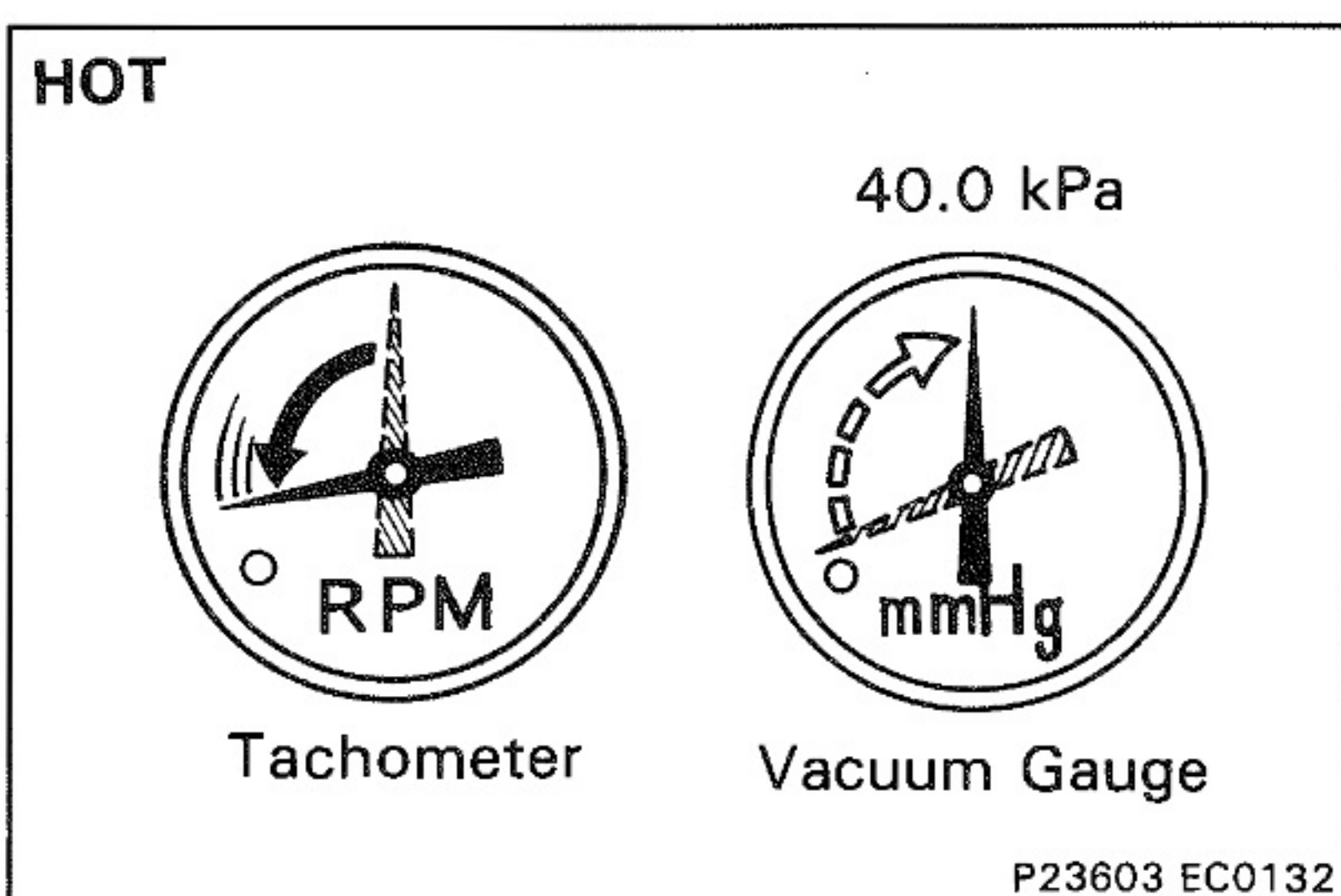
Using a 3-way connector, connect a vacuum gauge to the hose between the BACS union and VSV.

3. **INSPECT HOT ENGINE CONDITION**

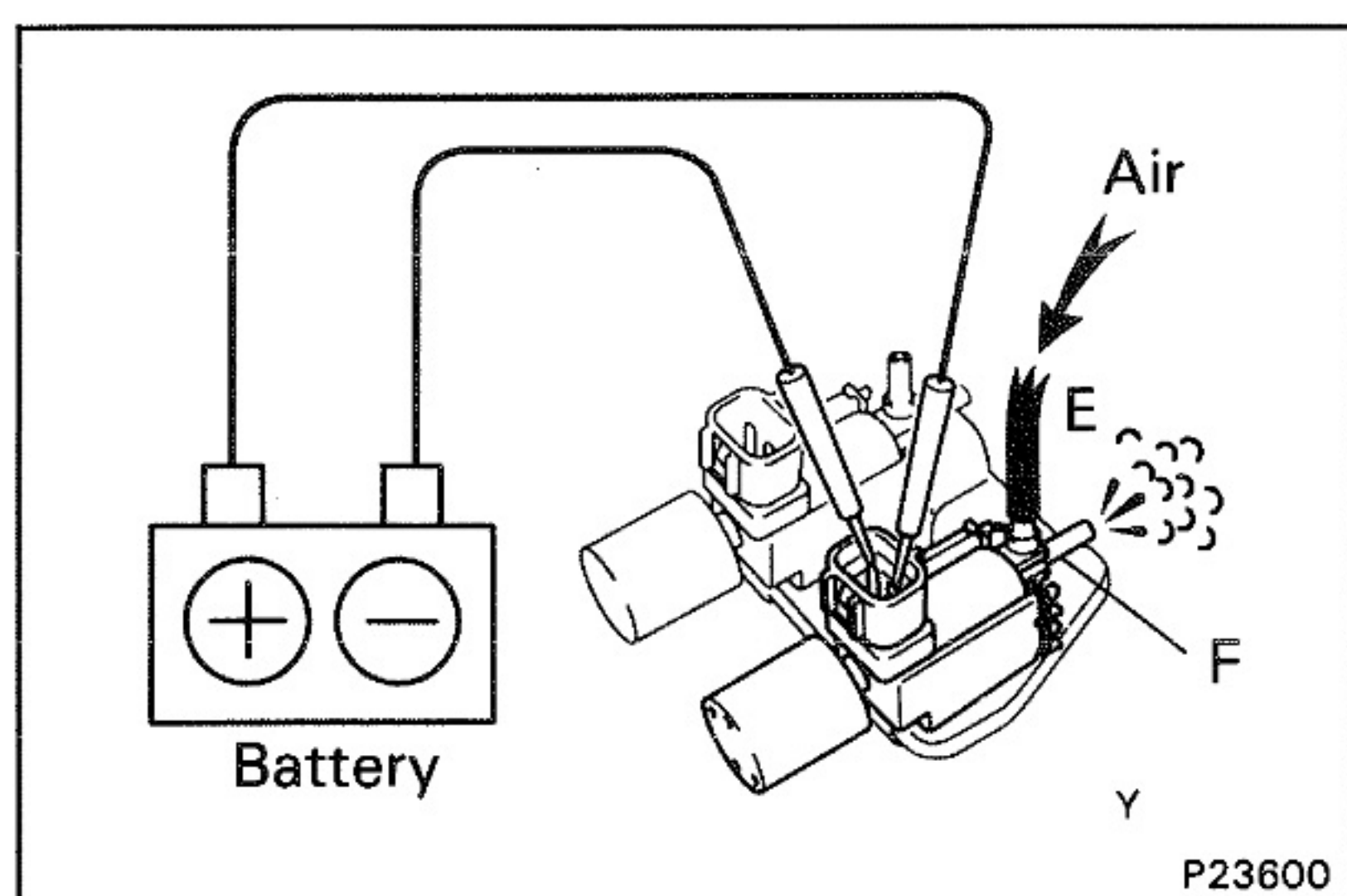
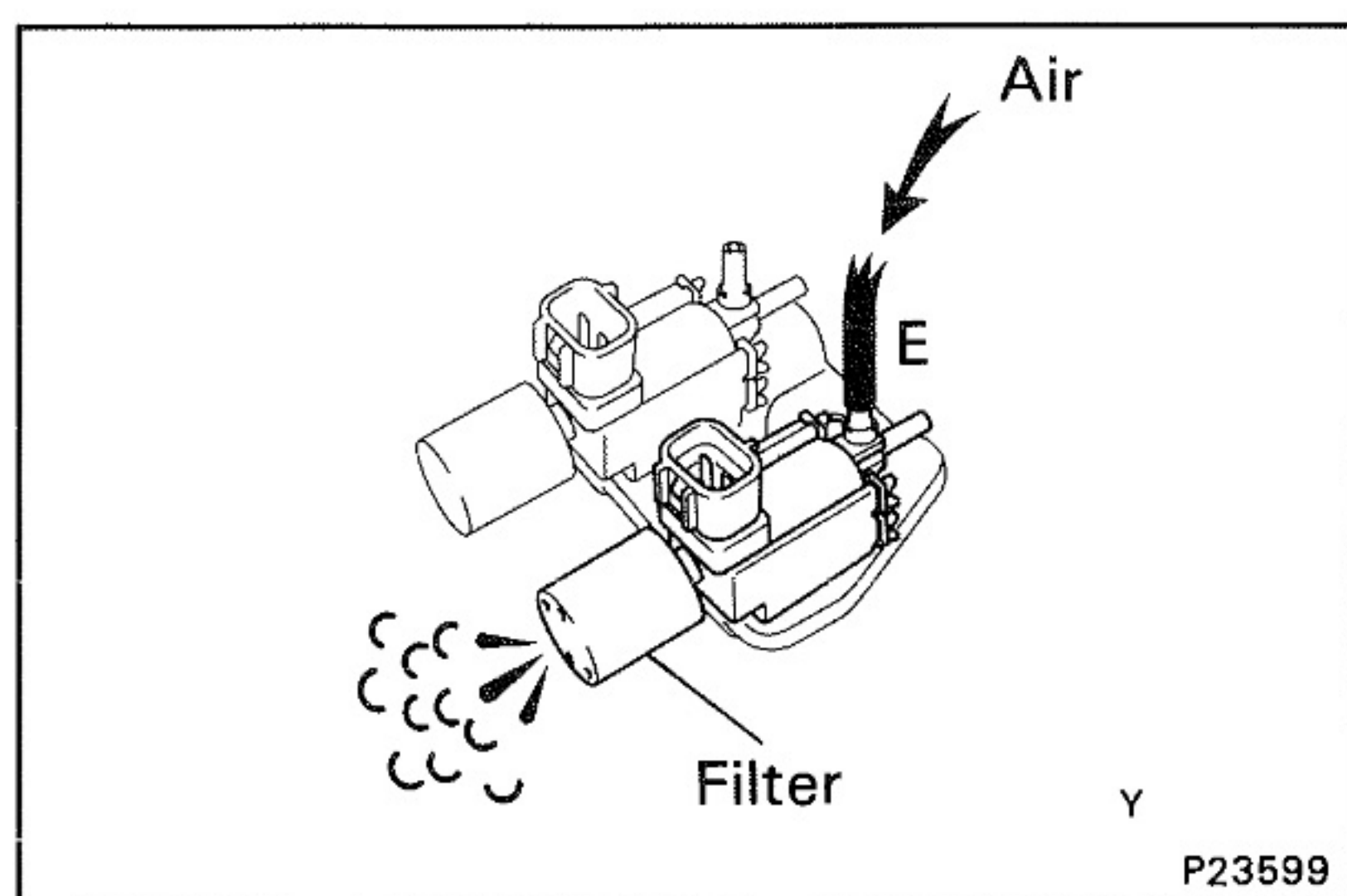
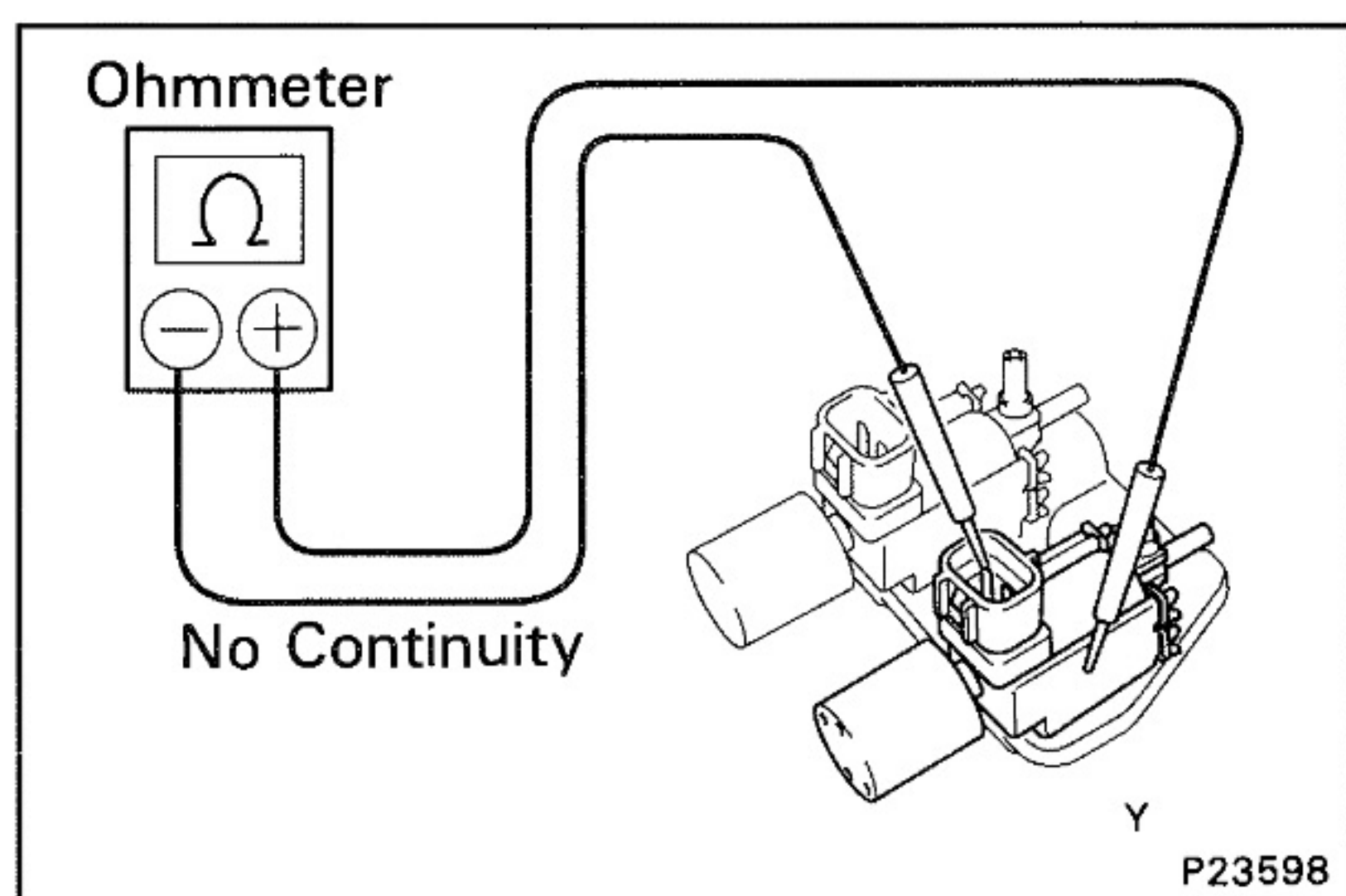
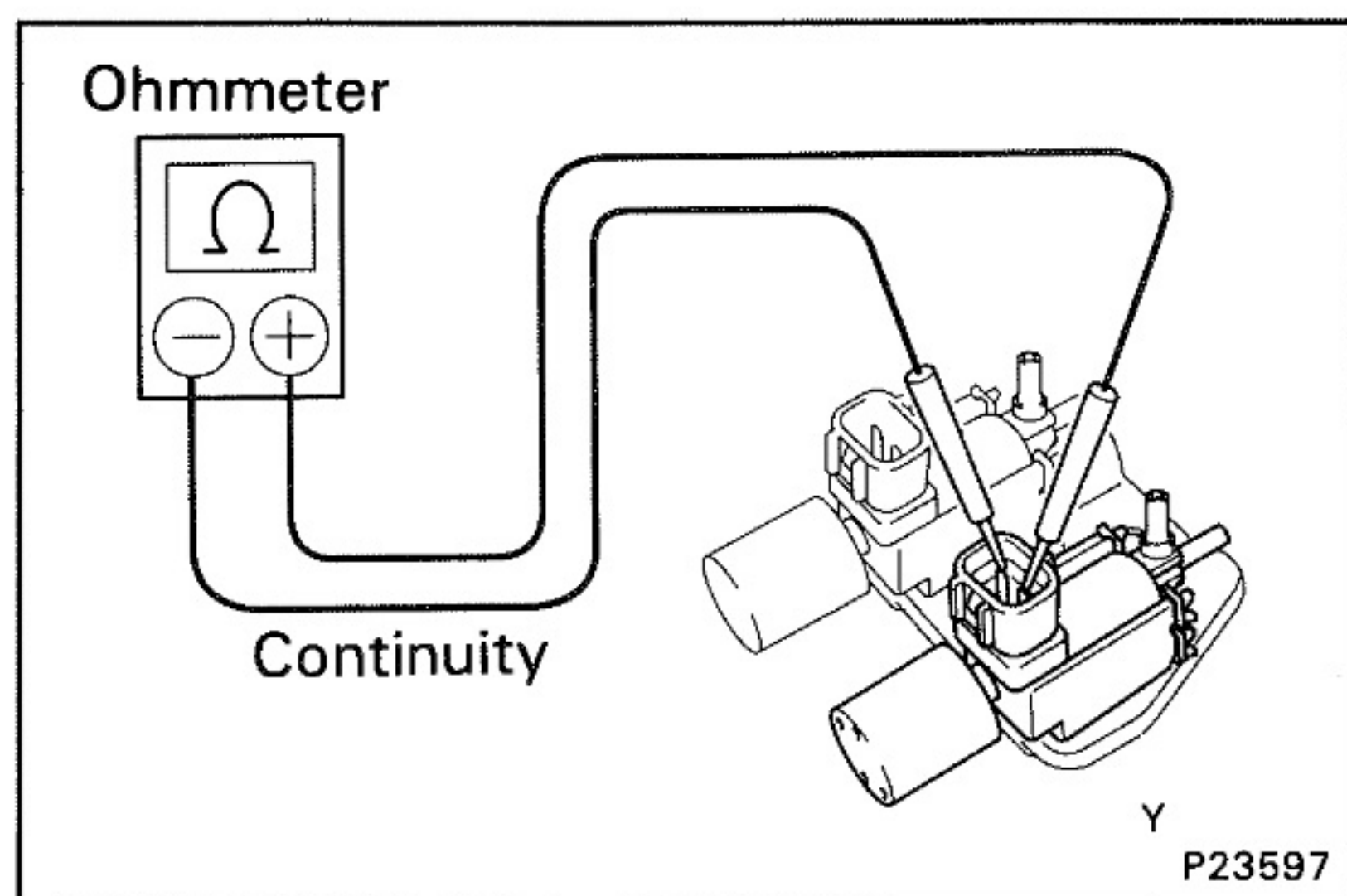
- (a) Warm up the engine. The coolant temperature should be above 50°C (122°F).
- (b) When the adjusting lever of the injection pump is quickly, pushed to full open, check that the vacuum gauge indicator slowly increases from 0 to 40.0 kPa (300 mmHg, 11.8 in.Hg).

