

WORKSHOP MANUAL

Volkswagen

L-Jetronic

ROBERT BOSCH

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This manual describes the trouble-shooting and repair of vehicles with the Robert Bosch L-Jetronic (EFI) System using mostly common workshop tools. You should understand this fuel injection system before you begin working on the vehicle. The Bosch Technical Instruction Booklet VDT-UBP 751/1B explains the L-Jetronic System in detail and will increase your understanding of this system. This will reduce repair times and facilitate the use of this Workshop Manual.

HOW TO USE THIS MANUAL

This manual is designed to assist the technician unfamiliar with Robert Bosch fuel injection systems in locating faults in the L-Jetronic system, isolating the component involved and testing the component for correct function. You will need a volt-ohmmeter and a pressure gauge as described in the *Tool List*. Electrical measurements are made at the terminals of the large plug at the end of the wiring harness after it is removed from the control unit, or at the terminals of the individual components themselves. Most components of this system cannot be repaired and will have to be replaced once you have determined them defective.

If you are already familiar with Bosch EFI systems and can identify and locate all the components in the vehicle, go directly to the *Trouble-Shooting Chart* to track down the faulty component according to the engine symptom given. Then go to the *Component Test Instructions* for directions on testing the suspected component. Technicians who are experienced in the various tests on this vehicle model can go directly to the *Test Chart* where the individual test steps and values are given.

An *Electric Wiring Diagram* is included at the end of the manual to assist you in tracing cables and locating the various terminals. Be sure to check and if necessary reset the CO adjustment before returning the car to the customer.

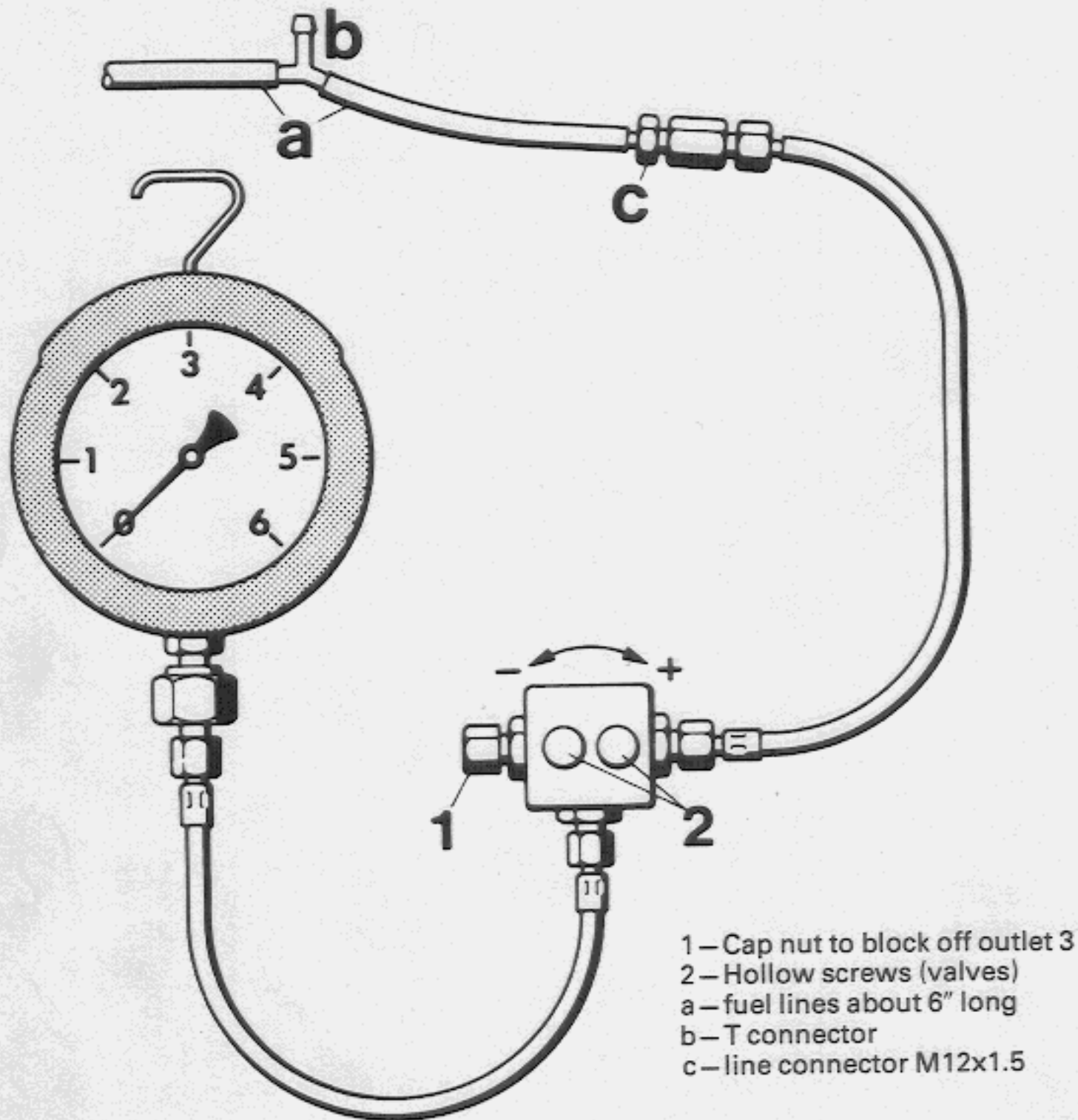
SAFETY INSTRUCTIONS

1. Never start the engine without battery cables firmly connected.
2. Never jump the battery to start the car.
3. Never remove cables from battery with engine running.
4. Always remove cables from battery before charging.
5. Never remove or attach wiring harness plug to Control Unit with the ignition on.
6. When turning the engine over to check compression, unplug the red cable from the battery to the relays.
7. Before testing the L-Jetronic system, be sure timing, dwell and spark plugs check out OK and are within specification.

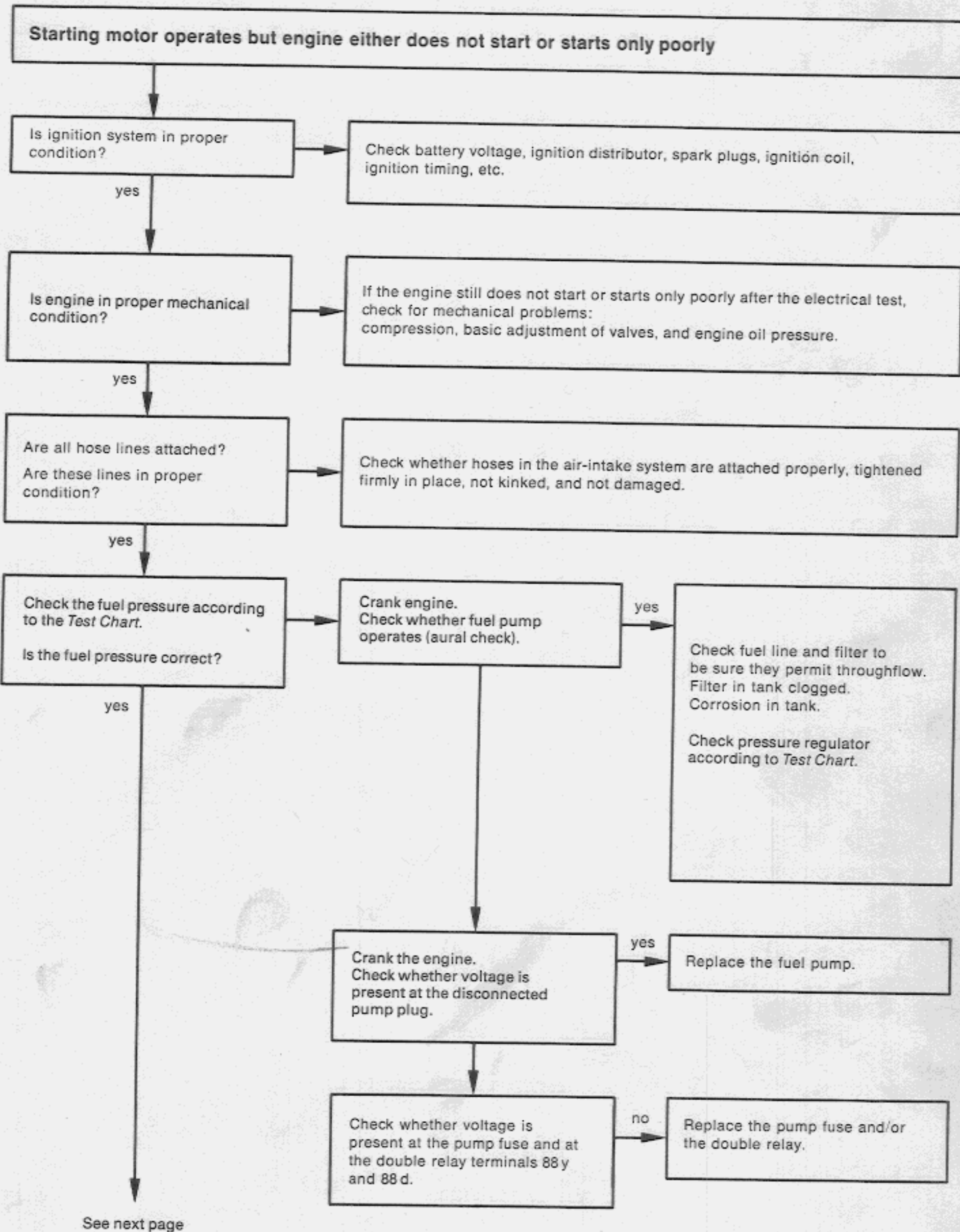
TOOL LIST

In addition to the pressure gauge and fittings shown below, a tachometer, CO meter and ohmmeter are needed for testing the L-Jetronic system in the vehicle as described in this manual.

The pressure gauge KDEP 1034 is the same unit used to test Robert Bosch K-Jetronic (CIS) systems and reads from 0-6 bar pressure. To use this gauge for testing vehicles with L-Jetronic, modify it as shown below. Order the complete gauge and directional control valve under the number **KDEP 1034**. The directional control valve alone is available under the order number **KDEP 1034/1**.



TROUBLE-SHOOTING CHART



Starting motor operates but engine either does not start or starts only poorly (continued)

Is the start valve in proper condition?

yes

See next page

Check cold start valve according to *Test Chart*.
Voltage at cold start valve OK?

