Chapter 4 Part D:
Fuel and exhaust systems - Magneti Marelli injection

Contents

Degrees of difficulty

Easy, suitable for novice with little experience 

Fairly easy, suitable for beginner with some experience 

Fairly difficult, suitable for competent DIY mechanic 

Difficult, suitable for experienced DIY mechanic 

Very difficult, suitable for expert DIY or professional 

Specifications

For engine to model applications refer to Chapter 2

Air cleaner

Element	Champion U543

Fuel filter

Type	Champion L201

System

Model application/type:	
BX 16 fuel injection	Magneti Marelli G6.10
Regulated operating pressure	0.8 bar
Idle speed	Controlled by ECU
CO percentage in exhaust gas	Controlled by ECU

1 General information and precautions

General information

On fuel-injected BX 16 models, a fully-integrated Magneti Marelli G6.10 engine management system is used to control both the single-point fuel injection and ignition systems. This system also incorporates a closed-loop catalytic converter and an evaporative emission control system, complying to the very latest emission control standards. The system operates as follows.

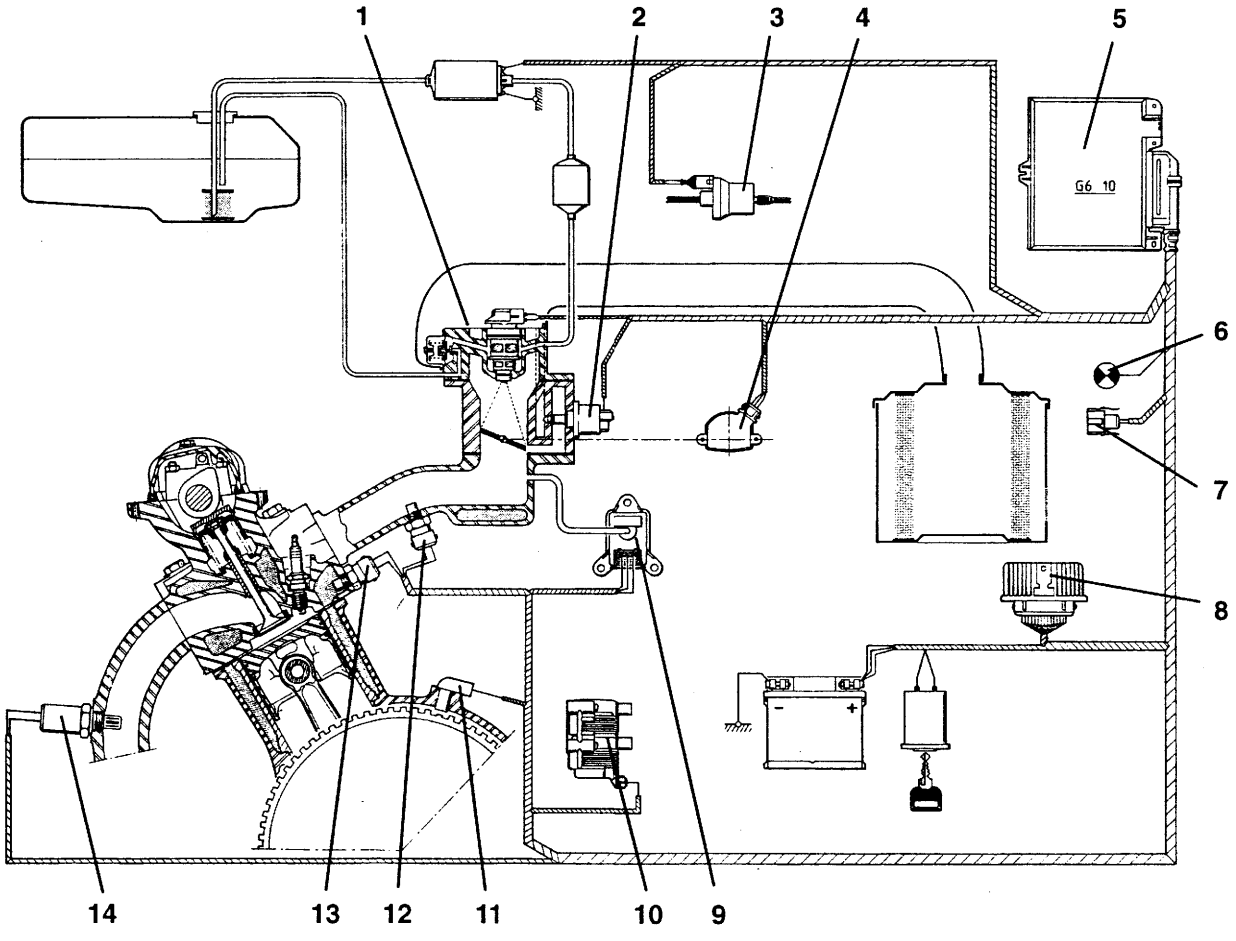
The fuel pump (mounted on the rear of the subframe) pumps fuel from the tank to injector via a filter. Fuel supply pressure is controlled by the pressure regulator in the throttle body assembly, which lifts to allow excess fuel to return to the tank when the optimum operating pressure of the system is exceeded.