IF NO PROBLEM IS FOUND WITH THIS INSPECTION, SYSTEM IS NORMAL; OTHERWISE INSPECT EACH PART

4. **REMOVE VACUUM GAUGE**



P23603 EC0132



INSPECTION OF VSV

1. INSPECT VSV FOR OPEN CIRCUIT

Using an ohmmeter, check that there is continuity between the terminals.

Resistance: 37 — 44 Ω at 20°C (68°F)

If there is no continuity, replace the VSV.

2. INSPECT VSV FOR GROUND

Using an ohmmeter, check that there is no continuity between each terminal and the body.

If there is continuity, replace the VSV.

3. INSPECT VSV OPERATION

(a) Check that air flows from port E to the filter.

(b) Apply battery voltage across the terminals.

(c) Check that air flows from ports E to F.

If operation is not as specified, replace the VSV.

INSPECTION OF VACUUM PUMP

(See page 2-7)

INSPECTION OF EVRV

(See page 2-7)

INSPECTION OF PRESSURE SENSOR

(See page 2-9)

DIAGNOSIS SYSTEM

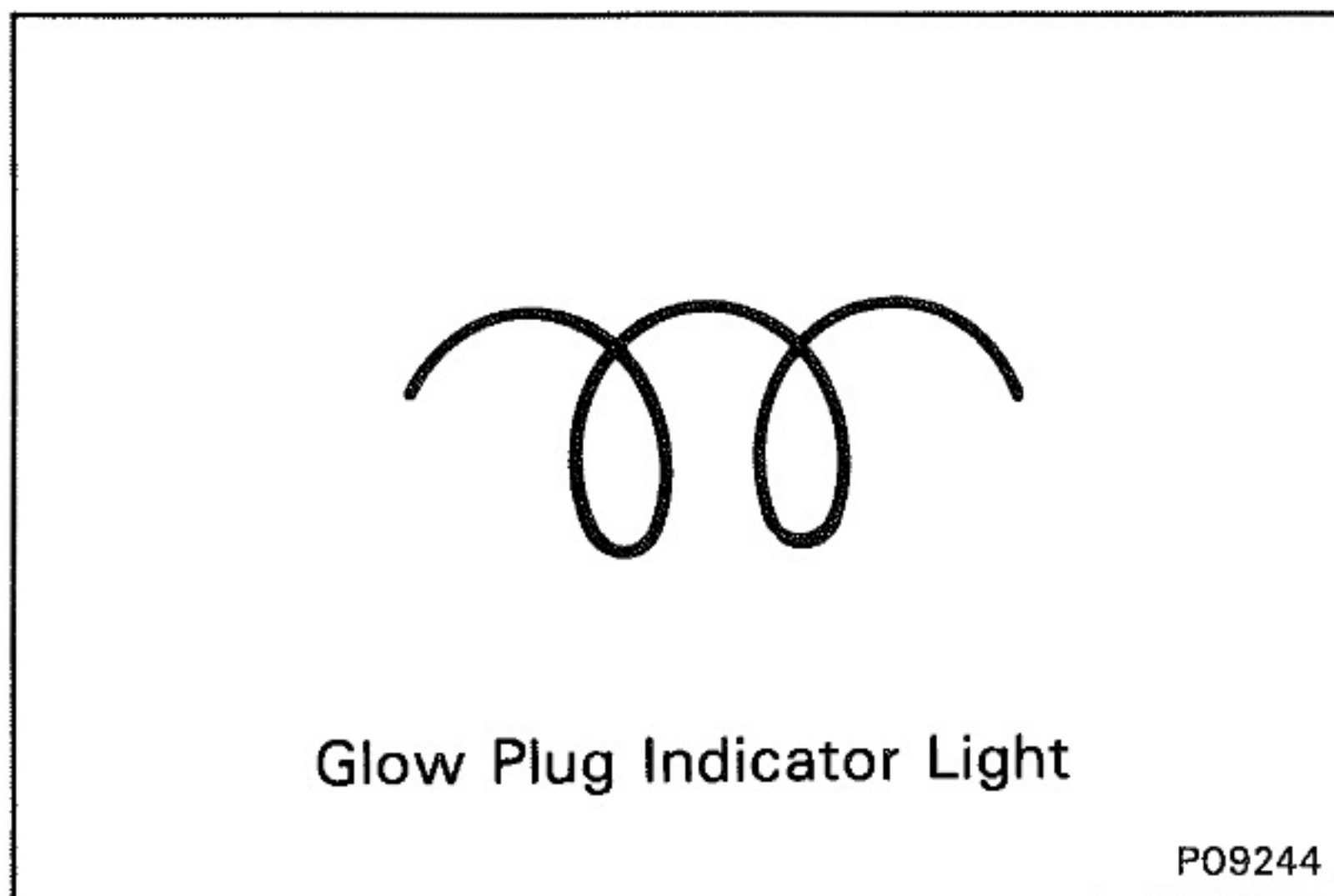
DESCRIPTION

The emission ECU contains a built-in self-diagnosis system which detects troubles within the engine signal network and then flashes the glow plug indicator light on the combination meter.

By analyzing various signals as shown in the later table (page 2-16), the emission ECU detects system malfunctions which are related to the various operating parameter sensors. The emission ECU stores the failure code associated with the detected failure until the diagnosis system is cleared by removing the ECU-B fuse with the ignition switch OFF.

The glow plug indicator light on the combination meter informs the driver that a malfunction has been detected.

The light goes off automatically when the malfunction has been cleared.



GLOW PLUG INDICATOR LIGHT CHECK

1. The glow plug indicator light will come on when the ignition switch is placed at ON and the engine is not running.
2. When the engine is started, the glow plug indicator light should go off.

If the light remains on, the diagnosis system has detected a malfunction or abnormality in the system.

OUTPUT OF DIAGNOSTIC CODES

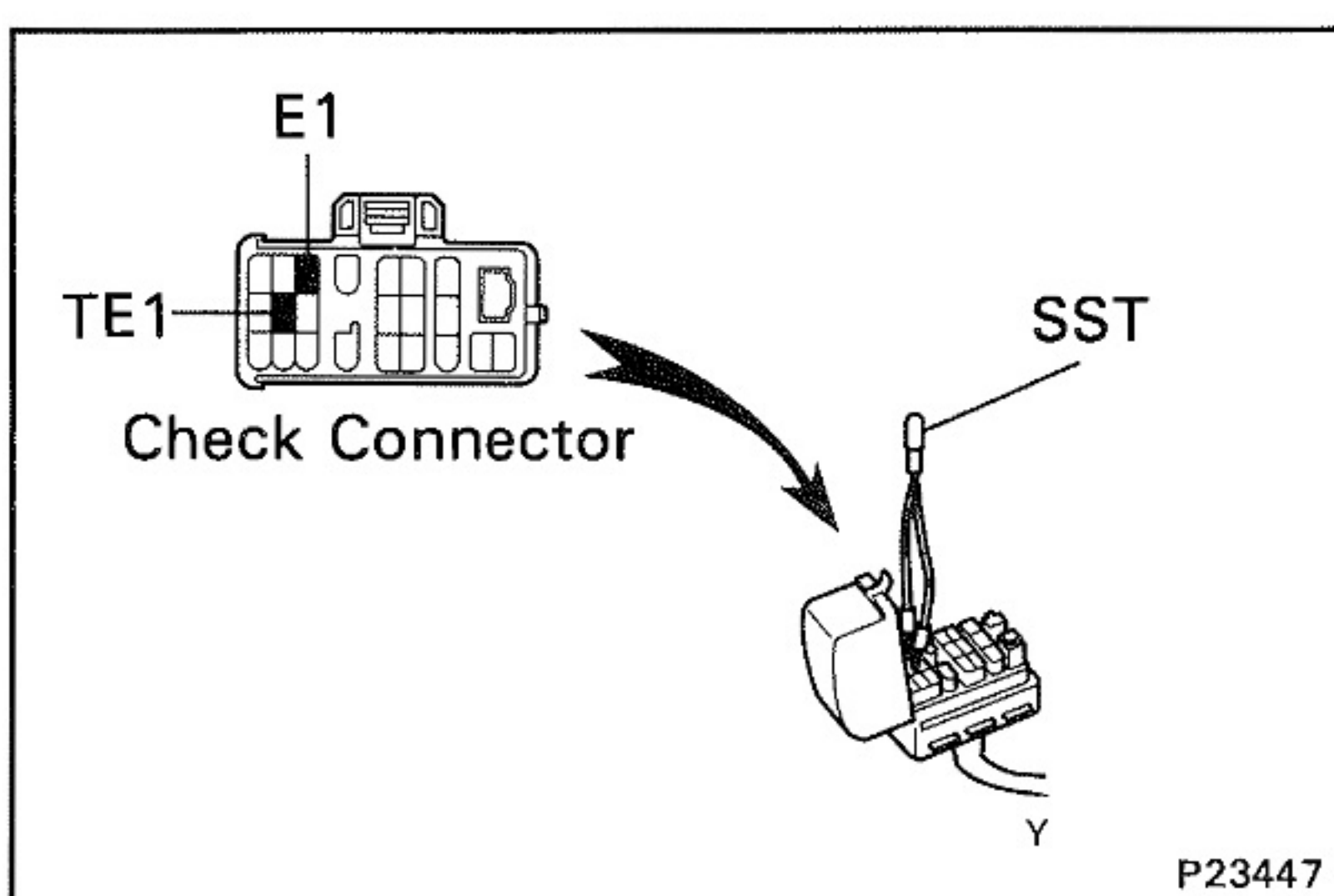
To obtain an output of diagnostic codes, proceed as follows:

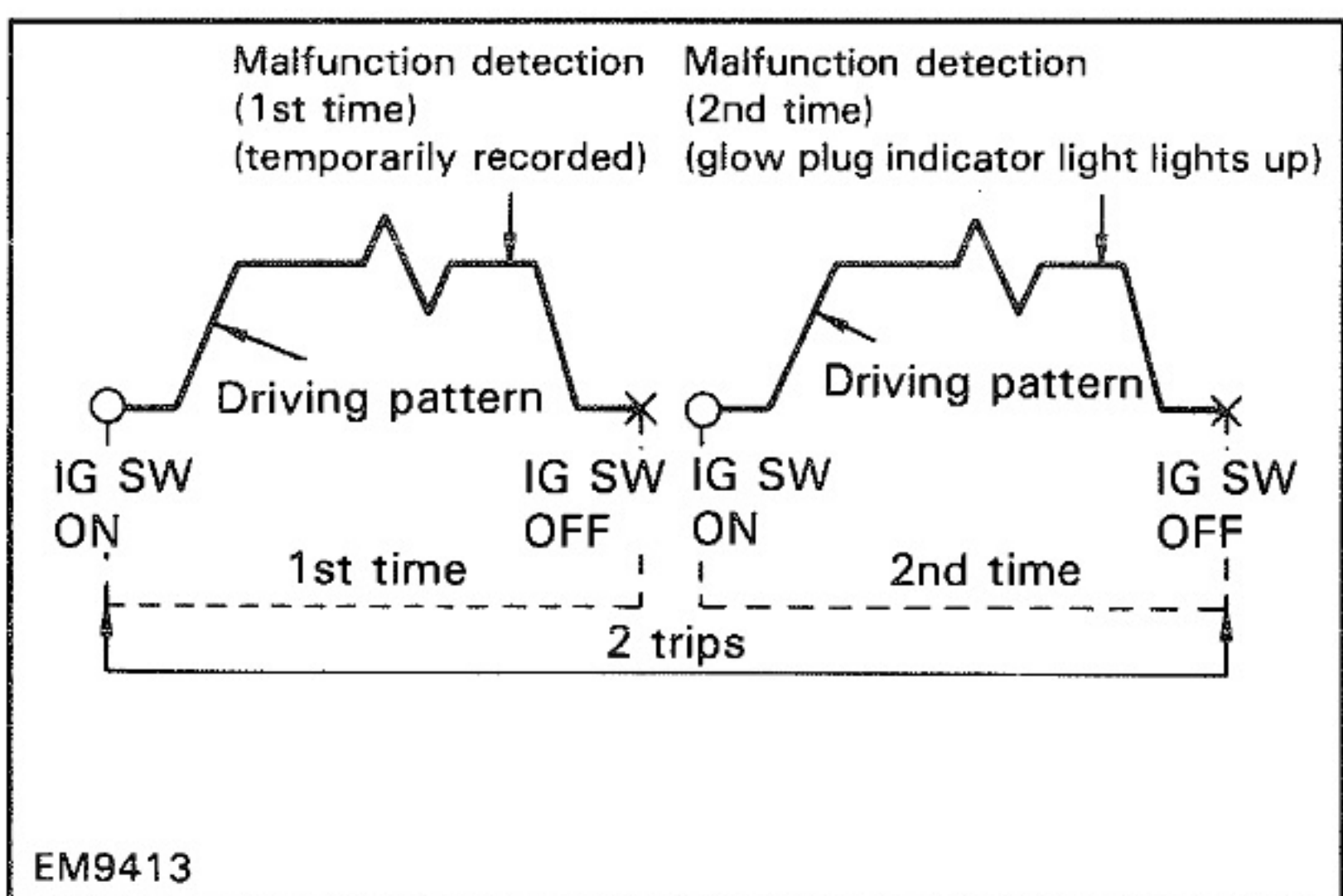
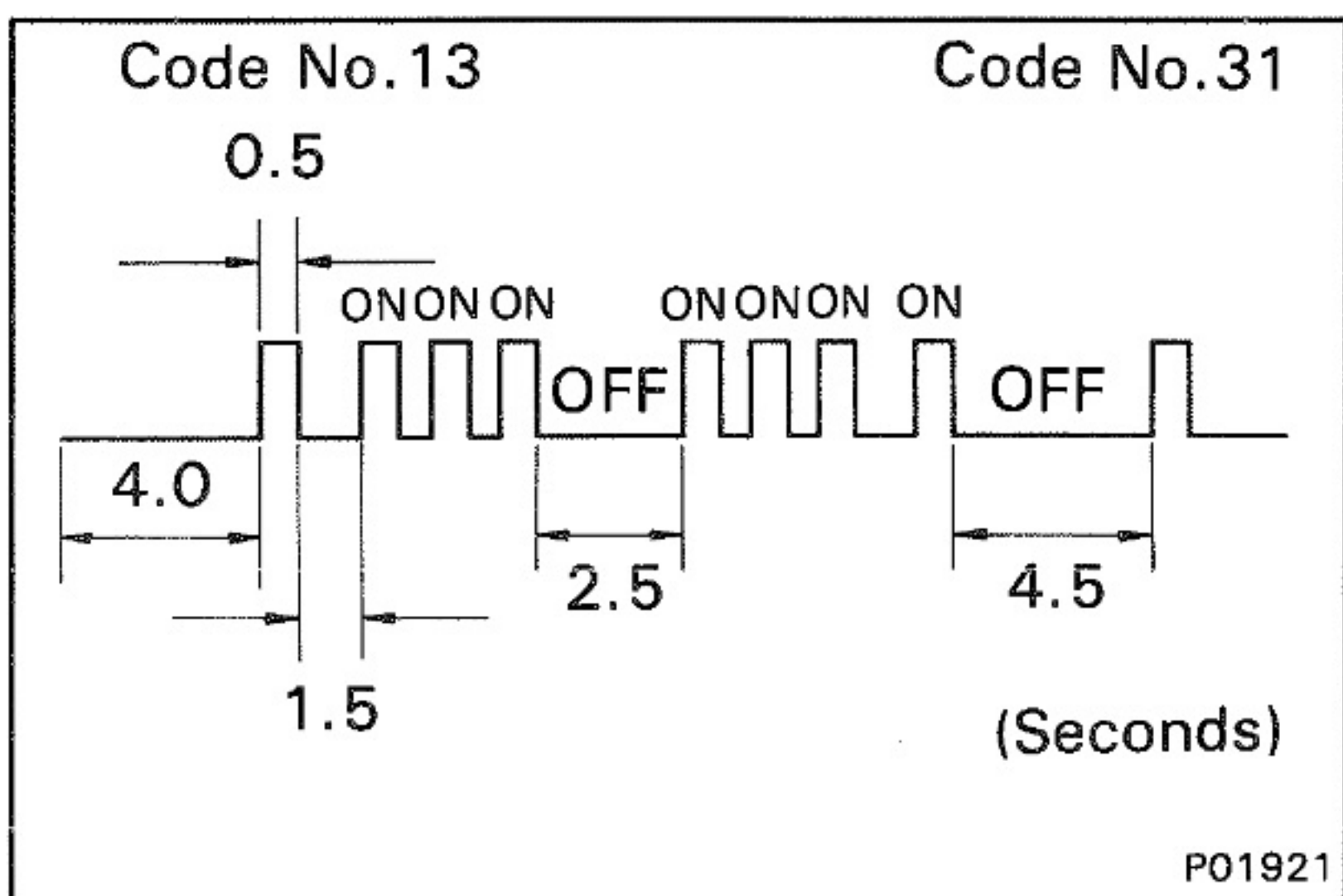
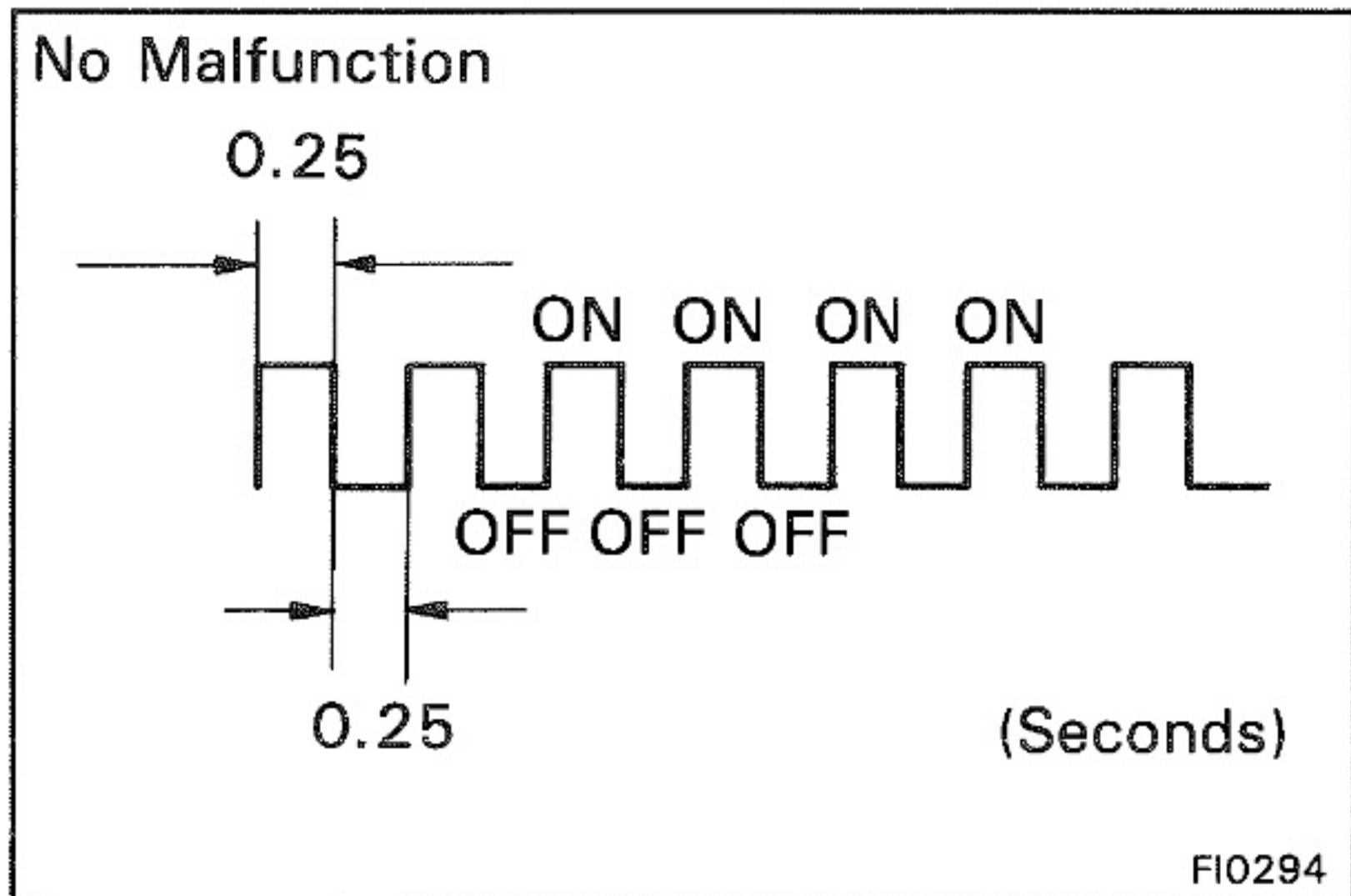
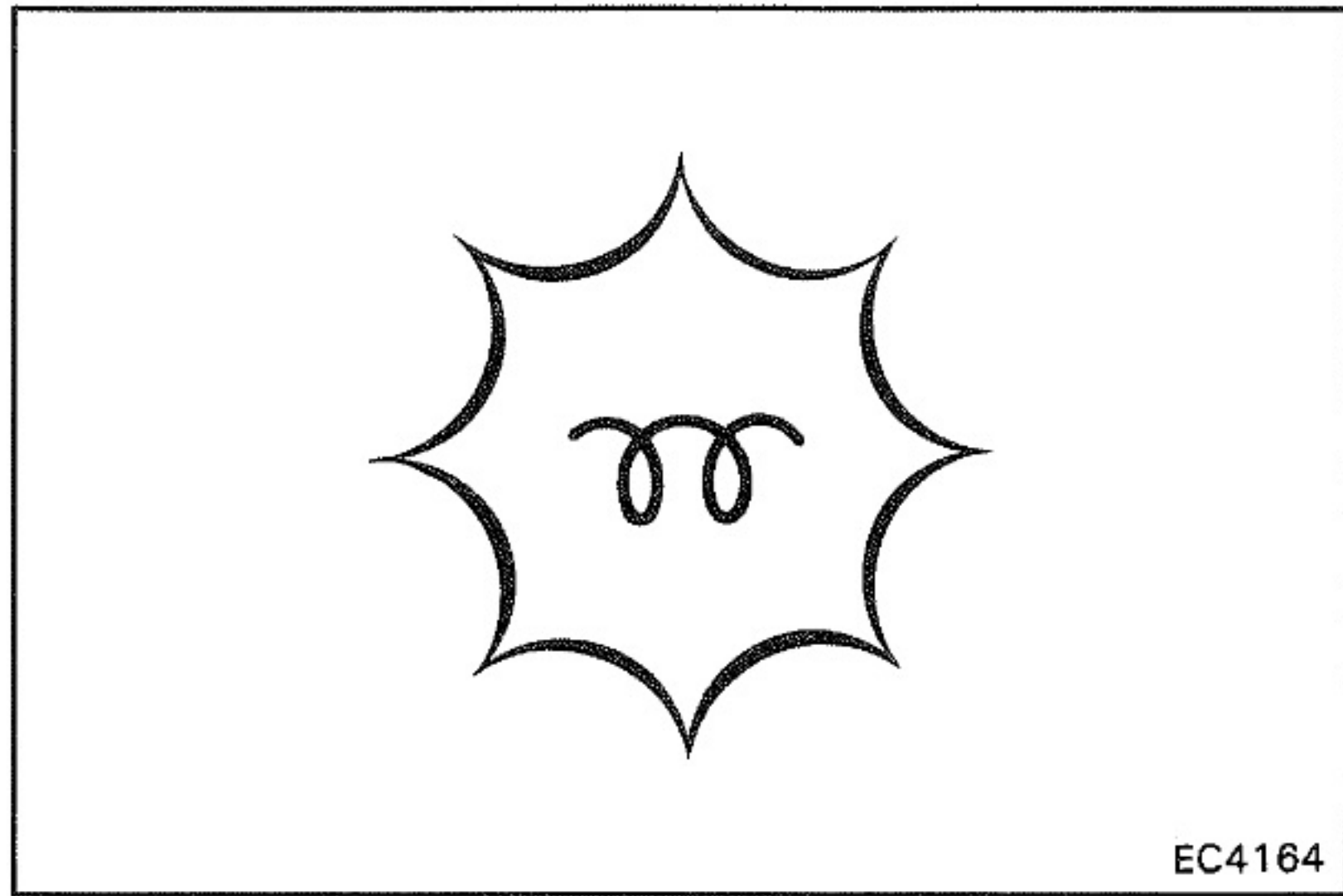
1. Initial conditions
 - (a) Battery voltage 11 volts or more
 - (b) Engine at normal operating temperature
 - (c) Accessories switched OFF
2. Turn the ignition switch ON.

NOTICE: Do not start the engine.

3. Using SST, connect terminals TE1 and E1 of the check connector.

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4. Read the diagnostic code as indicated by the number of flashes of the glow plug indicator light.

Diagnostic Codes (See page 2-16)

(a) Normal System Operation (no malfunction)

- The light will alternately blink ON and OFF 2 times per second.

(b) Malfunction Code Indication

- In the event of a malfunction, the light will blink every 0.5 seconds. The first number of blinks will equal the first digit of a 2-digit diagnostic code and, after a 1.5 second pause, the 2nd number of blink will equal the 2nd. If there are 2 or more codes, there will be a 2.5 second pause between each.
- After all the codes have been signaled, there will be a 4.5 second pause and they will all be repeated as long as the terminals TE1 and E1 of the check connector are connected.

HINT: In the event of a number of trouble codes, indication will begin from the smaller value and continue to the larger in order.