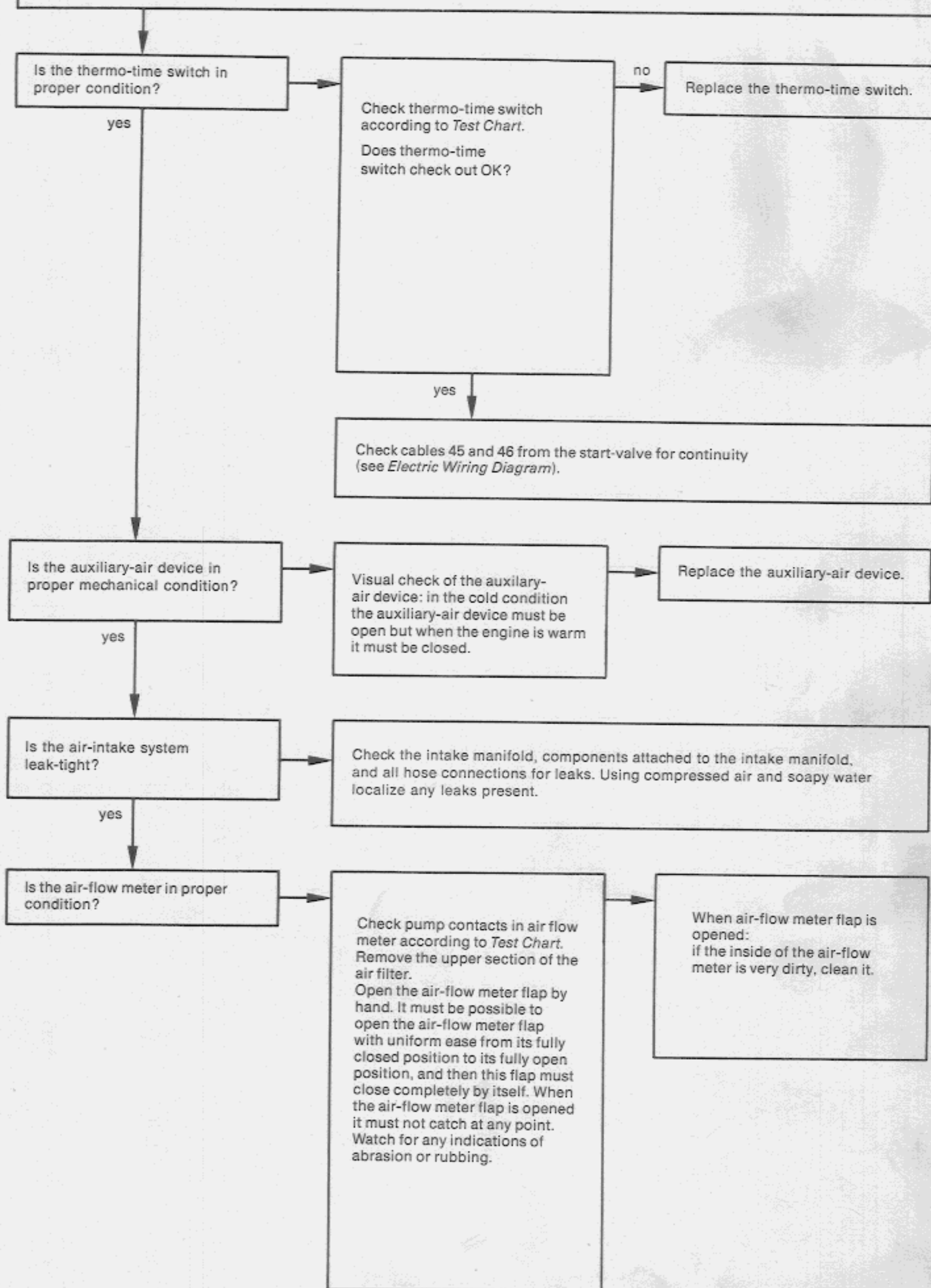
no

Check cable 45 for continuity to thermo-time switch terminal G. Check cable 46 for continuity to thermo-time switch terminal W.

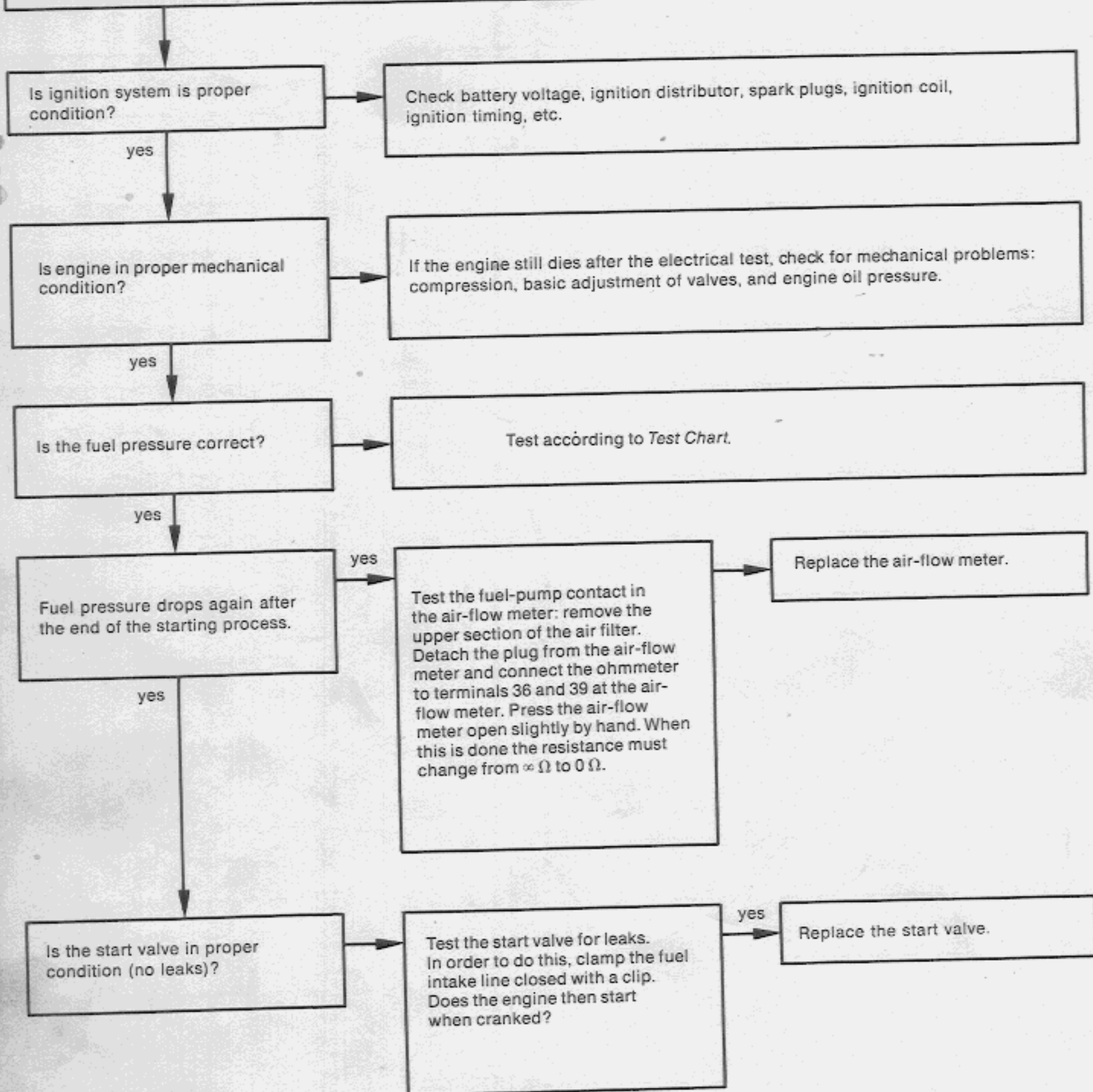
yes

Test the start valve mechanically
Remove the valve from the intake manifold and hold it in a container.
(Caution fire risk!)
During starting and with engine temperature below 50° F the valve must spray fuel (max 20 sec.). At a temperature above 104° F the valve must not spray fuel. With the ignition switched on and with pressure built up, the valve must also not spray fuel.
Carry out the spray test at temperatures above 104° F as follows:
remove the plug from the thermo-time switch and connect terminal "W" to ground.
If a spray test cannot be carried out, see cold-start relay.

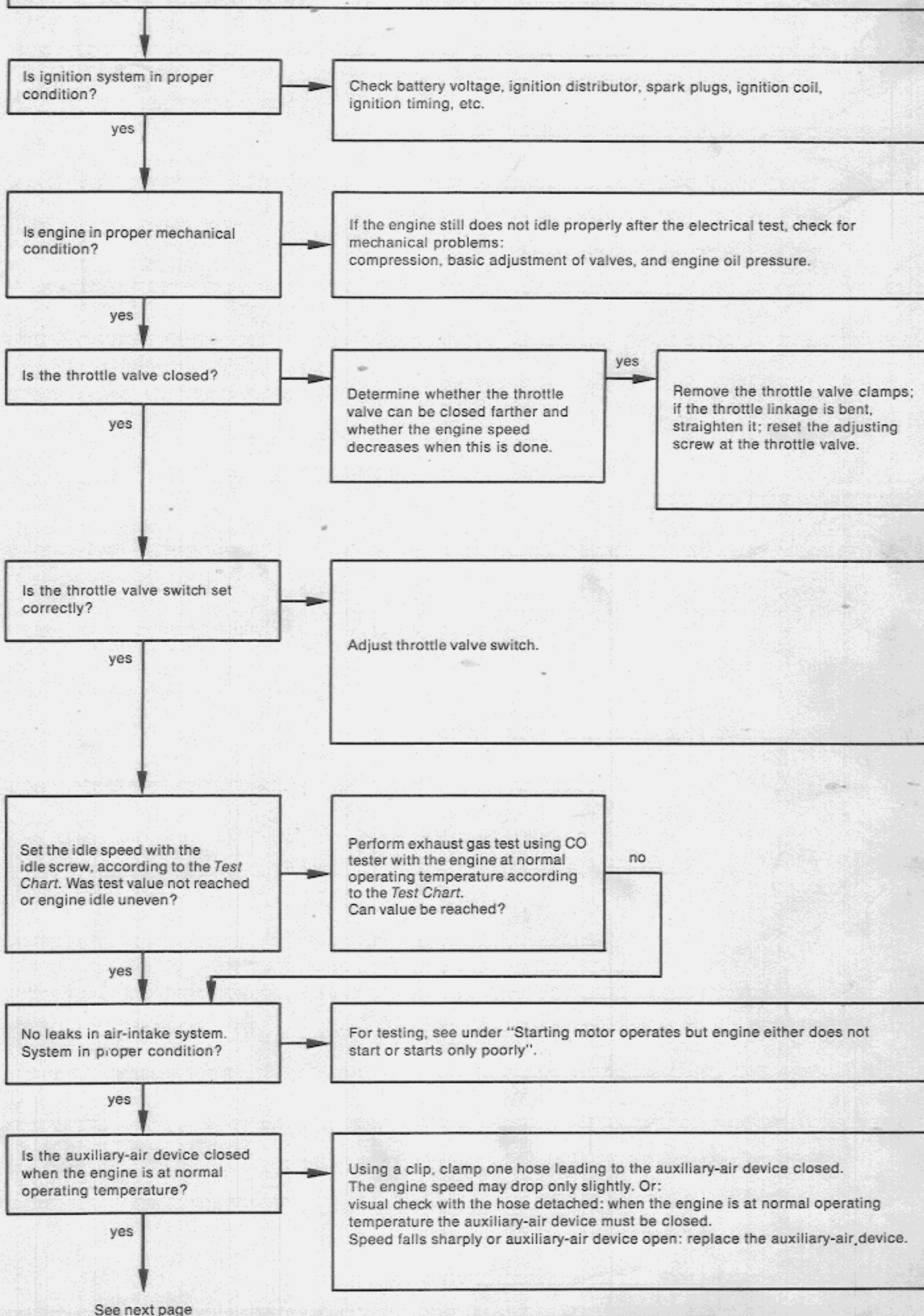
Starting motor operates but engine either does not start or starts only poorly (continued)