The electrical control system consists of the ECU, along with the following sensors **(see illustration)**:

a) Manifold absolute pressure (MAP) sensor - informs the ECU of engine load
b) Crankshaft sensor - informs the ECU of crankshaft position and engine speed
c) Throttle potentiometer - informs the ECU of throttle valve position and rate of throttle opening/closing
d) Coolant temperature sensor - informs the ECU of engine temperature
e) Fuel/air mixture temperature sensor - informs the ECU of temperature of fuel/air mixture charge entering cylinders
f) Lambda (oxygen) sensor - informs the ECU of oxygen content of exhaust gases

The ECU senses battery voltage, adjusting the injector pulse width to suit and using the stepper motor to increase the idle speed and therefore, the alternator output if the voltage is too low. Short-circuit protection and diagnostic capabilities are incorporated. The ECU can both receive and transmit information via the engine management circuit diagnostic connector, thus permitting engine diagnosis and tuning by special diagnostic equipment.

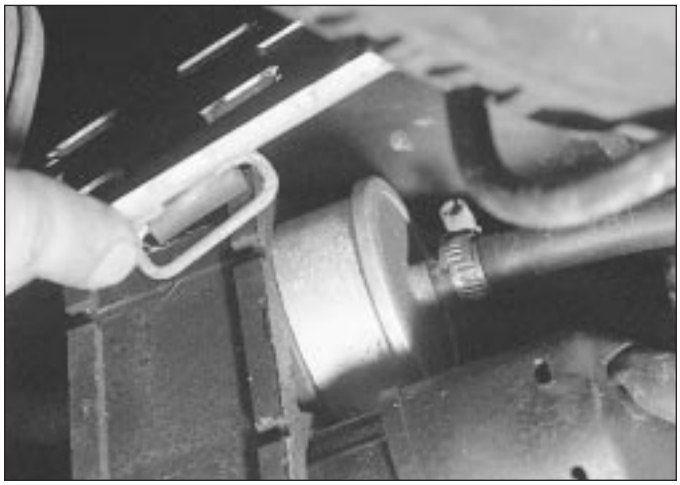
All the above signals are compared by the ECU which then selects the appropriate response and controls the ignition HT coil (varying the ignition timing as required), and the fuel injector (varying its pulse width the length of time the injector is held open - to provide a richer or weaker mixture, as appropriate). The mixture, idle speed and ignition timing are constantly varied by the ECU to provide the best settings for cranking, starting and engine warm-up, idle, cruising and acceleration.