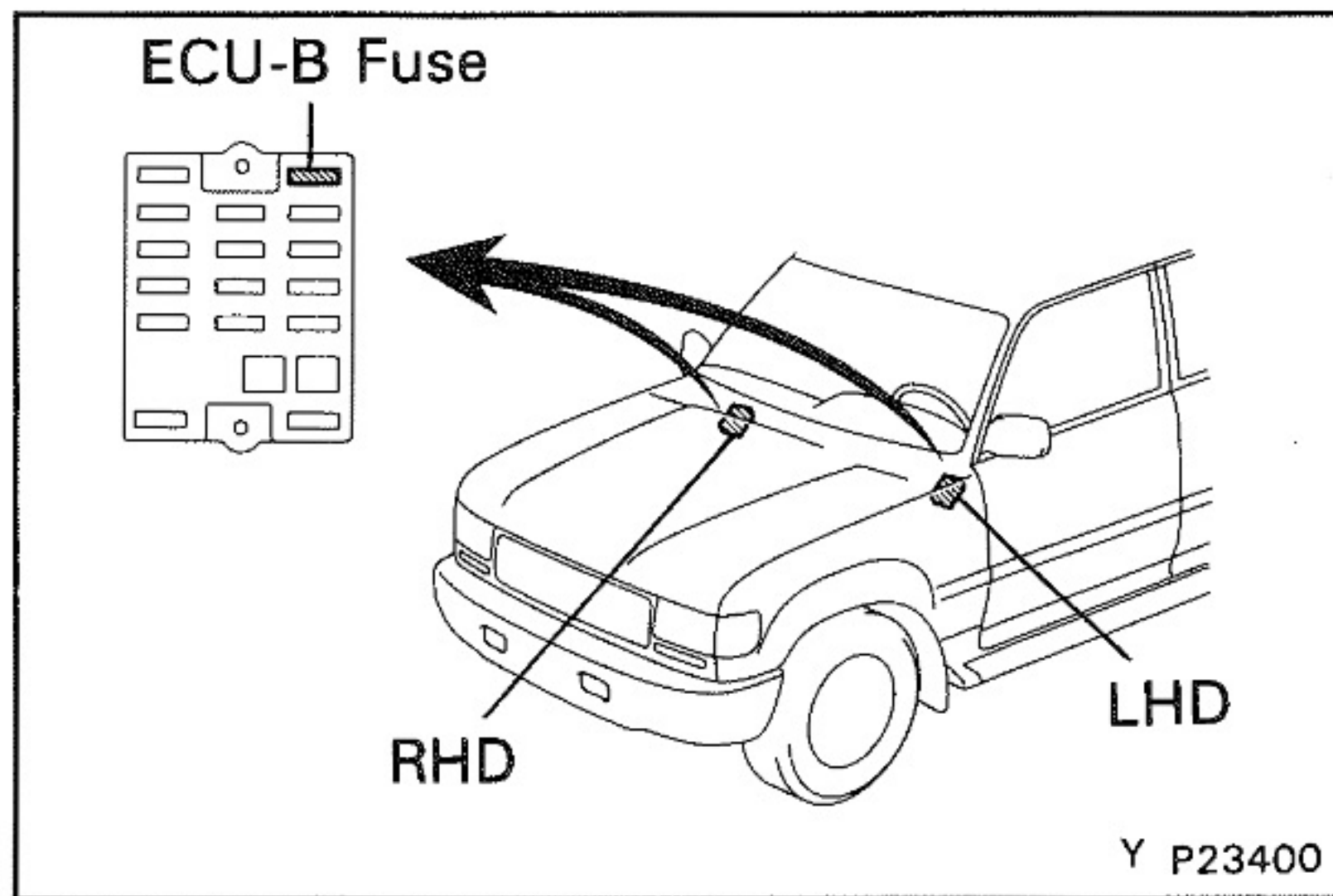
(c) 2 Trip Detection Logic

Diagnostic code 71 is use "2 trip detection logic". With this logic, when a malfunction is first detected, the malfunction is temporarily stored in the ECU memory. If the same case is detected again during the second drive test, this second detection causes the glow plug indicator light to light up.

The 2 trip repeats the same mode a 2nd time. (However, the ignition switch must be turned OFF between the 1st time and 2nd time.)

5. After the diagnostic check, remove SST.

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CANCELLING DIAGNOSTIC CODE

1. After repairing the trouble, the diagnostic code retained in memory by the ECU must be cancelled out by removing the ECU-B fuse, located behind driver's kick panel, for 10 seconds or more, depending on ambient temperature (the lower the temperature, the longer the fuse must be left out) with the ignition switch OFF.

HINT:

- Cancellation can also be done by removing the battery negative (—) terminal cable, but in this case, other memory systems (clock, etc.) will also be cancelled out.
 - If the diagnostic code is not cancelled out, it will be retained by the emission ECU and appear along with a new code in the event of future trouble.
 - If it is necessary to work on engine components requiring removal of the battery terminal, a check must first be made to see if a diagnostic code has been recorded.
2. After cancellation, perform a road test to confirm that a "normal" code is now displayed by the glow plug indicator light.

If the same diagnostic code appears, it indicates that the trouble area has not been repaired thoroughly.



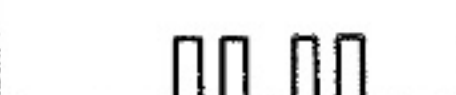





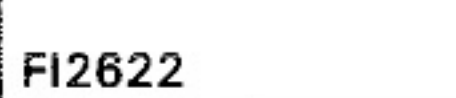
DIAGNOSIS INDICATION

1. Including "normal", the emission ECU is programmed with these 9 diagnostic codes.
2. If 2 or more malfunctions are present at the same time, the lowest-numbered diagnostic code will be displayed first.
3. Once the malfunction is corrected, the glow plug indicator light on the combination meter will go off but the diagnostic code(s) will remain stored in ECU memory.

DIAGNOSTIC CODES

HINT:

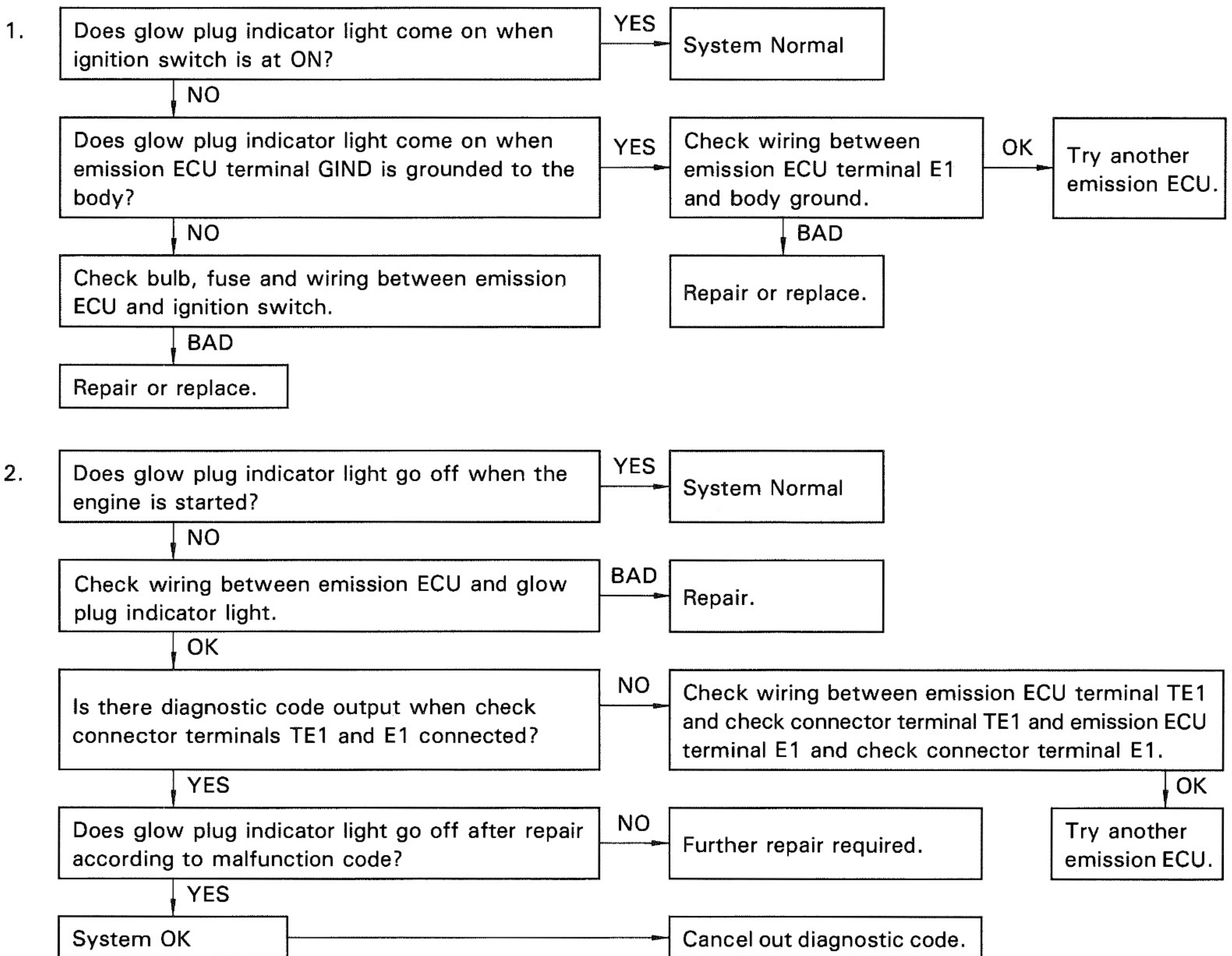
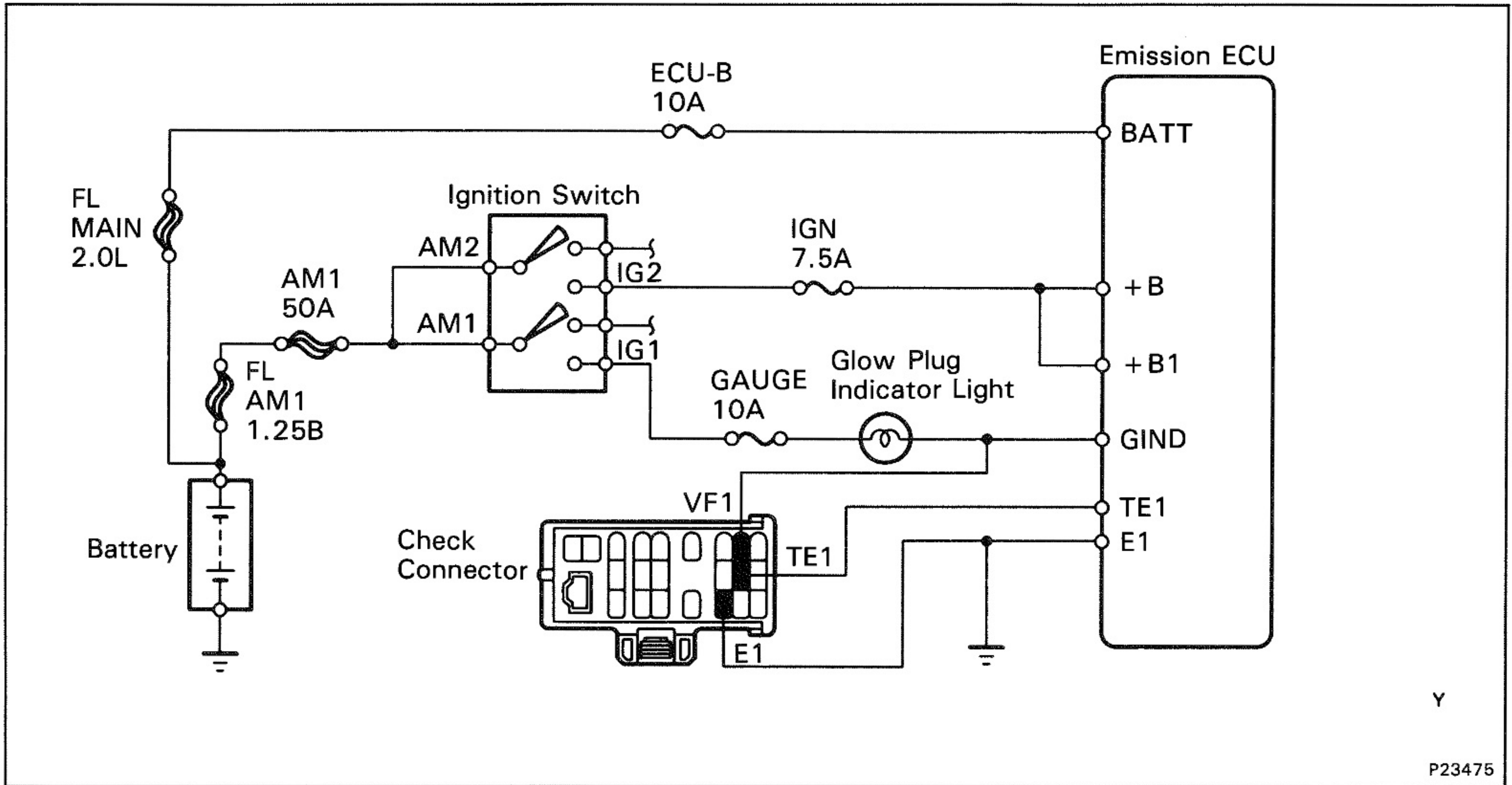
- If a malfunction is detected during the diagnostic code check, refer to the circuit indicated in the table, and turn to the corresponding page.
- Your readings may vary from the parameters listed in the table, depending on the instruments used.

Code No.	Number of blinks Glow Plug Indicator Light	System	Glow Plug *1 Indicator Light	Diagnosis	Trouble Area	Memory *2
—	 FI1401	Normal	—	No trouble code is recorded.	—	—
13	 FI1390	RPM Signal	ON	No NE signal to ECU for 0.5 sec. or more at above 1,000 rpm at STA "OFF"	<ul style="list-style-type: none"> • Open or short in NE circuit • Pick-up sensor • ECU 	○
22	 FI1392	Water Temp. Sensor Signal	ON	Open or short in water temp. sensor circuit for 0.5 sec. or more	<ul style="list-style-type: none"> • Open or short in water temp. sensor circuit • Water temp. sensor • ECU 	○
31	 FI1394	Pressure Sensor Signal	ON	Open or short in pressure sensor circuit for 2 sec. or more	<ul style="list-style-type: none"> • Open or short in pressure sensor circuit • Pressure sensor • ECU 	○
41	 FI1396	Throttle Position Sensor Signal	ON	Open or short in throttle position sensor circuit for 0.5 sec. or more	<ul style="list-style-type: none"> • Open or short in throttle position sensor circuit • Throttle position sensor • ECU 	○
42	 FI1397	Vehicle Speed Sensor Signal	OFF	All conditions below are detected continuously for 8 sec. or more. (a) Vehicle speed signal: 0 pulse (b) Engine speed: Between 2,000 rpm and 3,200 rpm (c) Accelerator opening angle: wider than 2/3 (d) Coolant temp.: 80°C (176°F) or more	<ul style="list-style-type: none"> • Open or short in vehicle speed sensor circuit • Vehicle speed sensor • ECU 	○
43	 FI1398	Starter Signal	OFF	<ul style="list-style-type: none"> • Short circuit in start signal circuit for 10 sec. or more • No STA signal to ECU 800 rpm with vehicle not moving 	<ul style="list-style-type: none"> • Open or short in starter signal circuit • Ignition switch • ECU 	○
71	 FI2622	EGR System Malfunction	ON	When abnormal feedback values have been obtained during EGR control operation. *3 2 trip detection logic	<ul style="list-style-type: none"> • Disconnection, clogging or damage of sensing pipe • Pressure sensor • Open or short in EVRV circuit • EVRV • Open or short in VSV circuit • VSV • ECU 	○
51	 FI1399	Switch Condi- tion Signal	OFF	No STA and A/C signals to ECU, with the check terminals TE1 and E1 connected	<ul style="list-style-type: none"> • Open or short in A/C switch circuit • A/C switch • ECU 	×

REMARKS:

- * 1: "ON" displayed in the diagnosis mode column indicates that the glow plug indicator light is lighted up when a malfunction is detected. "OFF" indicates that the glow plug indicator light does not light up during malfunction diagnosis, even if a malfunction is detected.
- * 2: "○" in the memory column indicates that a diagnostic code is recorded in the ECU memory when a malfunction occurs. "×" indicates that a diagnostic code is not recorded in the ECU memory even if a malfunction occurs.
- * 3: "2 trip detection logic" (See page 2-14).