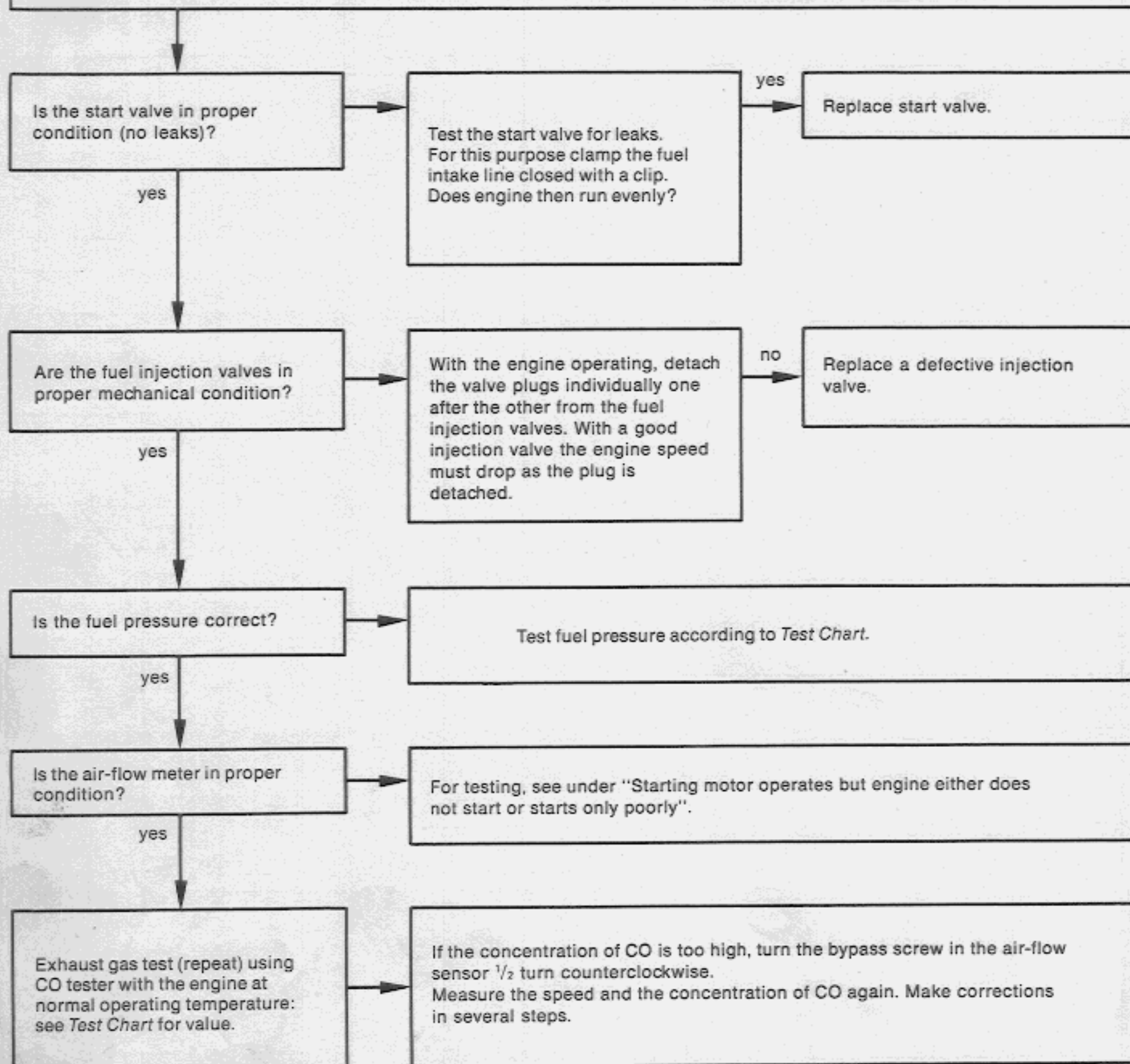
Engine starts but then dies

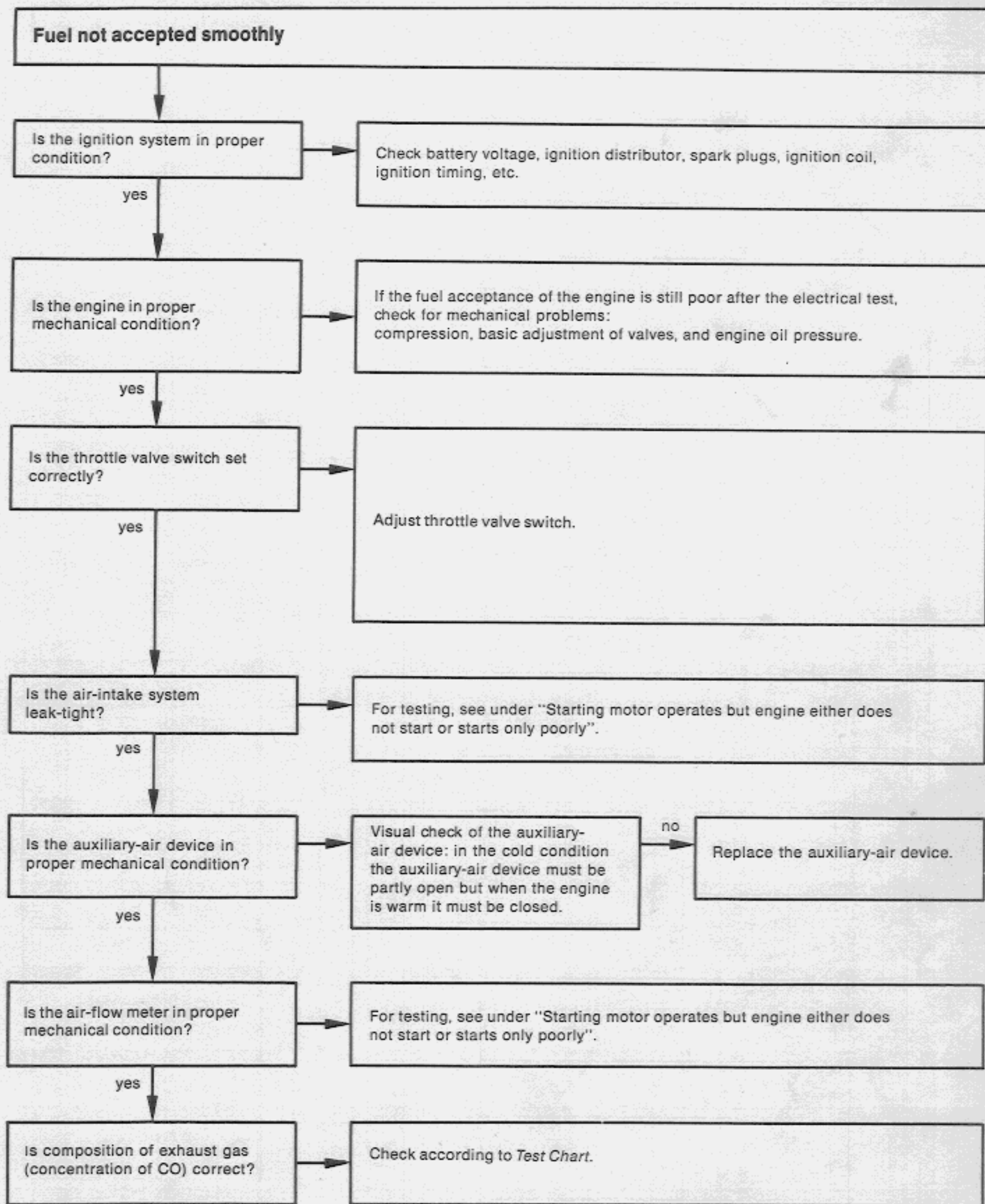


Rough engine idle, speed adjustment (idle), and exhaust gas test



Rough engine idle, speed adjustment (idle), and exhaust gas test (continued)





Engine misses occur under all operating conditions

Is the ignition system in proper condition?

Check battery voltage, ignition distributor, spark plugs, ignition coil, ignition timing, etc.

yes

Is engine in proper mechanical condition?

If engine misses still occur after the electrical test, check for mechanical problems: compression, basic adjustment of valves, and engine oil pressure.

yes

Are the plug connections in the L-Jetronic wiring harness in proper condition?

Check for engine misses caused by loose contacts as follows
Start engine with tachometer connected. Hold the engine speed constant while observing the reading and/or listening for engine misses. Move the wiring harness and the plug connections the reading must not vary and engine misses must not occur. Check the plug connections for correct seating and corrosion. Test ground cables 5, 16, 17, and 49 for continuity and loose contacts.

yes

Is the voltage supply for the fuel injection system in proper condition?

Detach both wiring harness plugs from the double relay. Check that all plug sleeves and electric cables are in proper condition. Check all connector cables for continuity. Move the wiring harness when doing this (suspicion of broken cables). See also preceding testing step with wiring harness.

yes

Is the start valve in proper condition (no leaks)?

Using a clip, clamp the fuel pressure hose closed in front of the connection at the start valve.
If this eliminates the engine misses, replace the start valve.