1.3 Magneti Marelli engine management system components

1 Throttle body injector housing
2 Idle speed stepper motor
3 Charcoal canister purge valve
4 Throttle potentiometer
5 ECU
6 Instrument panel warning light
7 Diagnostic wiring connector
8 Relay unit
9 Manifold absolute pressure (MAP) sensor
10 Ignition HT coil
11 Crankshaft sensor
12 Fuel/air mixture temperature sensor
13 Coolant temperature sensor
14 Lambda (oxygen) sensor

2.3 System diagnostic connector



5.1 Fuel pump and filter (plastic cover unclipped for clarity)

The ECU also regulates the engine idle speed via a stepper motor which is fitted to the throttle body. The motor has a pushrod which controls the opening of an air passage which bypasses the throttle valve. When the throttle valve is closed, the ECU controls the movement of the pushrod, which in turn regulates the amount of air which flows through the throttle body, so controlling the idle speed. The bypass passage is also used as an additional air supply during cold starting. There is no provision for adjustment of the idle speed, except by reprogramming of the ECU using special diagnostic equipment. The idle speed will vary constantly under ECU control.

The ECU controls the ignition side of the engine management system (see Chapter 5) and the exhaust and evaporative emission control systems described later in this Chapter.

If there is an abnormality in any of the readings obtained from any of engine management circuit sensors, the ECU has a back-up facility. It ignores any abnormal sensor signals and assumes a pre-programmed value which will allow the engine to continue running at reduced efficiency. On entering the back-up facility, the ECU will illuminate the engine management warning light in the instrument panel, thereby informing the driver of the fault. It then stores the relevant fault code in the ECU memory. If the warning light is illuminated, the vehicle should be taken to a Citroën dealer for system testing at the earliest opportunity.

Precautions

Refer to the precautions listed in Part C of this Chapter, noting the following:

Unleaded petrol - usage

As with all models equipped with a catalytic converter, these models must be run on 95 RON unleaded fuel only. The use of leaded fuel will seriously damage the catalytic converter.

2 System testing

Note: *Ensure that all wiring connectors are secure and free of corrosion before checking for faults in the engine management system.*

1 If a fault appears in the engine management (ignition/fuel injection) system, first ensure that all the system wiring connectors are securely connected and free of corrosion.

2 Ensure that any fault is not due to poor maintenance. That is, check that the air cleaner element is clean, the spark plugs are in good condition and correctly gapped, that the valve clearances are correctly adjusted and that the engine breather hoses are clear and undamaged.

3 If these checks fail to reveal the cause of the problem, the vehicle should be taken to a Citroën dealer for testing. A wiring block connector is incorporated in the engine management circuit, into which a special electronic diagnostic tester can be plugged **(see illustration)**. The tester will locate the fault quickly and simply, alleviating the need to test all the system components individually, which is a time-consuming operation that carries a high risk of damaging the ECU.

3 Air cleaner element - renewal

Refer to Chapter 1, Section 28.

4 Fuel system - depressurisation

Refer to Section 3 in Part B of this Chapter.

5 Fuel pump - removal and refitting

Refer to Section 4 in Part B of this Chapter **(see illustration)**.

6 Fuel filter - removal and refitting

Refer to Chapter 1, Section 35.

7 Fuel tank - removal, inspection and refitting

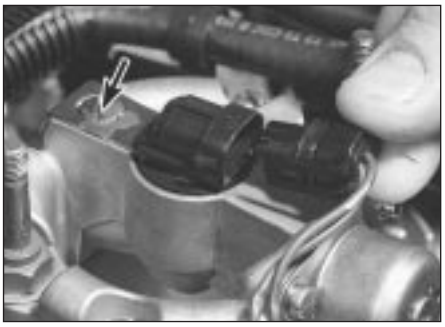
Refer to Section 7 in Part B of this Chapter

8 De-aeration reservoir - removal and refitting

Refer to Section 8 in Part B of this Chapter.

9 Idle speed and mixture - adjustment

The idle speed, mixture adjustment and ignition timing are all monitored and controlled by the ECU, and do not normally require adjustment. While experienced home mechanics with a considerable amount of skill and equipment (including a good-quality tachometer and carefully-calibrated exhaust gas analyser) may be able to check the exhaust CO level and the idle speed, if these are found to be in need of adjustment then the vehicle must be taken to a suitably-equipped Citroën dealer.



10.2 Disconnecting injector wiring connector - injector retaining screw arrowed

Adjustments can be made only by re-programming the ECU, using special diagnostic equipment connected to the system via the diagnostic connector.