INSPECTION OF DIAGNOSIS CIRCUIT



TROUBLESHOOTING WITH VOLT/OHMMETER

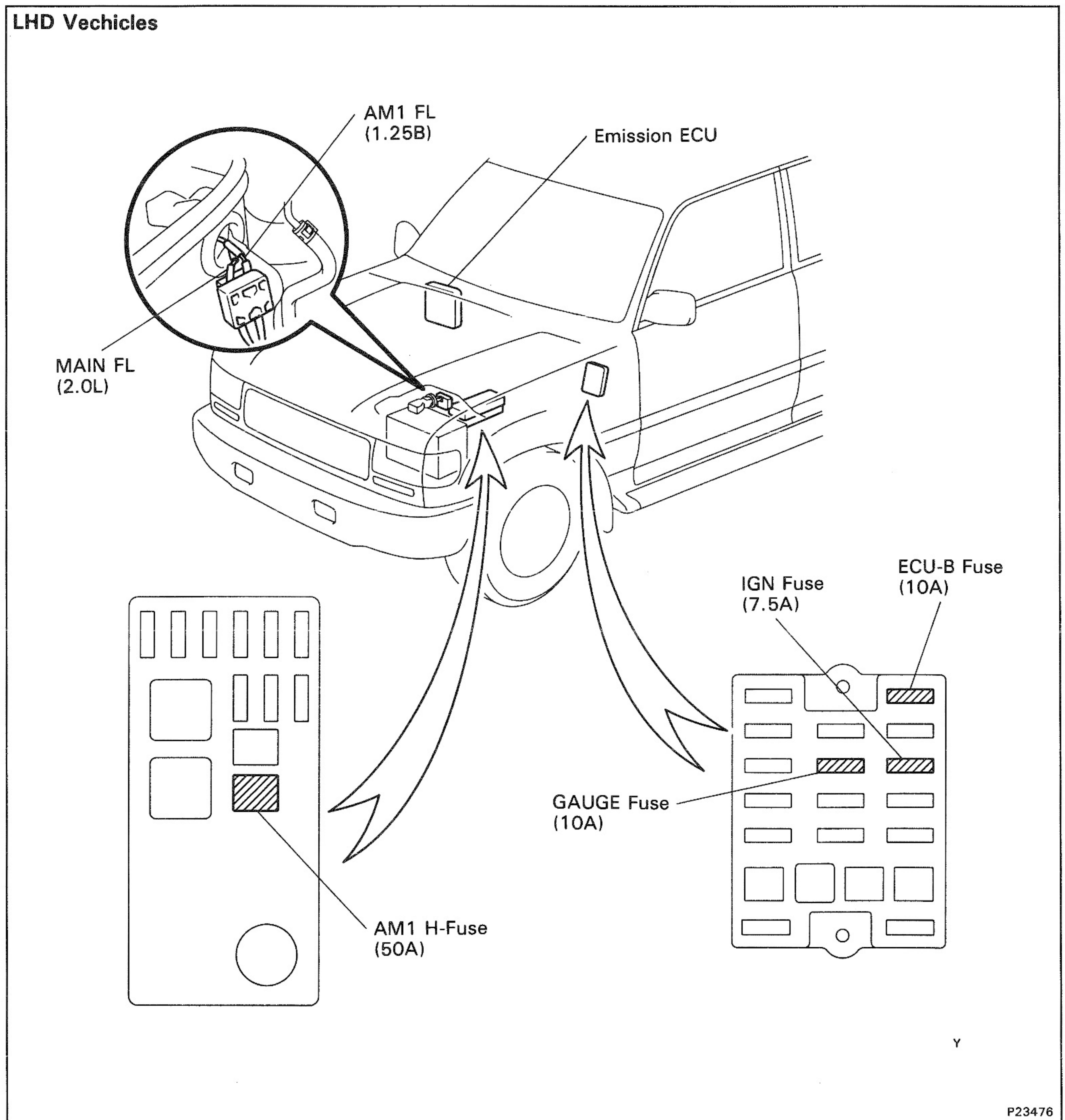
HINT: These troubleshooting procedures are designed for inspection of each separate system, therefore the procedure may vary somewhat. However, troubleshooting should be performed while referring to the inspection methods described in this manual.

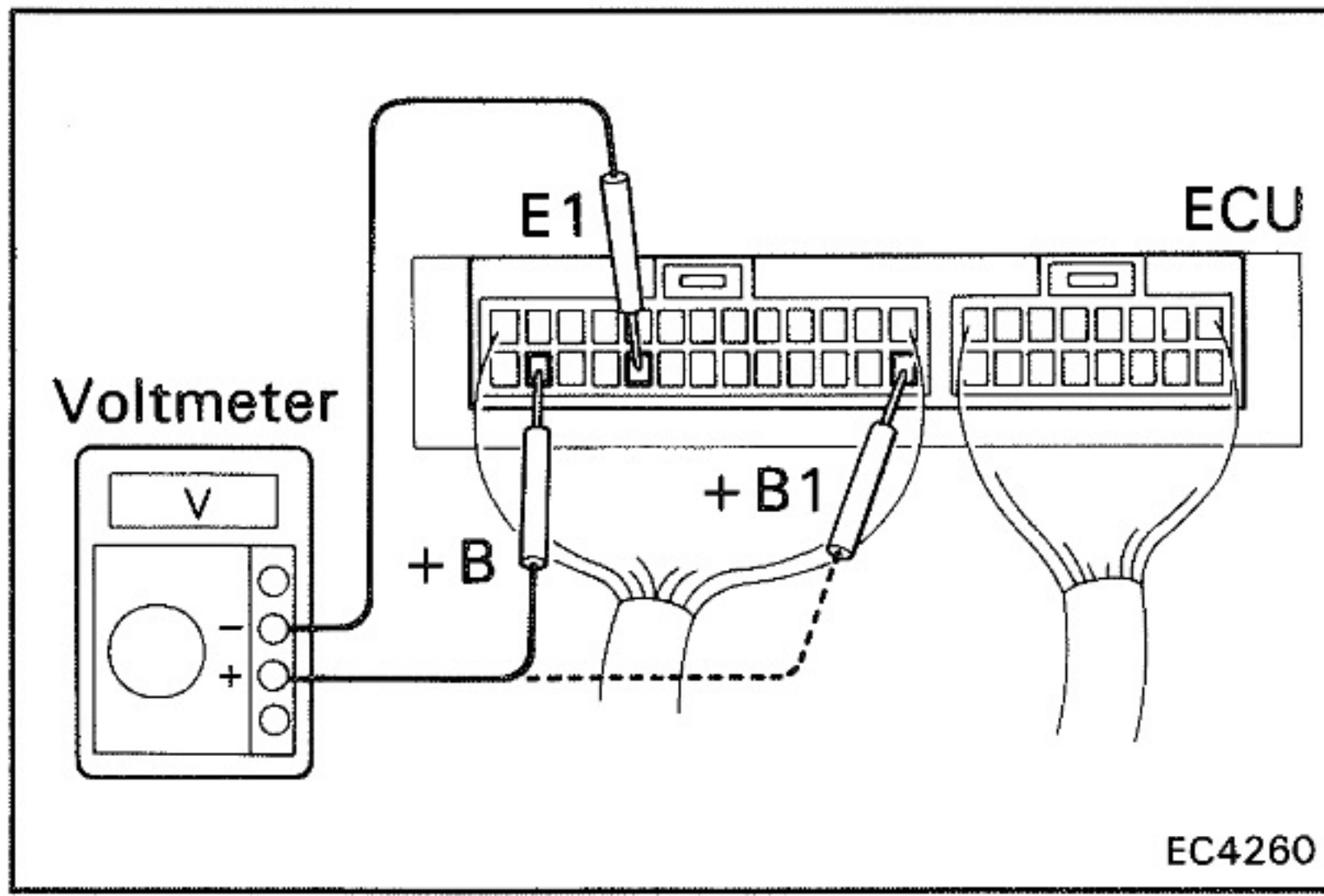
Before beginning inspection, it is best to first make a simple check of the fuses, fusible links and the condition of the connectors.

These troubleshooting procedures are based on the supposition that the trouble lies in either a short or open circuit in a component outside the computer or a short circuit within the computer.

If engine trouble occurs even though proper operating voltage is detected in the computer connector, then the emission ECU is faulty and should be replaced.

LOCATION OF FUSES AND FUSIBLE LINKS





DIAGNOSIS SYSTEM CHECK PROCEDURE

HINT:

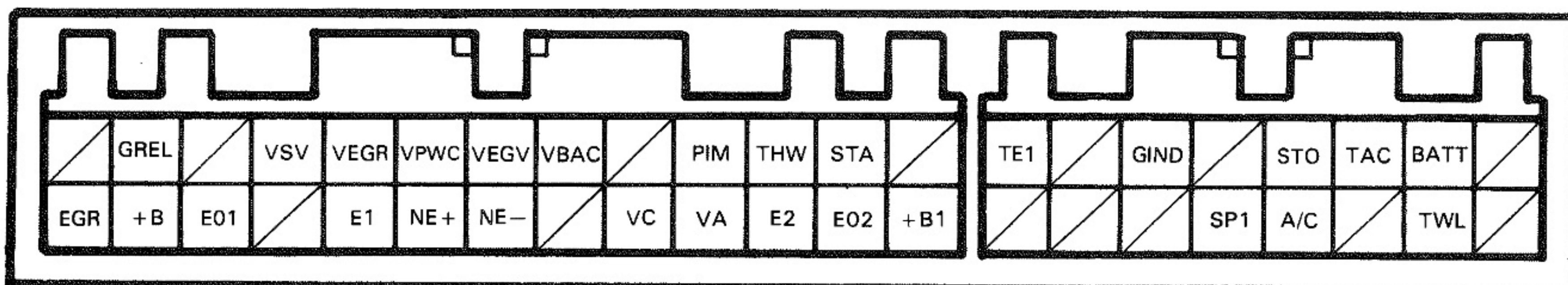
1. Do all voltage measurements with the connectors connected.
2. Verify that the battery voltage is 11 V or more when the ignition switch is at "ON".

Using a voltmeter with high impedance (10 kΩ/V minimum), measure the voltage at each terminal of the wiring connectors.

Terminals of Emission ECU

Symbol	Terminal Name	Symbol	Terminal Name
	—	E2	SENSOR GROUND
EGR	EVRV	STA	IGNITION SWITCH (ST1)
GREL	INTAKE HEATER RELAY	E02	ENGINE GROUND
+B	IGNITION SWITCH (IG2)		—
	—	+B1	IGNITION SWITCH (IG2)
E01	POWER GROUND	TE1	CHECK CONNECTOR
VSV	VSV FOR PRESSURE SENSOR		—
	—		—
VEGR	VSV FOR EGR (NO.1)		—
E1	ENGINE GROUND	GIND	GLOW PLUG INDICATOR LIGHT
VPWC	VSV FOR SICS		—
NE+	PICK-UP SENSOR ⊕		—
VEGV	VSV FOR EGR (NO.2)	SP1	VEHICLE SPEED SENSOR
NE-	PICK-UP SENSOR ⊖	STO	VOLTAGE CONVERTER RELAY
VBAC	VSV FOR BACS	A/C	A/C AMPLIFIER
	—	TAC	TACHOMETER
	—		—
VC	SENSOR POWER SOURCE	BATT	BATTERY
PIM	PRESSURE SENSOR	TWL	TURBO PRESSURE INDICATOR
VA	THROTTLE POSITION SENSOR		—
THW	WATER TEMP. SENSOR		—