yes

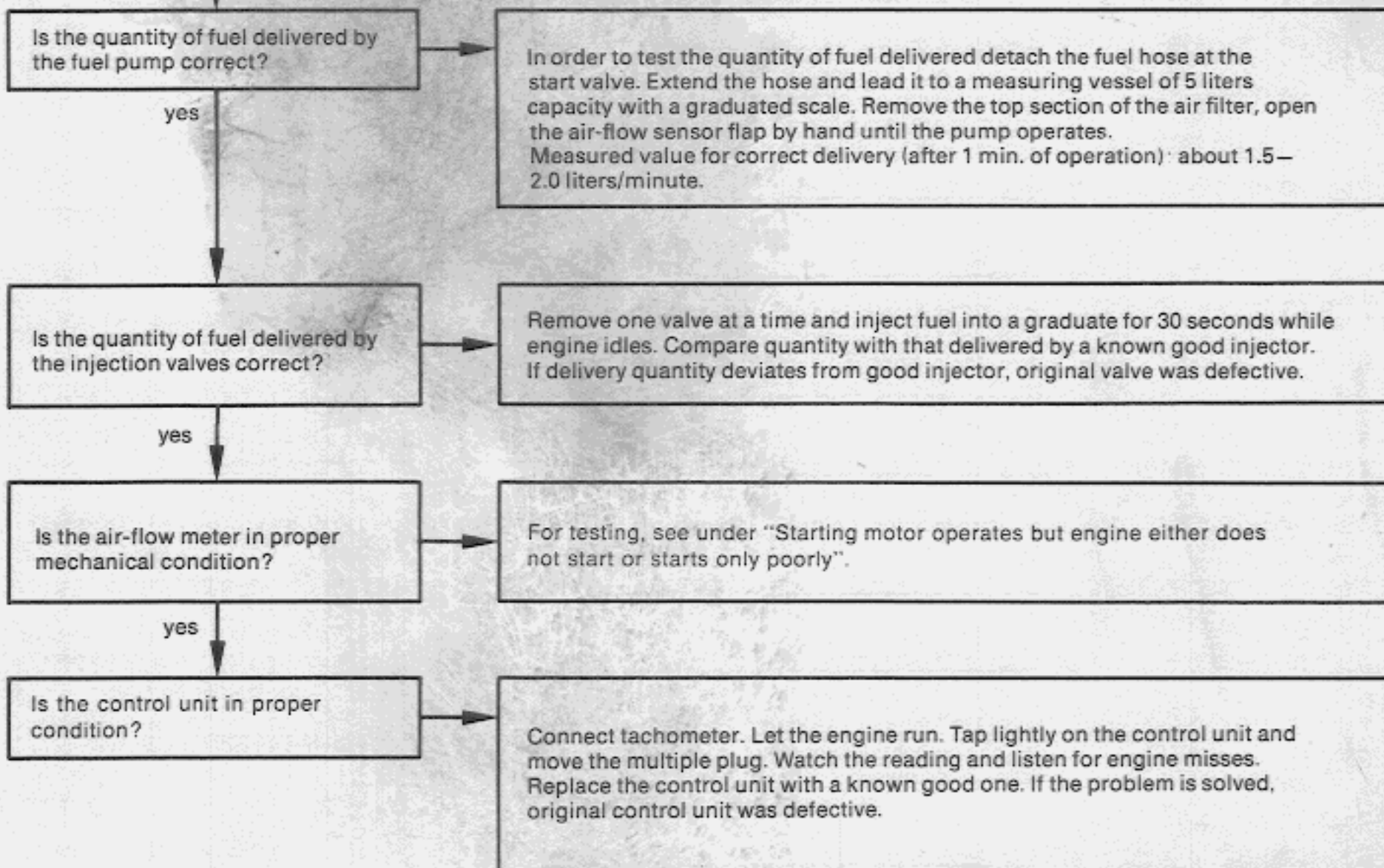
Are the alternator and regulator in proper condition?
(Engine misses caused by voltage peaks.)

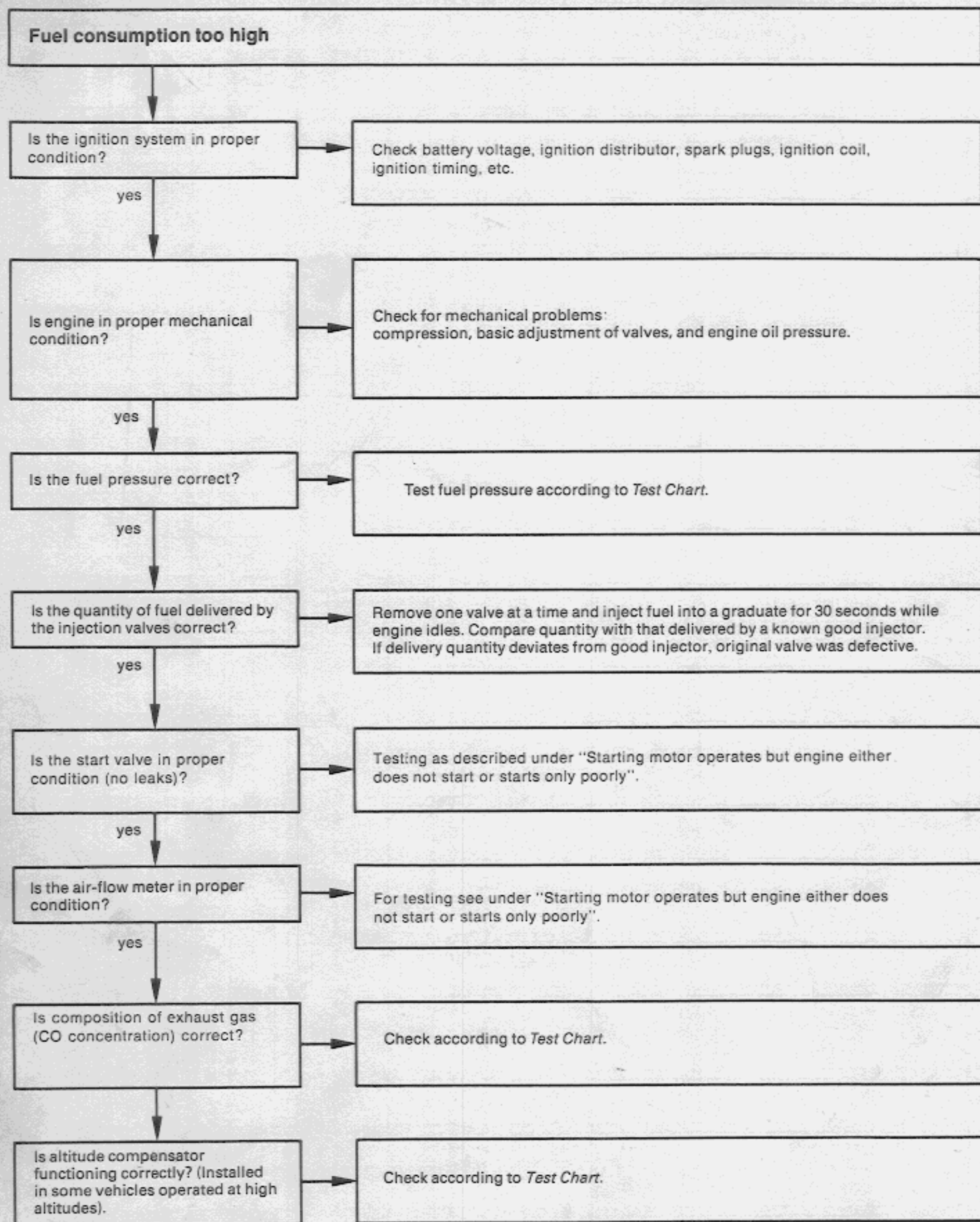
With the engine stopped remove the plug from the alternator. Start the engine. If this eliminates the engine misses, check the alternator and regulator.

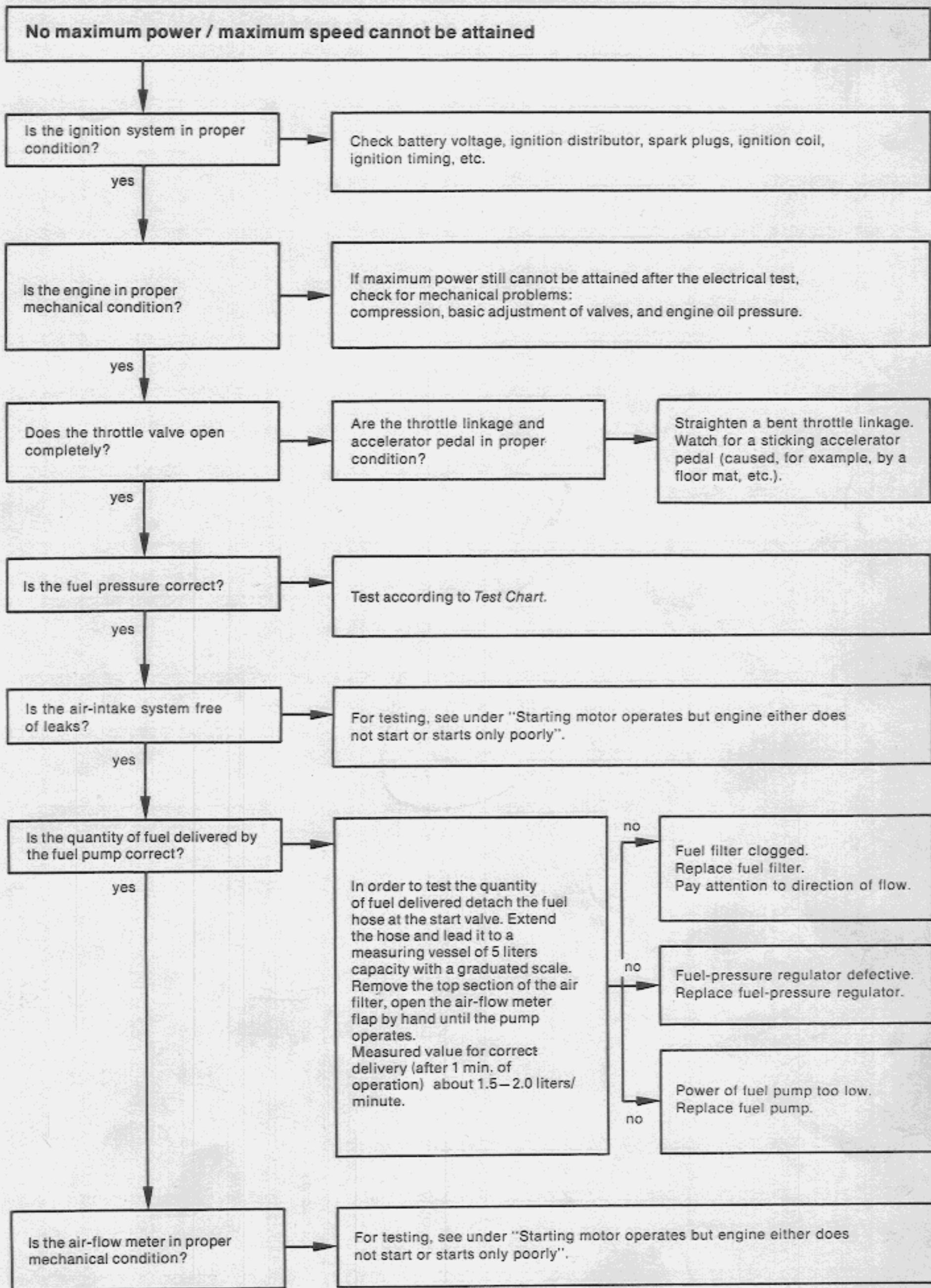
yes

See next page

Engine misses occur under all operating conditions (continued)