10 Fuel injector - removal and refitting

Note: *If a faulty injector is suspected, before condemning the injector, it is worth trying the effect of one of the proprietary injector-cleaning treatment. If this fails, the vehicle should be taken to a Citroën dealer for testing. At the time of writing, it appears that the fuel Injector is not available separately and, if faulty, the complete upper throttle body assembly must be renewed.*

12.1a Undo the two nuts . . .

Removal

1 Undo the two nuts securing the **inlet** trunking to the throttle body and position the trunking clear of the body along with its rubber sealing ring.
2 Release the retaining tangs and disconnect the injector wiring connector **(see illustration)**.
3 Undo the retaining screw, then remove the retaining clip and lift the injector out of the housing, noting its sealing ring. As the screw is slackened, place a rag over the injector to catch any fuel spray which may be released.

Refitting

4 Refitting is a reverse of the removal procedure, ensuring that the injector sealing ring is in good condition.

12.1b . . . then disconnect inlet trunking and remove rubber sealing ring

11 Accelerator cable - removal and refitting

Refer to Section 13 in Part B of this Chapter but note that there is no need to check the idle speed after refitting. Adjust the cable until there is only a small amount of freeplay present at the throttle body end of the cable.

12 Throttle body assembly - removal and refitting

Removal

1 Undo the two nuts securing the inlet trunking to the throttle body and position the trunking clear of the body along with its rubber sealing ring **(see illustrations)**.
2 Depress the retaining tabs and disconnect the wiring connectors from the throttle potentiometer, the stepper motor and the injector wiring loom connector which is situated on the front of the throttle body **(see illustrations)**.
3 Bearing in mind the information given on depressurising the fuel system, release the retaining clips and disconnect the fuel feed and return hoses from the throttle body assembly **(see illustration)**.
4 Disconnect the accelerator inner cable from the throttle cam, then free the outer cable from its retaining bracket and position it clear of the throttle body **(see illustration)**.

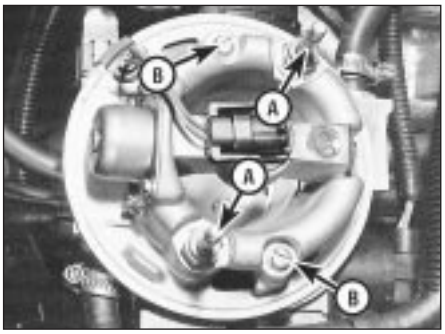
12.2a Disconnect wiring connectors from throttle potentiometer . . .

12.2b . . . the idle control stepper motor . . .

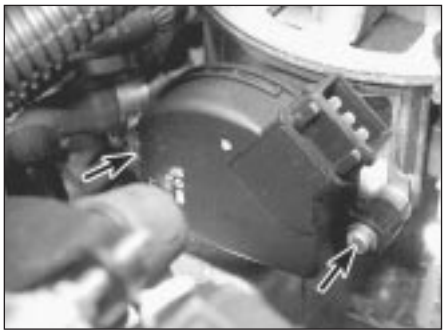
12.2c . . . and the injector wiring loom

12.3 Slacken throttle body fuel feed hose retaining clip

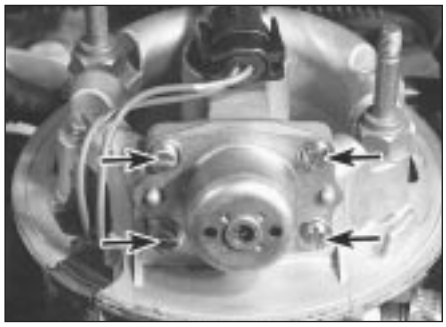
12.4 Disconnecting accelerator inner cable from throttle cam



12.7 Throttle body retaining bolts (A) and housing retaining screws (B)



13.2 Throttle potentiometer retaining screws (arrowed)



14.2 Fuel pressure regulator retaining screws (arrowed)

5 Disconnect the purge valve hose from the front of the throttle body assembly and the breather hose from the rear of the throttle body.
6 Working quickly to minimise coolant loss, disconnect the two coolant hoses from the rear of the throttle body assembly. Plug each hose end with a suitable bolt or screw.
7 Undo the two retaining bolts and remove the throttle body assembly from the manifold along with its sealing gasket **(see illustration)**.
8 If necessary, with the throttle body removed, undo the two retaining screws and separate the upper and lower sections. Note the gasket which is fitted between the two.