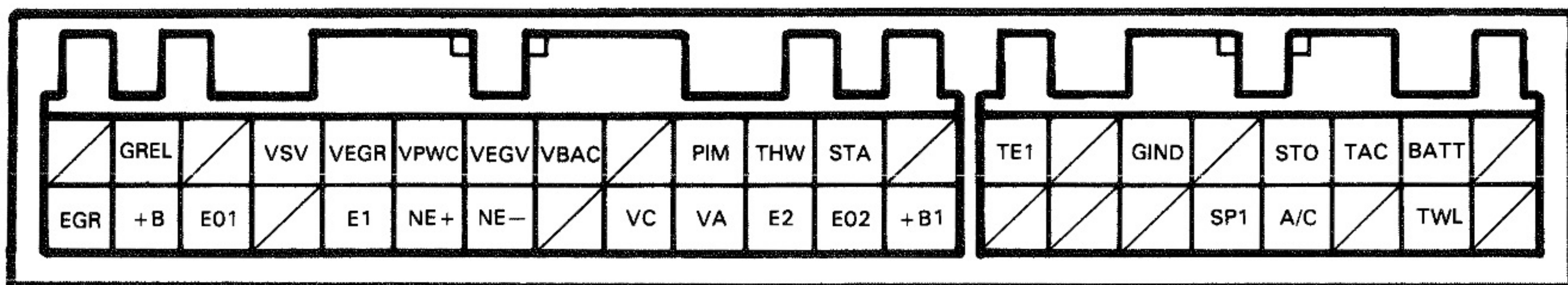
Emission ECU Terminals



Voltage at ECU Wiring Connectors

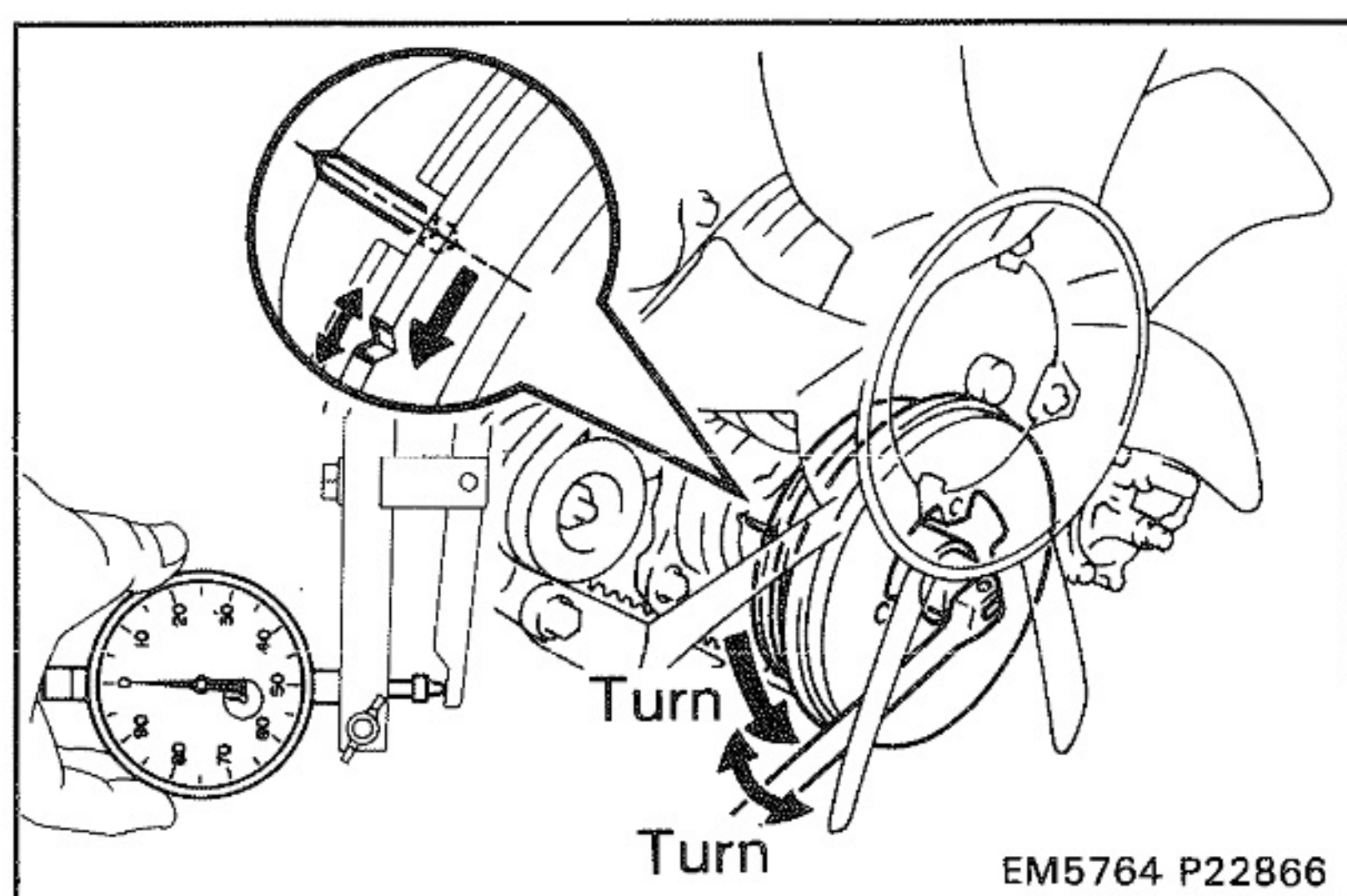
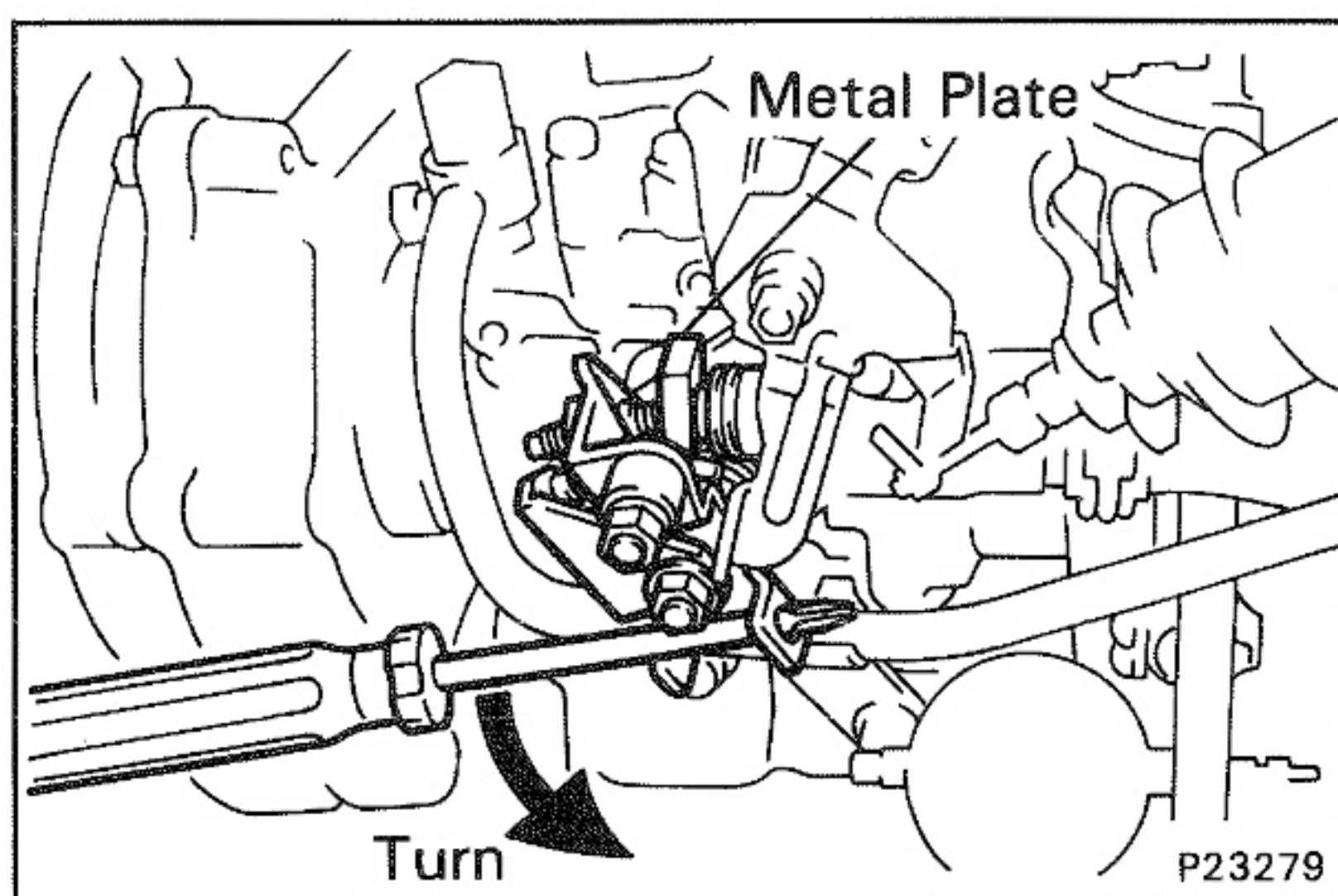
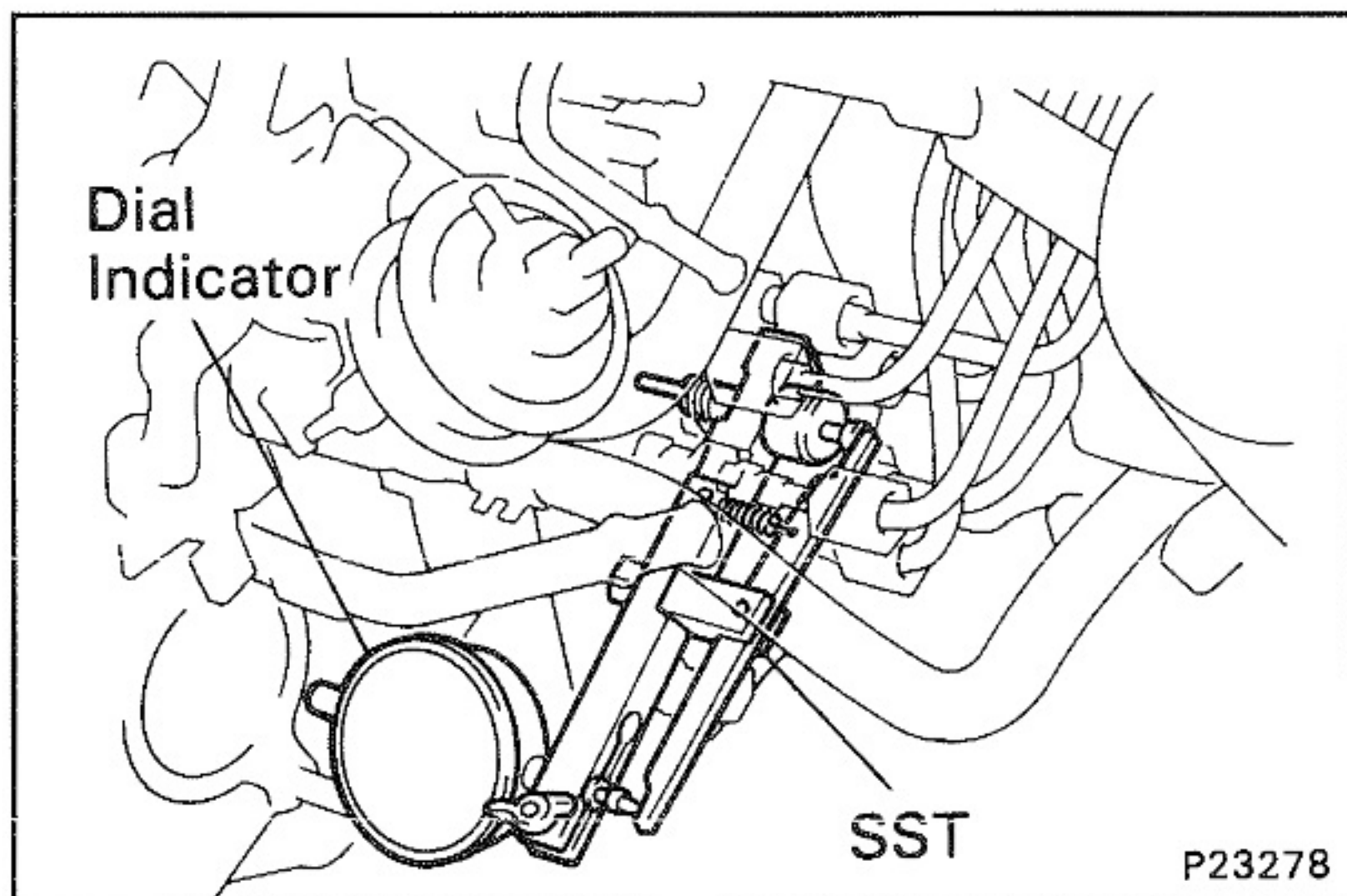
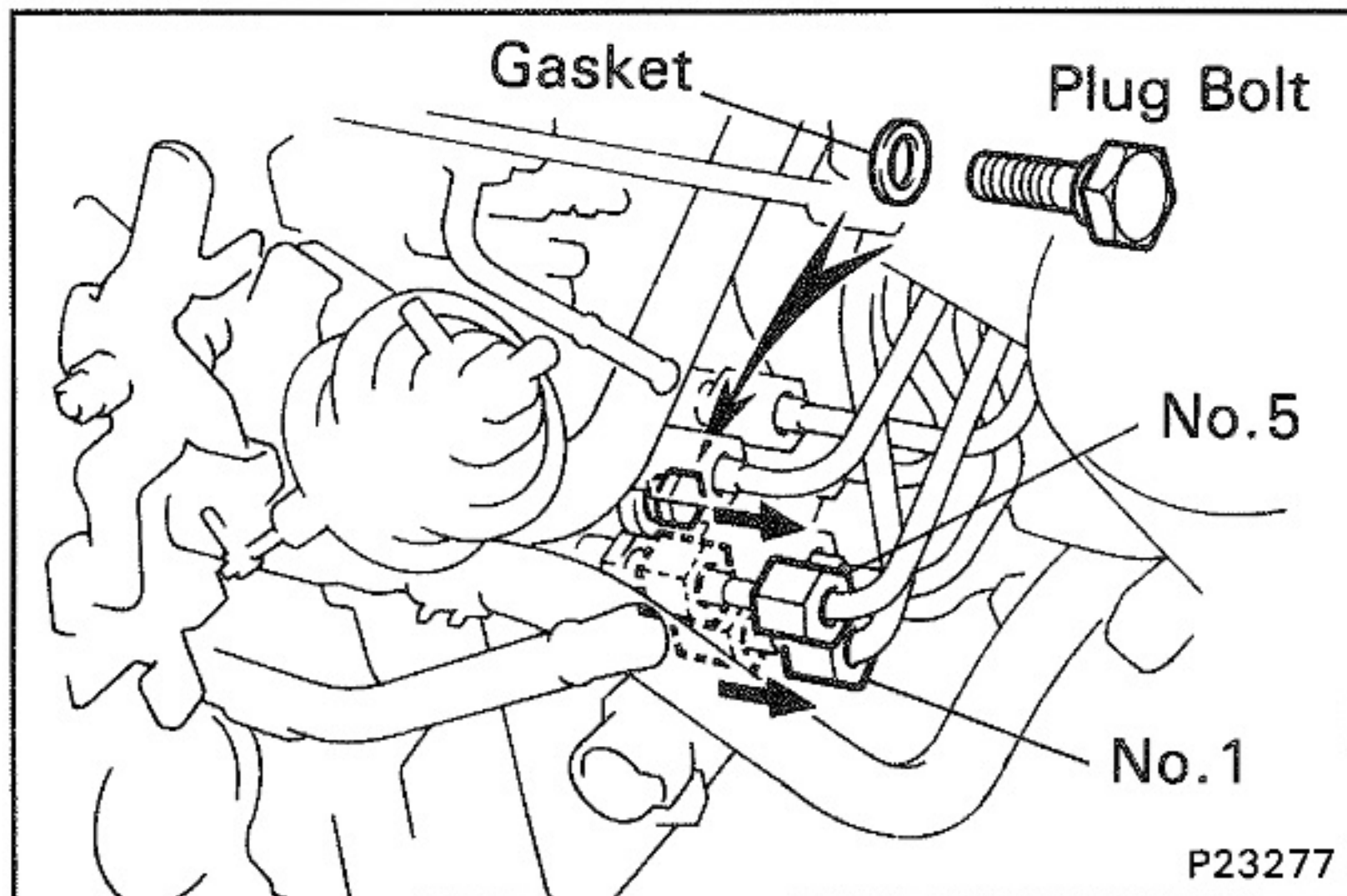
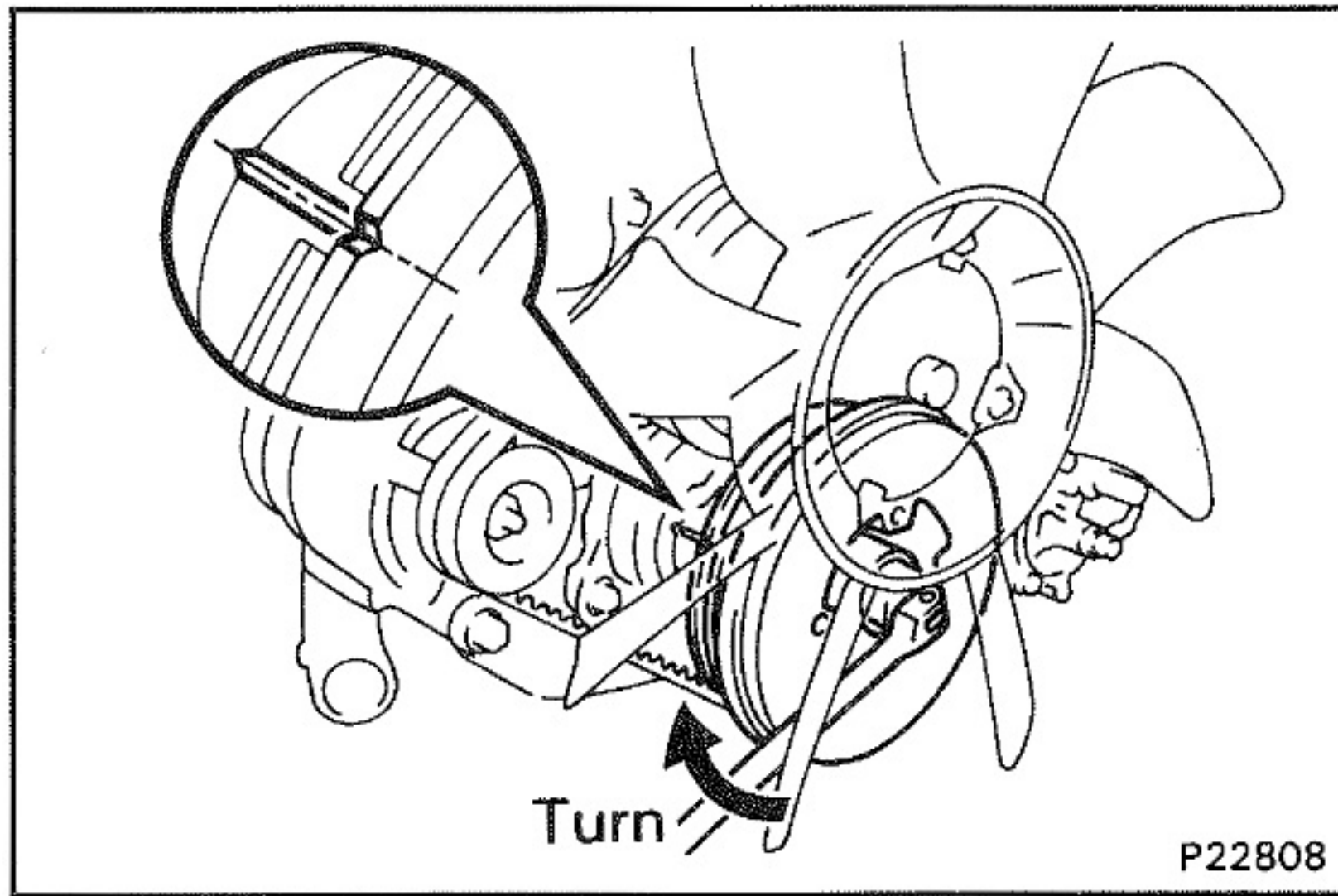
Terminals	Condition		STD voltage (V)	
BATT – E1	—		9 – 14	
+B +B1 – E1	IG switch ON		9 – 14	
PIM – E2			1.0 – 2.0	
VC – E2			4.5 – 5.5	
VEGV – E1			9 – 14	
VPWC – E1			9 – 14	
VEGR – E1			9 – 14	
VBAC – E1			9 – 14	
GIND – E1			IG switch ON	0 – 3
	Idling	9 – 14		
GREL – E1	IG switch ON	9 – 14		
	Idling	0.5 or less		
TWL – E1	IG switch ON	0 – 3		
	Idling	9 – 14		
VA – E2	IG switch ON	Adjusting lever fully closed	3.2 – 4.9	
THW – E2		Adjusting lever fully open	0.2 – 1.6	
		Coolant temp. 80°C (176°F)	0.2 – 1.0	
SP1 – E1		Rotate driving wheel	Pulse generation	
TE1 – E1		Check connector TE1 – E1 not connected	9 – 14	
		Check connector TE1 – E1 connected	0 – 3	
STA – E1	Cranking		6 or more	
TAC – E1	Idling		Pulse generation	
NE+ – NE–			Pulse generation	
EGR – E1			Engine speed 1,000 to 4,000 rpm	9 – 14
			Engine speed 4,200 rpm	Pulse generation
A/C – E1	A/C switch OFF		0 – 1.5	
	A/C switch ON		7.5 – 14	
STO – E1	Cranking		Pulse generation	
TAC – E1	Idling		Pulse generation	
VSV – E1	Idling		9 – 14	
	Fully accelerate		0 – 3	