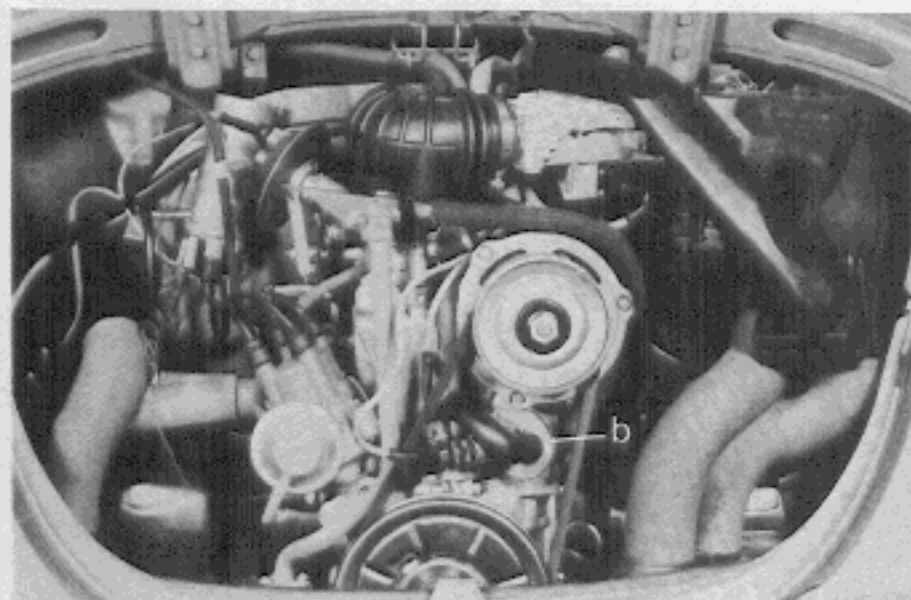




COMPONENT TEST INSTRUCTIONS

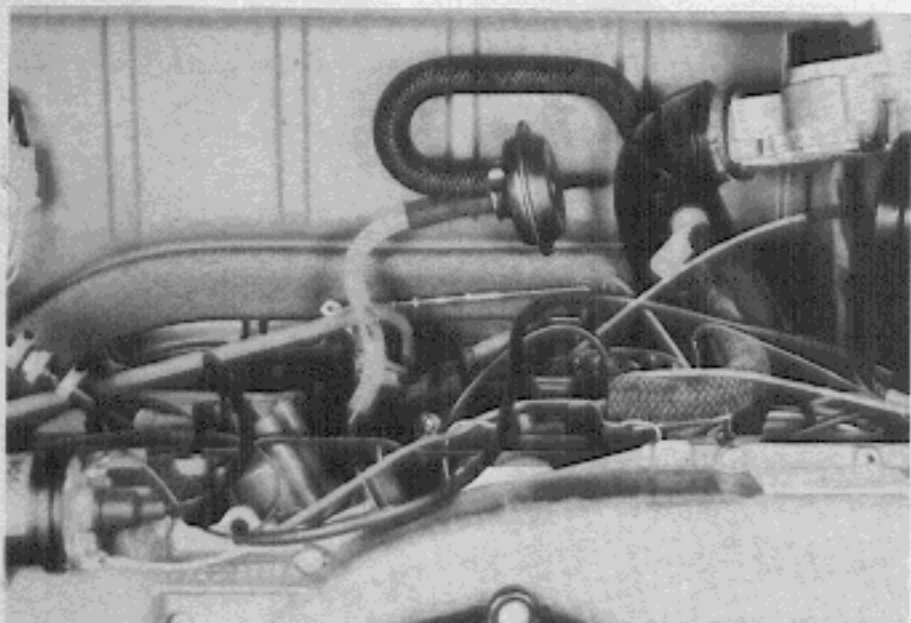
To check the entire system for air leaks, disconnect one hose from the auxiliary air valve and blow compressed air through the hose with the throttle open. Soapy water on hoses and connections will then indicate leaks.

TYPE 1 (BEETLE)



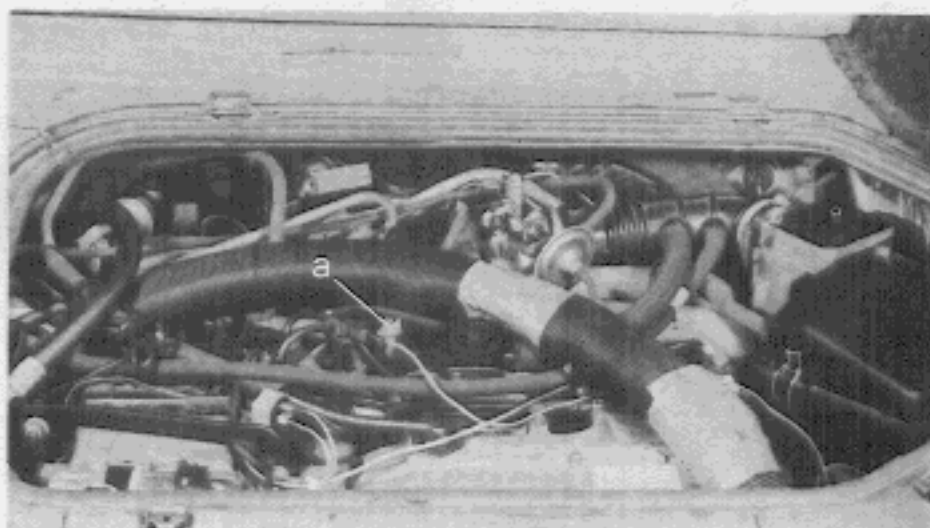
- a— Thermo-time switch
- b— Auxiliary air valve
- c— Air flow meter

TYPE II (BUS)



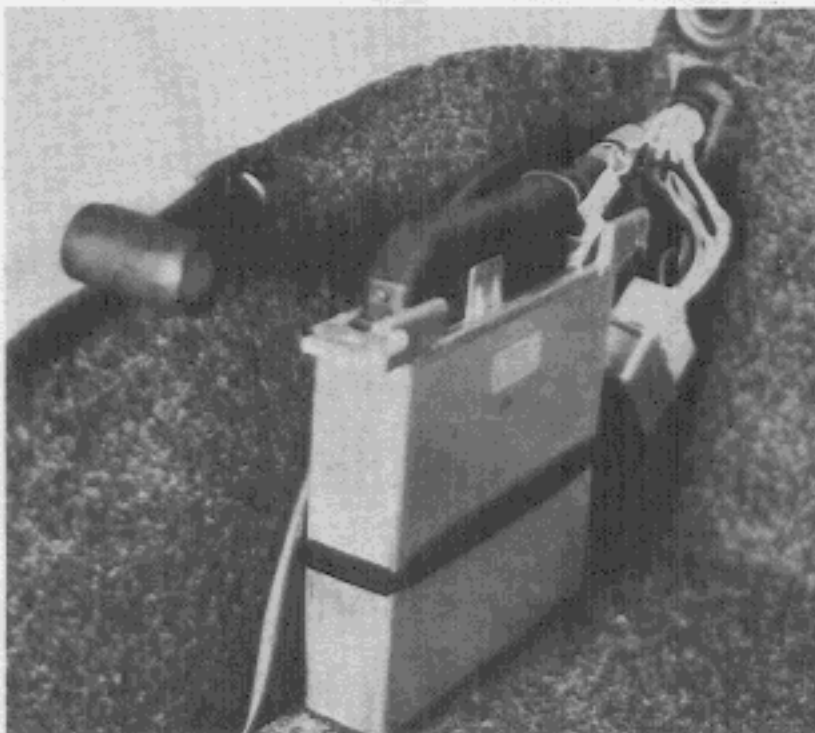
- a— Cold start valve
- b— Auxiliary air valve (behind crankcase vent hose)
- c— Air flow meter

TYPE 412

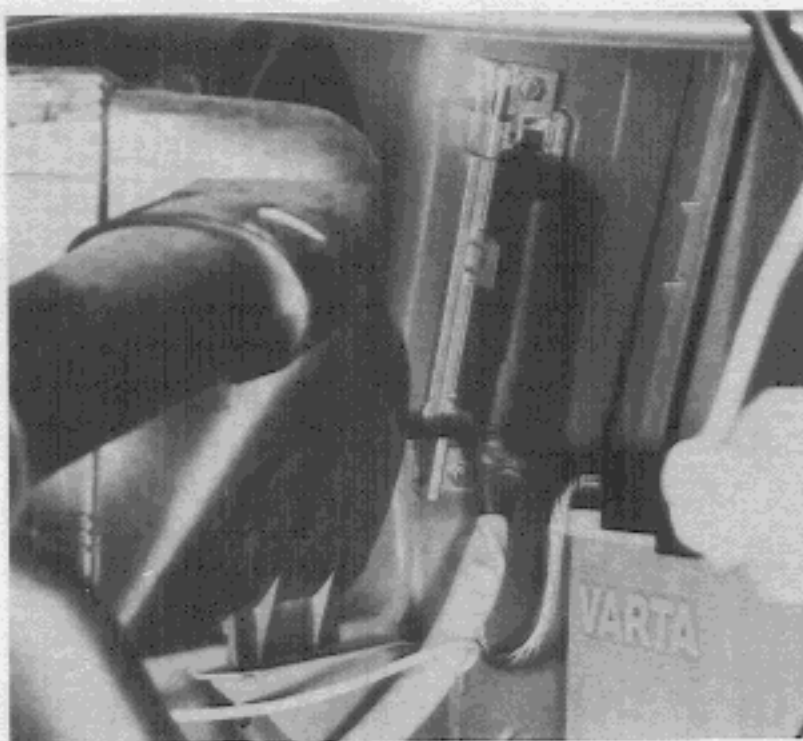


- a— Cold start valve
- b— Pressure regulator
- c— Air flow meter

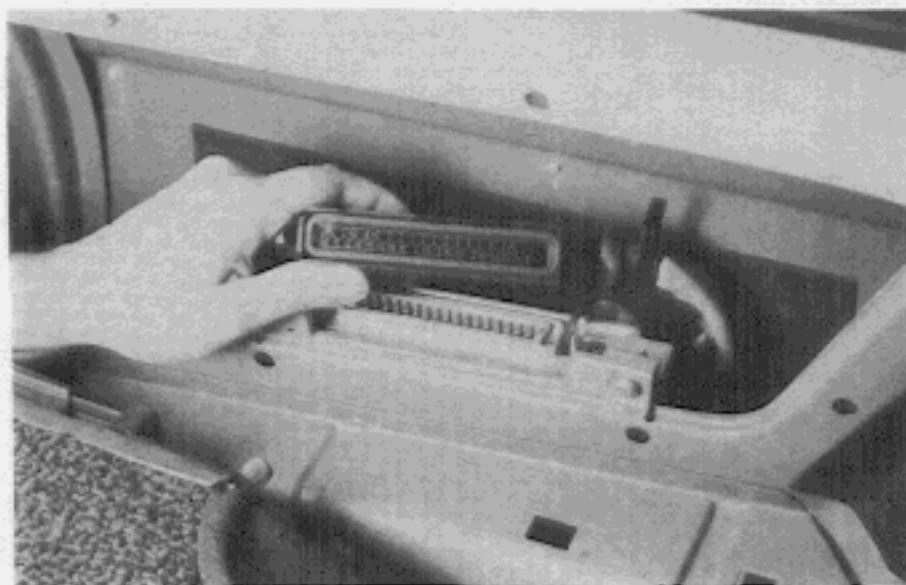
The **control unit** in the Beetle is located behind the rear seat together with the relays.



In the Bus, the control unit is located at the right hand side of the engine compartment. The relays are mounted on the left side firewall.