Emission ECU Terminals



ENGINE ADJUSTMENT

INJECTION TIMING 3-2
IDLE SPEED AND MAXIMUM SPEED 3-4



INJECTION TIMING

1. SET NO.1 OR NO.6 CYLINDER TO TDC/COMPRESSION

Turn the crankshaft pulley clockwise, and align its groove with the groove of the timing belt cover.

2. INSTALL SST AND DIAL INDICATOR

- (a) Remove the plug bolt and gasket from the distributive head plug of the injection pump.
- (b) Loosen the 2 union nuts holding the injection pump to the No. 1 and No. 5 injection pipes, and slide the 2 union nuts rearward.

- (c) Install SST (plunger stroke measuring tool) and a dial indicator to the plug bolt hole of distributive head plug.
SST 09275—54011

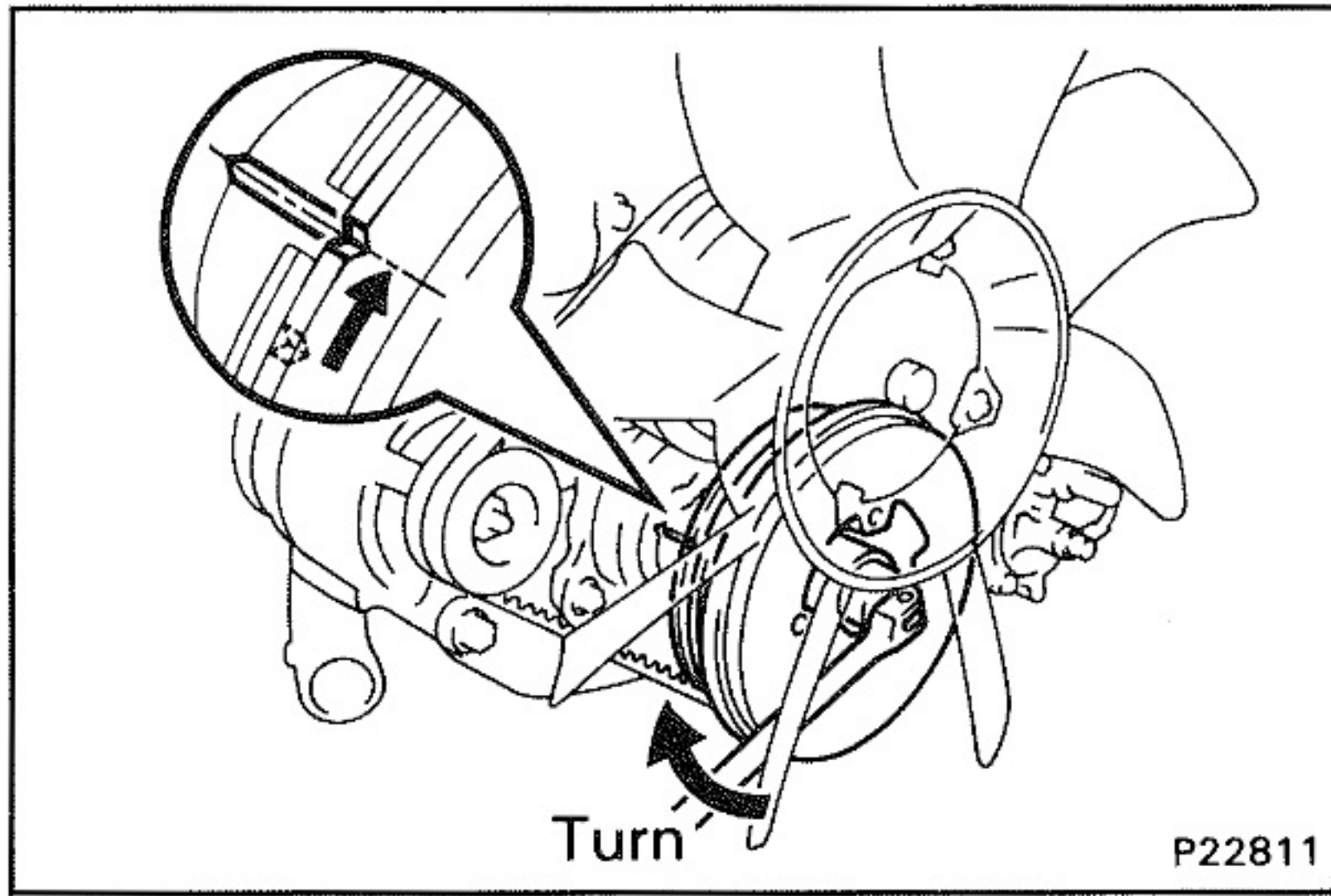
3. RELEASE ACSD ADVANCE

- (a) Using a screwdriver, turn the cold starting lever counter-clockwise approx. 20°.
- (b) Put a metal plate (thickness of 9.0 — 10 mm (0.354 — 0.394 in.)) between the cold starting lever and thermo wax plunger.

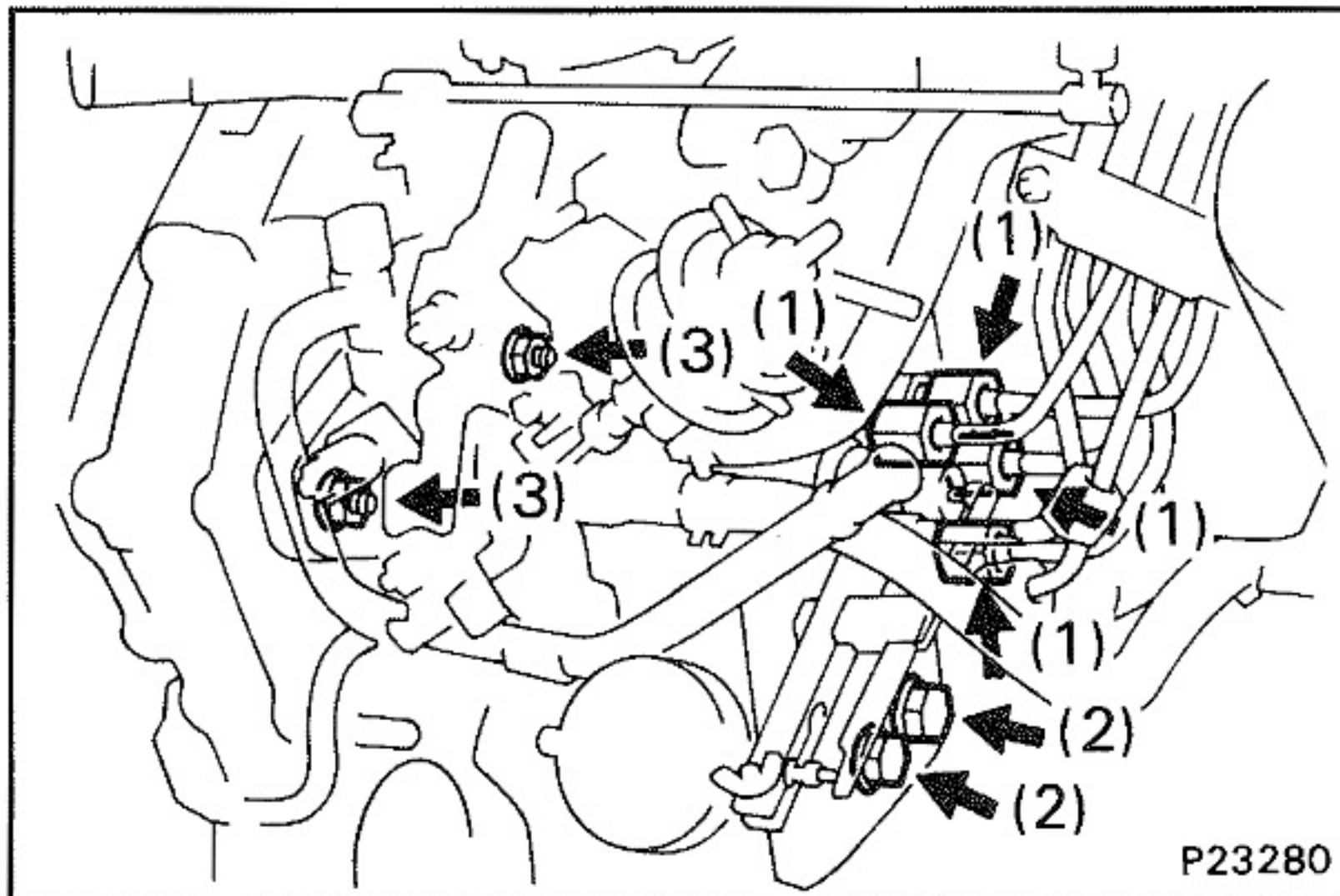
4. INSPECT AND ADJUST INJECTION TIMING

- (a) Slowly rotate the crankshaft pulley counterclockwise and set the dial indicator at 0 mm (0 in.) when the dial indicator reaches the minimum value.
- (b) Turn the crankshaft to the left and right and check that the dial indicator shows the minimum value.

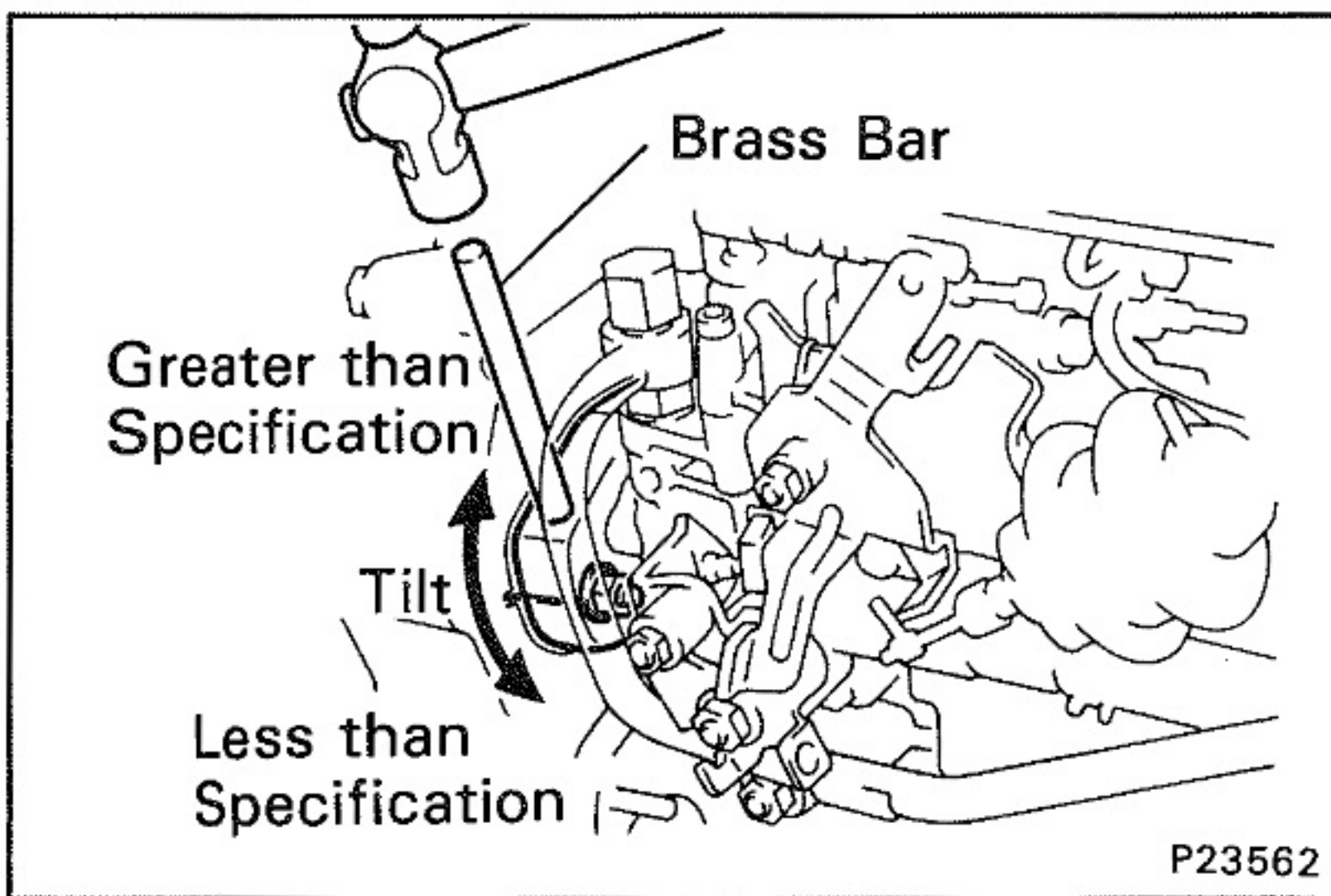
NOTICE: Check that the minimum value is set at 0 mm (0 in.).