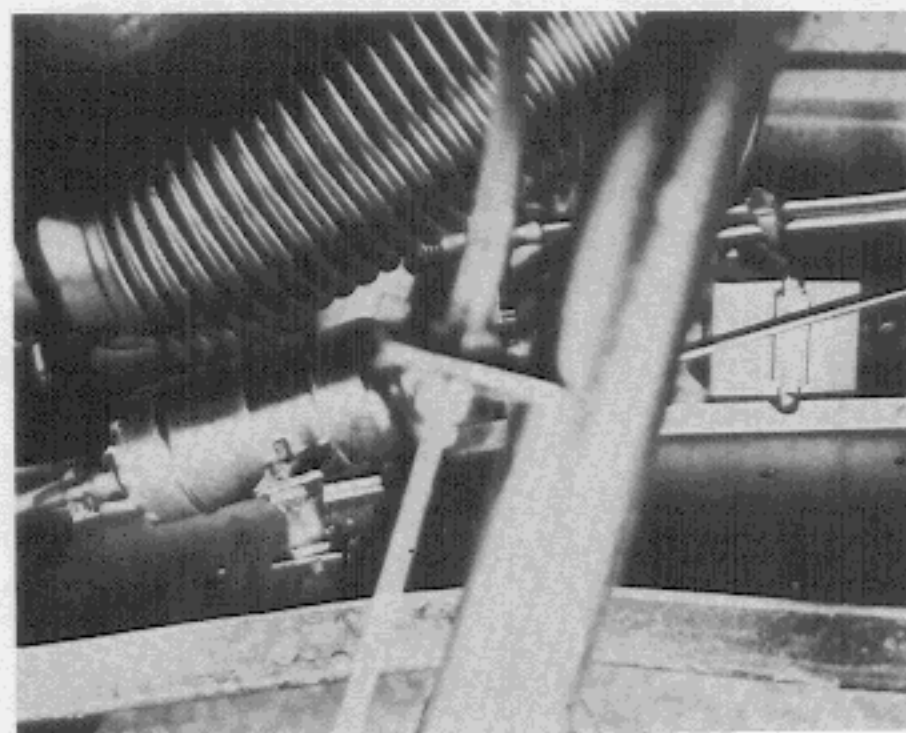


The control unit and relays in 412 models are behind the passenger side rear seat trim panel.

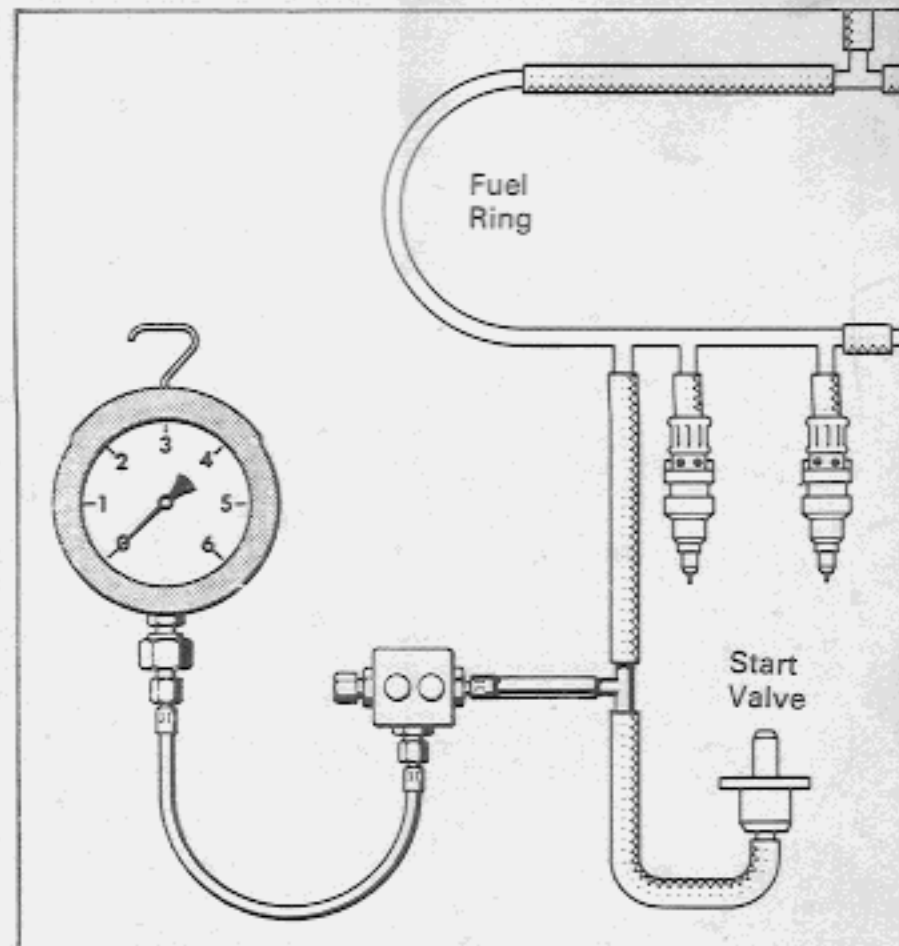


The wiring harness plug is removed from the ECU for many of the tests described in the *Test Chart*.

The **fuel pump** and **fuel filter** are located under the vehicle next to the gas tank in all models (Bus shown). The voltage check described in the *Test Chart* is performed at the plug contacts after the plug is removed.



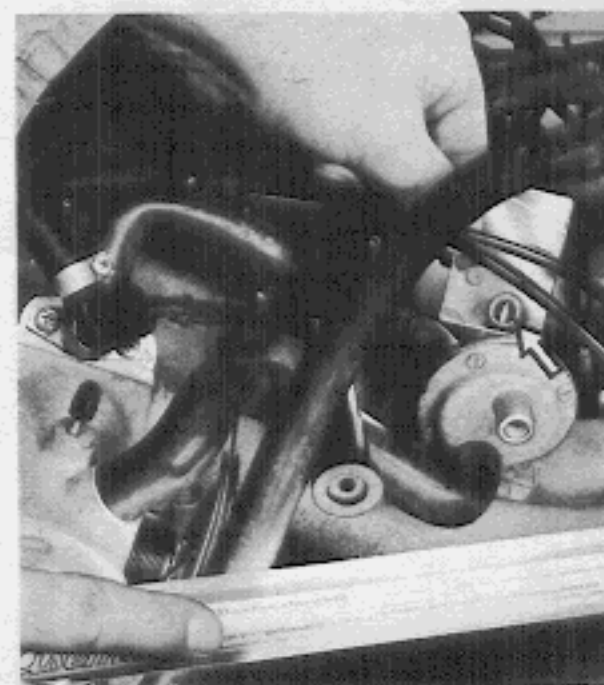
The fuel pressure test is made inside the engine compartment by removing the hose from the start valve and connecting pressure gauge KDEP 1034 in series with the line using a T-piece and extra length of hose as shown below.



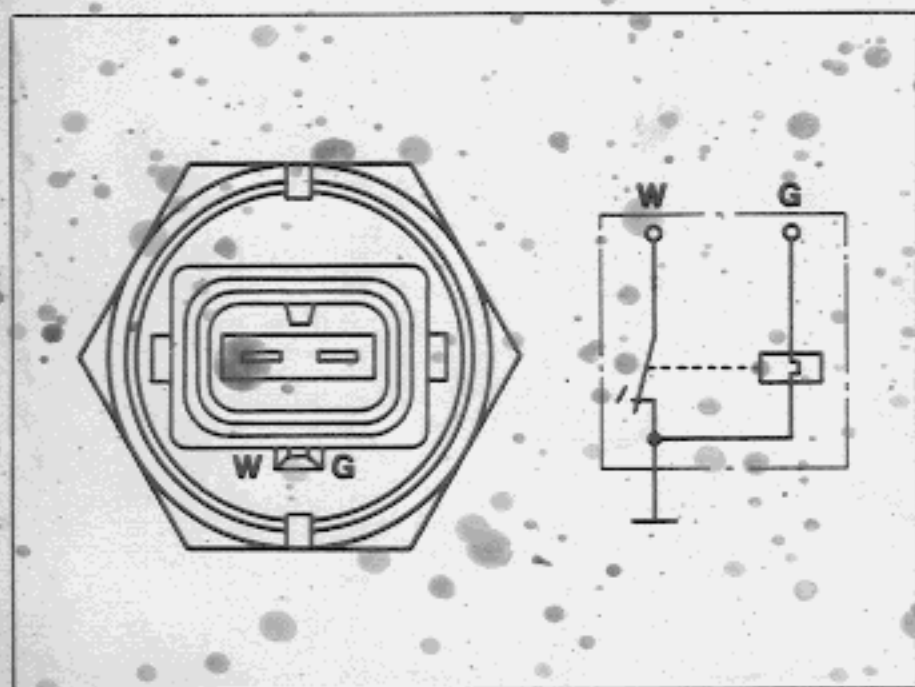
Before testing the system for correct pressure value, remove the pressure regulator vacuum hose at the regulator or manifold and block the opening (see *Fuel System Description*). Start the engine and let it idle. Read the gauge for the correct pressure as shown in the *Test Chart*: **2.2-2.6 bar**. Now reconnect the vacuum hose to the regulator. The pressure should drop to about 2 bar at idle, and rise again when the throttle is opened. If this is not the case, check the vacuum hose for leaks.

A clean, unclogged filter is a prerequisite for accurate fuel pressure and delivery tests as described in the *Test Chart*.

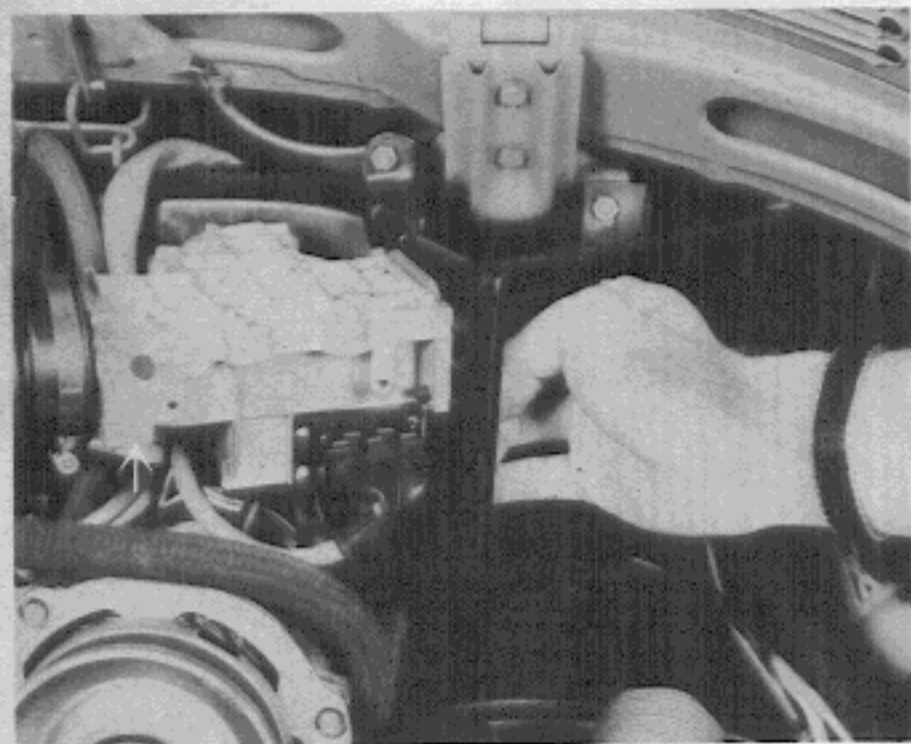
To test the **auxiliary air valve**, remove the 2 hoses from the valve and use a mirror and light source to look through the valve. It should be partially open when the engine is cold and fully closed when the engine is warmed up.