- (c) Slowly rotate the crankshaft pulley clockwise until its groove is aligned with the groove of the timing gear cover.
- (d) Measure the plunger stroke.
Plunger stroke: 1.52 — 1.58 mm (0.0598 — 0.0622 in.)



- (e) Loosen these nuts and bolt:
 - (1) 4 remaining union nuts holding injection pipes to injection pump
 - (2) 2 bolts holding injection pump to injection pump stay
 - (3) 2 nuts holding injection pump to timing gear case**NOTICE: Do not turn the nuts more than 90°.**



- (f) Adjust plunger stroke by slightly tilting the injection pump body.
If the stroke is less than specification, tilt the pump toward the engine.
If the stroke is greater than specification, tilt the pump away from the engine.

HINT:

- If the stroke is less than specification, move the injection pump toward the engine.
- Using a brass bar and hammer, gradually tap the pump flange away from the engine.

- (g) Tighten these nuts and bolts:
 - 2 nuts holding injection pump to timing gear case
Torque: 18 N·m (185 kgf·cm, 13 ft·lbf)
 - 2 bolts holding injection pump to injection pump stay
Torque: 69 N·m (700 kgf·cm, 51 ft·lbf)
- (h) Recheck the plunger stroke.

5. REMOVE METAL PLATE

6. REMOVE SST AND DIAL INDICATOR

- (a) Remove the SST and dial indicator.
SST 09275—54011
- (b) Install a new gasket and the plug bolt of the distributive head plug.
Torque: 25.5 N·m (260 kgf·cm, 19 ft·lbf)

7. TIGHTEN INJECTION PIPE UNION NUTS

Torque: 24.5 N·m (250 kgf·cm, 18 ft·lbf)

8. START ENGINE AND CHECK FOR LEAKAGE

IDLE SPEED AND MAXIMUM SPEED

1. INITIAL CONDITIONS

- (a) Engine at normal operating temperature
- (b) Air cleaner installed
- (c) All accessories switched OFF
- (d) All vacuum lines properly connected
- (e) Valve clearance set correctly
- (f) Injection timing set correctly
- (g) Steering wheel at straight-ahead position

2. CONNECT TACHOMETER

3. INSPECT AND ADJUST IDLE SPEED

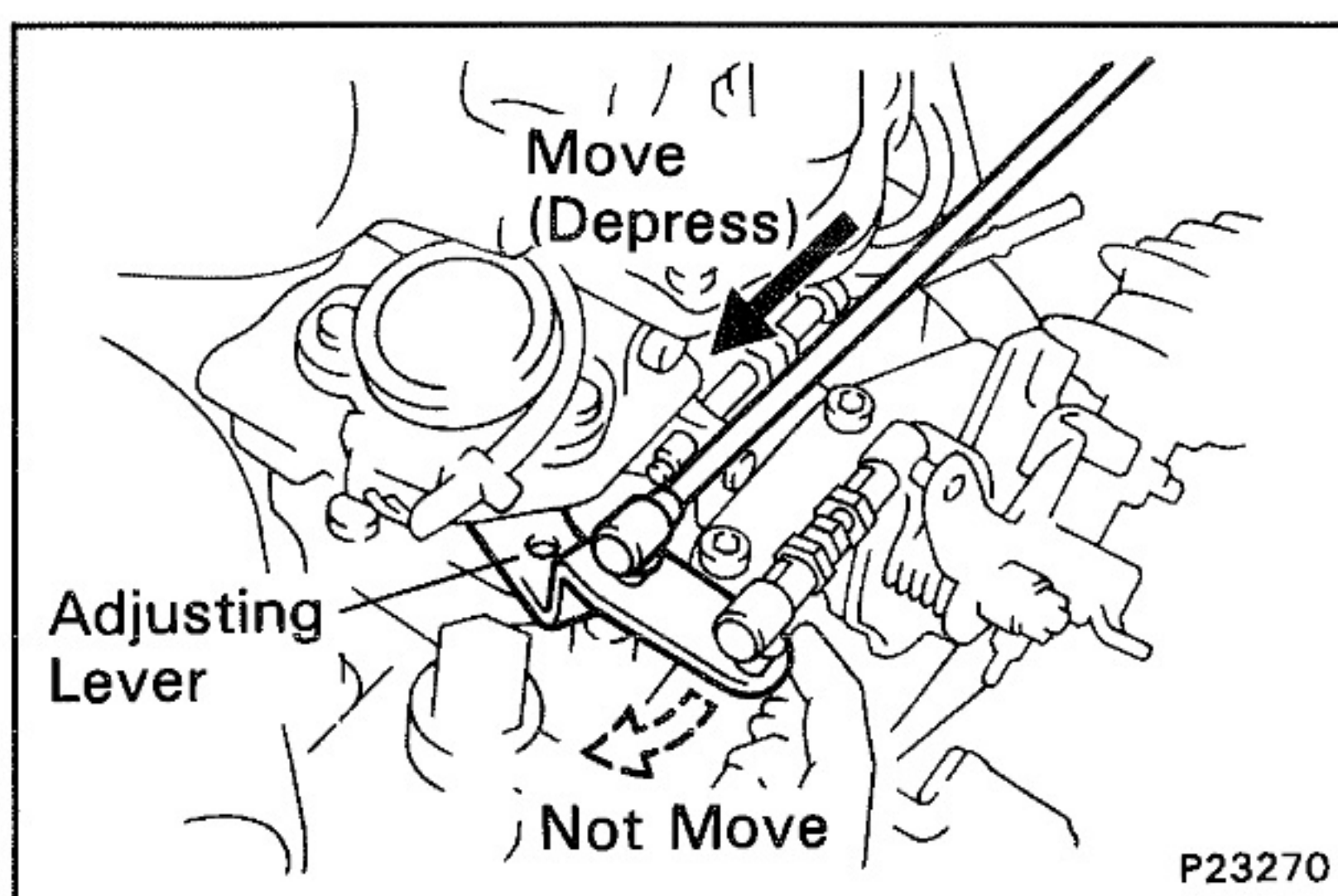
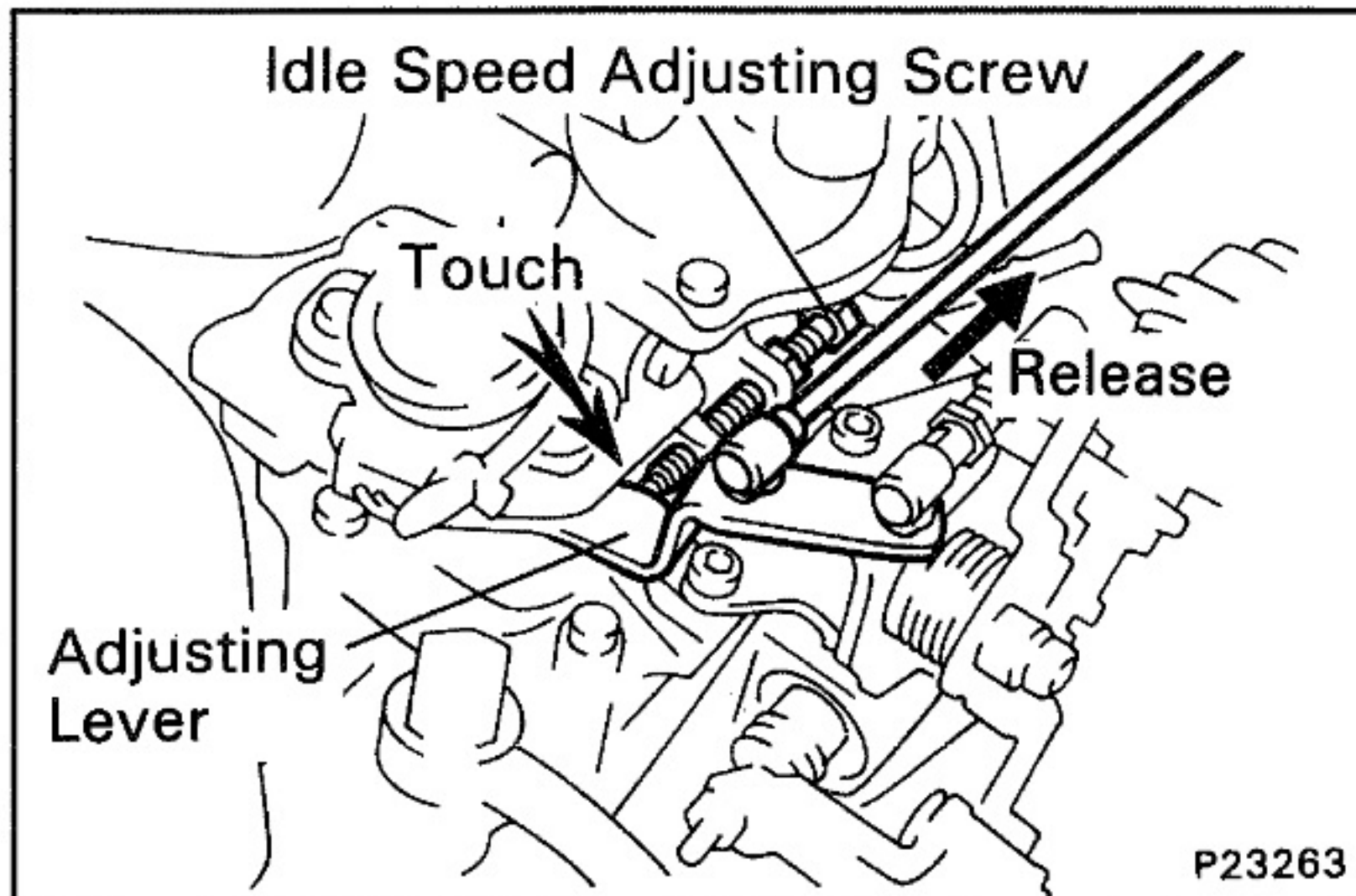
- (a) Check that the adjusting lever touches the idle speed adjusting screw when the accelerator pedal is released.

If not, adjust the accelerator linkage.

- (b) Start the engine.
- (c) Check the idle speed.

Idle speed: 700 ± 50 rpm

- (d) Adjust the idle speed.
 - Disconnect the accelerator linkage.
 - Loosen the lock nut of the idle speed adjusting screw.
 - Adjust the idle speed by turning the idle speed adjusting screw.
 - Securely tighten the lock nut, and recheck the idle speed.
 - Reconnect the accelerator linkage.
 - After adjustment, adjust the accelerator linkage.



4. CHECK AND ADJUST MAXIMUM SPEED

- (a) Depress the accelerator pedal all the way. Then check that the adjusting lever does not move when you try to push it to the maximum speed side.

If not, adjust the accelerator linkage.

- (b) Start the engine.
- (c) Depress the accelerator pedal all the way.
- (d) Check the maximum speed.

Maximum speed: $4,400 \pm 100$ rpm

If the maximum speed is not as specified, remove the injection pump and adjust the maximum speed.

SPECIFICATIONS

ENGINE TUNE-UP DATA A-2

ENGINE TUNE-UP DATA

Drive belt (Alternator)				
Deflection w/ 98 N (10 kgf, 22.0 lbf)				
	New belt	6 — 8 mm	0.24 — 0.31 in.	
	Used belt	8 — 11 mm	0.31 — 0.43 in.	
Tension (Reference) w/ SST				
	New belt	45 — 55 kgf		
	Used belt	20 — 35 kgf		
HINT:				
<ul style="list-style-type: none"> • "New belt" refers to a belt which has been used less than 5 minutes on a running engine. • "Used belt" refers to a belt which has been used on a running engine for 5 minutes or more. • After installing the drive belt, check that it fits properly in the ribbed grooves. 				
Engine coolant capacity				
	w/ Front and rear heaters	12.0 liters	12.7 US qts	10.7 Imp.qts
Engine oil capacity				
Drain and refill	w/ Oil filter change	9.7 liters	10.3 US qts	8.5 Imp.qts
	w/o Oil filter change	8.4 liters	8.9 US qts	7.4 Imp.qts
Dry fill		10.0 liters	10.6 US qts	8.8 Imp.qts
Engine oil API grade		CD or better		
Battery specific gravity				
	105D31L (R)	1.27 — 1.29 (when fully charged at 20°C (68°F))		
	Others	1.25 — 1.27 (when fully charged at 20°C (68°F))		
Injection nozzle opening pressure				
	No.1 (Primary)	17,652 — 18,633 kPa (180 — 190 kgf/cm ² , 2,560 — 2,702 psi)		
	No.2 (Secondary)	23,046 — 24,026 kPa (235 — 245 kgf/cm ² , 3,342 — 3,485 psi)		
Valve clearance (Cold)				
	Intake	0.17 — 0.23 mm	0.007 — 0.009 in.	
	Exhaust	0.47 — 0.53 mm	0.019 — 0.021 in.	
Injection timing				
	Plunger stroke	1.52 — 1.58 mm	0.0598 — 0.0622 in.	
Idle speed		700 ± 50 rpm		
Maximum speed		4,400 ± 100 rpm		
PS idle-up setting speed		700 ± 50 rpm (steering at full lock)		
A/C idle-up setting speed		775 — 850 rpm (A/C ON)		
Injection order		1 — 4 — 2 — 6 — 3 — 5		
Compression pressure at 280 rpm		STD	3,432 kPa (35.0 kgf/cm ² , 498 psi) or more	
		Limit	2,452 kPa (25.0 kgf/cm ² , 356 psi)	
Difference of pressure between each cylinder		490 kPa (5.0 kgf/cm ² , 71 psi) or less		