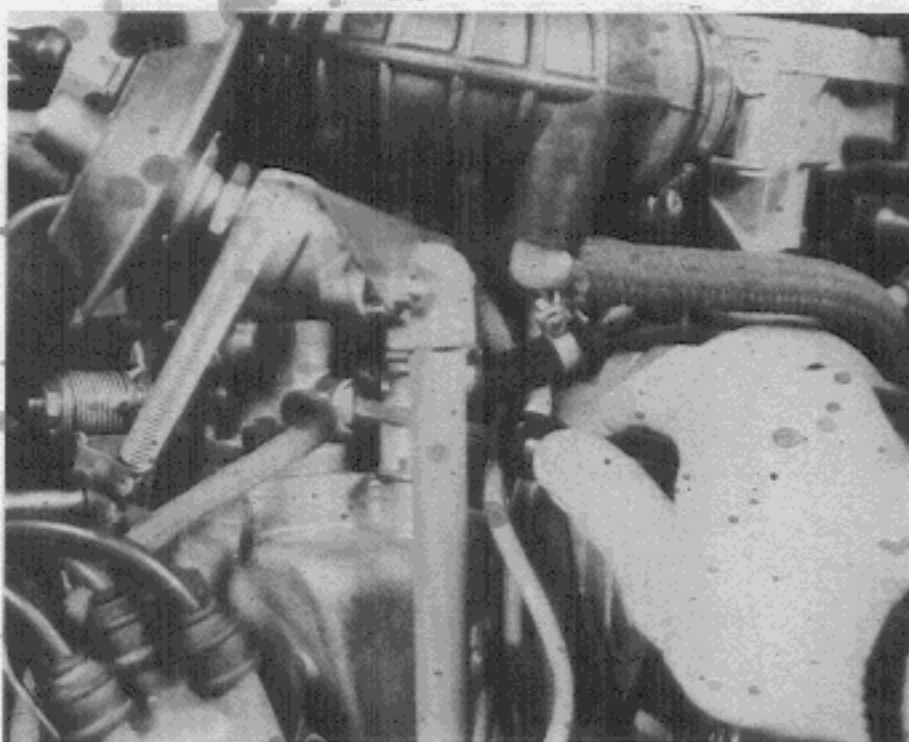
The **thermo-time switch** is tested in the vehicle for correct resistance values at certain engine temperatures as given in the *Test Chart*. For this purpose remove the plug from the switch and measure directly at the terminals of the switch. The illustration below shows the condition of the thermo-time switch when the coolant temperature is below 50°F: terminal W is connected to ground to complete the circuit and activate the cold start valve.



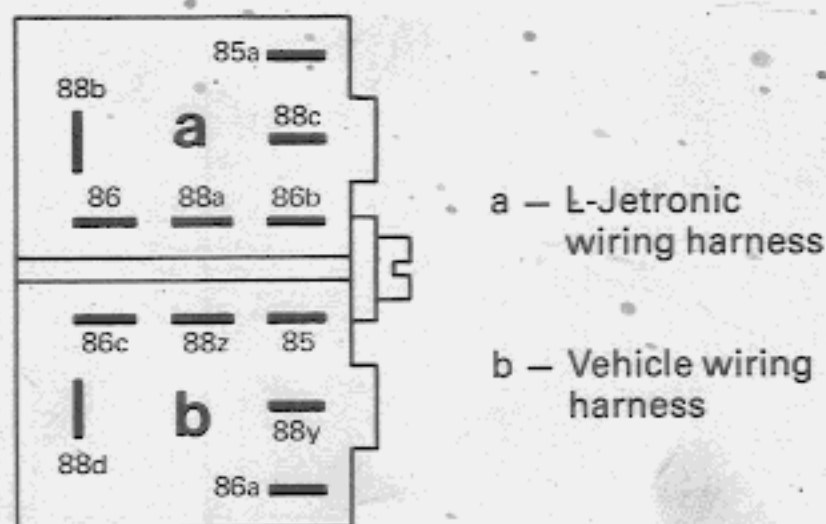
The **air flow meter** is accessible after the air filter has been removed (Beetle shown below). Then the flap can be deflected by hand to test the pump safety contacts as described in the *Test Chart*. The bypass air screw in the air flow meter (arrow) controls idle mixture. Turning the screw out (counter-clockwise) reduces CO. See the *Test Chart* for correct values.



Idle speed on all VW vehicles is set with the large bypass screw in the throttle housing (Beetle shown below). On Type II models (Bus), it may be necessary to adjust the EGR linkage for smooth idle before setting idle speed. See the *Test Chart* for correct values.



To test the voltage supply to the injection valves, unscrew the double relay and turn it around so both terminal sets are accessible.



With the ignition on, there should be full system voltage between terminal 88z and ground and between 88b and ground. If this is not the case, the relay is defective.

Also check the voltage at terminals 43/1 and 43/2 against ground to insure that the injection valves are being supplied with full system voltage. See the *Electrical Wiring Diagram* for terminal identifications.

TEST CHART

ALL MEASUREMENTS ARE MADE ON THE TERMINALS OF THE DISCONNECTED WIRING HARNESS PLUG TO THE CONTROL UNIT (ECU) WITH IGNITION OFF UNLESS OTHERWISE INDICATED.

Voltage Supply

OPERATE: Ignition on.

MEASURE: Voltage supply to the ECU.

VALUE: 11-12.5 V between terminal 10 and system ground at terminal 17 of ECU plug.

DEVIATION: **No reading:** open circuit in cable from main relay to ECU; main relay does not energize, ignition switch defective (check for voltage at terminals 86c and 88y of relay against ground). Check cable 10 connecting main relay and ECU for continuity. Check cable 17 to ground.

Voltage below 11 V: Contact resistance in cable 10 or 17 or at relay contacts.

OPERATE: Ignition on.

MEASURE: Function of main relay section.

VALUE: 11-12.5 V between relay terminals 88a, 88c and 88z with respect to ground (terminal 85).

DEVIATION: If any of the terminals does not give system voltage, the relay is defective.

OPERATE: Ignition on.

MEASURE: Function of pump relay section.

VALUE: 52-78 Ω between ECU plug terminal 20 and system ground at terminal 17.

DEVIATION: If resistance of pump relay coil is out of specification, check cable from ECU plug terminal 20 to relay terminal 86b for continuity and relay terminal 85 for continuity to ground. If these both check OK, relay is defective.

VOLTAGE SUPPLY TEST CONTINUED ON NEXT PAGE

TEST CHART

Voltage Supply (continued)

OPERATE: Starter.

MEASURE: Voltage from ECU plug terminal 4 to ground at terminal 17.

VALUE: 9-12 V.

DEVIATION: **No reading, but starter operates:** relay defective, open circuit from relay terminal 86 to ECU terminal 4, open circuit from starter terminal 50 to relay terminal 86a.

No reading, starter does not operate: ignition switch defective or open circuit in cables to or from ignition switch.

Voltage below 9 V: battery low or voltage drop in cable from ignition switch to starter terminal 50 (check cable).

Air Flow Meter

OPERATE: Deflect meter flap slightly.

MEASURE: Function of pump contacts.

VALUE: Transition from $\infty\Omega$ (flap closed) to 0Ω (flap slightly open) between terminals 36 and 39 on air flow meter.

DEVIATION: If no transition from infinity to zero, replace air flow meter.

CO: Using the bypass air screw in the air flow meter to adjust idle mixture, set the CO to the value shown with the engine at normal operating temperature.

412: 1.5-2.5%

Type I (Beetle): max. 1.5% (Federal)
max. 1.0% (CAL, before converter)

Type II (Bus): max. 1.0% (on CAL models before converter)

IDLE: With the engine at normal operating temperature, set the idle speed with the bypass screw on the throttle housing.

412: manual 800-900 RPM
automatic 900-1000 RPM

Type I (Beetle) 800-950 RPM

Type II (Bus): 850-950 RPM (manual)
900-1000 RPM (automatic)

TEST CHART

Throttle Valve Switch

These instructions apply to all 412 models and Type I (Beetle) and Type II (Bus) thru 1977. Beginning with 1978 models, the throttle valve switch only controls the EGR valve thru terminals 42 and 44.

OPERATE: Accelerator in idle position.

MEASURE: Function of idle contacts.

VALUE: 0Ω (continuity) between terminals 2 and 18 of ECU plug.

DEVIATION: **Resistance** $\infty\Omega$: throttle valve switch incorrectly adjusted. Open circuit in cable (check cables). If direct reading at terminals 2 and 18 of throttle valve switch still gives infinite resistance ($\infty\Omega$), replace throttle valve switch.

OPERATE: Accelerator fully depressed.

MEASURE: Function of full load contacts.

VALUE: 0Ω between terminals 3 and 18 of ECU plug.

DEVIATION: **Resistance** $\infty\Omega$: throttle valve switch incorrectly adjusted or short circuit in cables. Pull plug from throttle valve switch. If meter at ECU plug still reads $\infty\Omega$, cable is defective. Otherwise adjust or replace throttle valve switch.

NOTE: Between idle and full load positions, resistance across throttle valve switch terminals is $\infty\Omega$.

TEST CHART

Fuel Pump, Pressure Regulator and Relay

OPERATE: Turn on ignition and deflect air flow meter flap by hand to energize relays and operate fuel pump. Connect pressure gauge KDEP 1034 as described in the *Component Test Instructions*.

MEASURE: Pressure in fuel line and function of pressure regulator.

VALUE: 2.2-2.6 bar.

DEVIATION: **No pressure build-up (pump does not start):** pull plug from pump and measure voltage at plug contacts. If 12 V, pump is defective. If 0 V, check pump fuse in B+ line to relay terminal 88y. If relay is operating, then check cable from relay terminal 88d to pump. If cables OK, relay is defective. **Pressure above or below specification:** check fuel filter and return lines for free passage. If all fuel lines are OK, pressure regulator is defective.

OPERATE: Ignition with fuel hose removed from cold start valve and placed in a graduate. Deflect air flow meter flap by hand to operate fuel pump.

MEASURE: Delivery quantity of fuel pump.

VALUE: 1.5-2.0 liters per minute.

DEVIATION: If fuel filter and lines are free and correct delivery quantity cannot be reached, fuel pump is defective.

Temperature Sensor

MEASURE: Resistance of the temperature sensor.

VALUE: 2-3 K Ω at 68°F between ECU plug terminals 13 and 17 (ground). At 14°F, 7-12 K Ω ; at 176°F, 250-400 Ω .

DEVIATION: **Meter reads $\infty\Omega$:** check temperature sensor directly at terminals on sensor. If sensor resistance is OK, replace cables. If tester shows 0 Ω (continuity) at sensor terminals, replace sensor.

Meter reads 0 Ω : pull plug from sensor. If meter at ECU plug then reads $\infty\Omega$, replace sensor. If not, replace cables.

TEST CHART

Injection Valves

MEASURE: Resistance of coil winding in injection valve.

VALUE: 2-3 Ω between terminals on each injector.

DEVIATION: If winding is open ($\infty\Omega$) or shorted (0 Ω), replace injector.

Check resistance of series resistors for injection valves: 5-7 Ω each. With ignition on, supply voltage of 11-12.5 V must be present from terminal 43/1 and terminal 43/2 of series resistors to ground.

Cold Start Valve

OPERATE: Engine at idle speed with electrical plug disconnected from start valve.

MEASURE: Voltage supply at cold start valve.

VALUE: 11-12.5 V between terminals 45 and 46 of the disconnected cold start valve plug with engine temperature below 86°F.

0 V between terminals as above with engine temperature above 104°F.

DEVIATION: If values given are not reached, check thermo-time switch for proper function (see below). Check cables 45 and 46 for continuity.

MEASURE: Resistance of start valve coil windings.

VALUE: About 4 Ω between terminals 45 and 46 of cold start valve.

DEVIATION: If windings are open ($\infty\Omega$) or shorted (0 Ω), replace start valve.

TEST CHART

Thermo-Time Switch

MEASURE: Resistance between terminal "W" on thermo-time switch and ground

VALUE: 0 Ω with engine temperature below
50°F (thermo-time switch 0 280 130 219)
56°F (thermo-time switch 0 280 130 221)
86°F (thermo-time switch 0 280 130 214)

 $\infty\Omega$ with engine temperature above
68°F (thermo-time switch 0 280 130 219)
74°F (thermo-time switch 0 280 130 221)
104°F (thermo-time switch 0 280 130 214)

DEVIATION: If resistance value lies outside of specification, thermo-time switch is defective.

Altitude Compensator

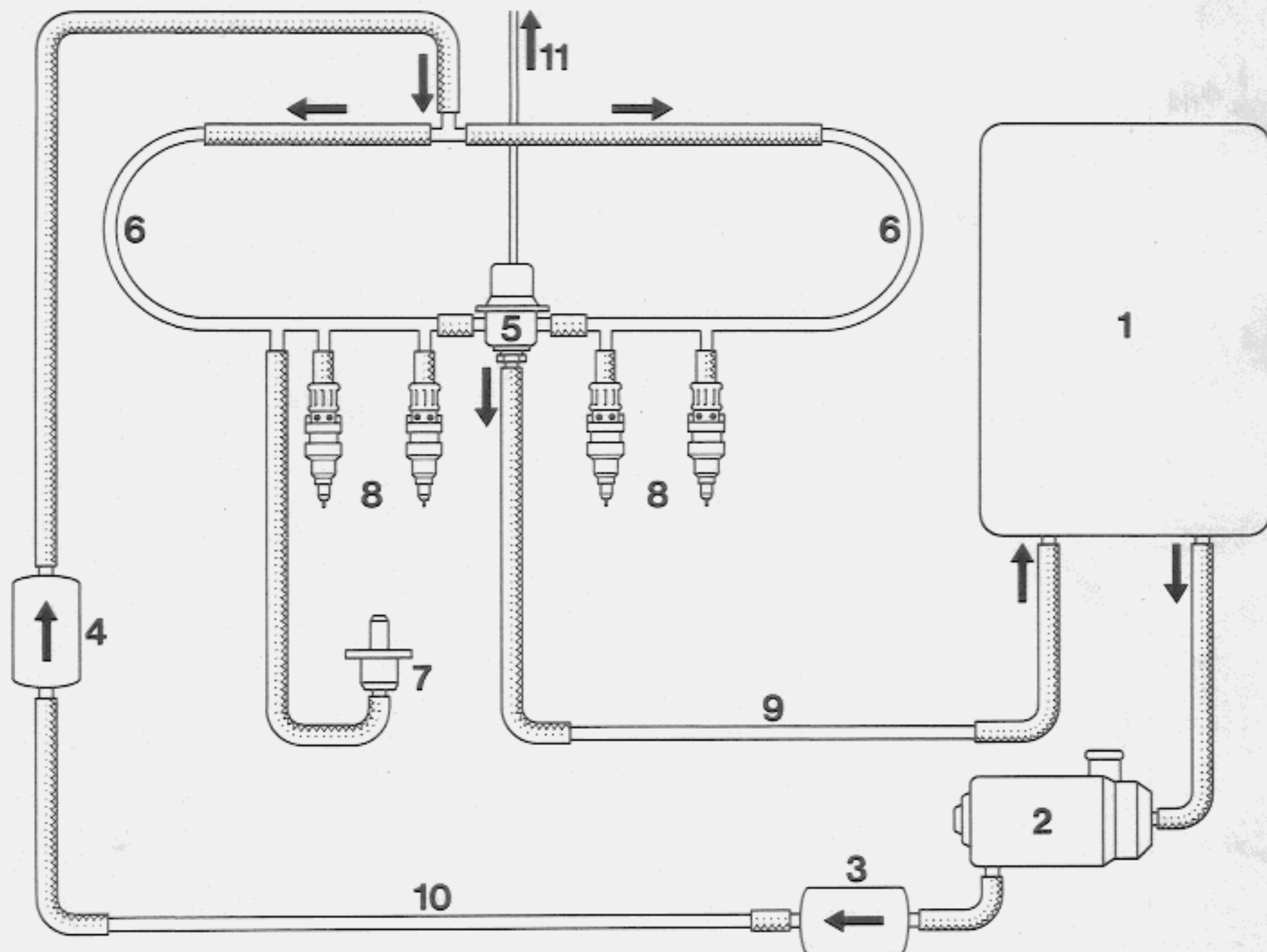
This device is installed near the control unit in some models operated at high altitudes. See the *Electric Wiring Diagram* for more information.

MEASURE: Resistance of windings in altitude compensator.

VALUE: 1-10 k Ω between terminals 6 and 9 of ECU plug, 0.2-2 k Ω between terminals 6 and 12.

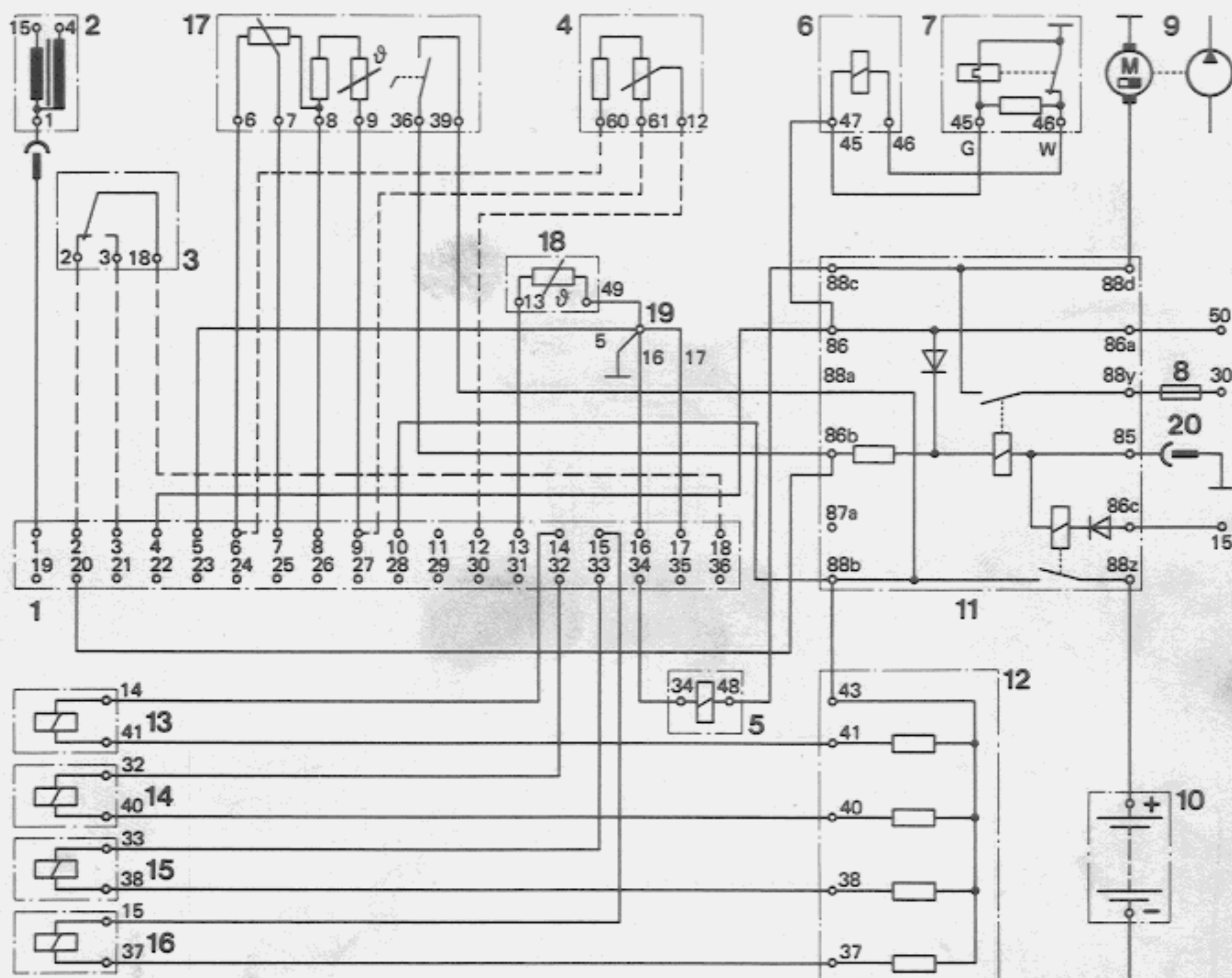
DEVIATION: If readings out of specification, check cables to altitude compensator. If cables check OK, compensator is defective.

FUEL SYSTEM DESCRIPTION



- 1 – Fuel tank
- 2 – Electric fuel pump
- 3 – Expansion chamber (optional)
- 4 – Fuel filter
- 5 – Pressure regulator
- 6 – Fuel ring
- 7 – Cold start valve
- 8 – Fuel injection valves
- 9 – Fuel return line
- 10 – Fuel pressure line
- 11 – To intake manifold (this hose removed for fuel pressure test)

ELECTRIC WIRING DIAGRAM



- | | |
|-----------------------------------|-------------------------------|
| 1—Control unit plug | 11—Double relay |
| 2—Ignition coil | 12—Pre-resistors |
| 3—Throttle valve switch* | 13—Cylinder 4 Injection valve |
| 4—Altitude compensator (optional) | 14—Cylinder 3 |
| 5—Auxiliary air valve | 15—Cylinder 2 |
| 6—Cold start valve | 16—Cylinder 1 |
| 7—Thermo-time switch | 17—Air flow meter |
| 8—Fuel pump fuse | 18—Temperature sensor |
| 9—Electric fuel pump | 19—System ground |
| 10—Battery | 20—Relay ground |

*The throttle valve switch on 1975-77 Type 1 (Beetle) and Type II (Bus) models has two additional contacts (terminals 42 and 44) to control the EGR valve. Beginning with 1978 models, all terminals except EGR control are unused.