Refitting

9 Refitting is a reverse of the removal procedure, bearing in mind the following points.

a) Where necessary, ensure that the mating surfaces of the upper and lower throttle body sections are clean and dry, then fit a new gasket and reassemble the two, tightening the retaining screws securely.
b) Ensure that the mating surfaces of the manifold and throttle body are clean and dry, then fit a new gasket. Securely tighten the throttle body retaining bolts.
c) Ensure that all hoses are correctly reconnected and, where necessary, that their retaining clips are securely tightened.
d) Adjust the accelerator cable so that only a small amount of freeplay is present at the throttle body end of the cable.
e) If necessary, top-up the cooling system.

13 Throttle potentiometer - removal and refitting

Removal

1 Disconnect the battery negative terminal, then depress the retaining tabs and disconnect the wiring connector from the throttle potentiometer.
2 Undo the two retaining screws and remove the throttle potentiometer from the right-hand side of the throttle body assembly **(see illustration)**.

Refitting

3 Refitting is a reversal of the removal procedure. Ensure that the throttle potentiometer tang is correctly engaged with the throttle spindle.

14 Fuel pressure regulator - removal and refitting

Note: *At the time of writing, it appears that the fuel pressure regulator is not available separately. If the regulator is faulty, then the complete upper throttle body assembly must be renewed. Refer to a Citroën dealer for further information. Although the unit can be dismantled for cleaning, it should not be disturbed unless absolutely necessary.*

Removal

1 Undo the two nuts securing the **inlet** trunking to the throttle body and position the trunking clear of the body along with its rubber sealing ring.
2 Using a suitable marker pen, make alignment marks between the regulator cover and throttle body, then undo the four retaining screws **(see illustration)**. As the screws are slackened, place a rag over the cover to catch any fuel spray which may be released.
3 Lift off the cover, then remove the spring and withdraw the diaphragm, noting its correct fitted orientation.
4 Remove all traces of dirt and examine the diaphragm for signs of splitting. If damage is found, it will be necessary to renew the complete upper throttle body assembly.

Refitting

5 Refitting is a reverse of the removal procedure. Ensure that the diaphragm and cover are fitted the correct way around and the retaining screws are securely tightened.

15 Idle control stepper motor - removal and refitting

Note: *If a faulty stepper motor is suspected, then the vehicle should be taken to a Citroën dealer for testing. At the time of writing, it appears that the stepper motor is not available separately. If faulty, the complete lower throttle body assembly must be renewed.*

To remove the stepper motor, depress the retaining tabs and disconnect the wiring connector. Undo the two retaining screws and withdraw the motor from the rear of the throttle body assembly **(see illustration)**.

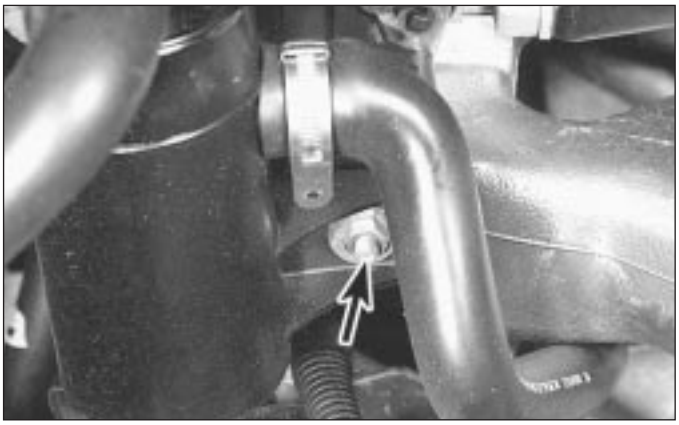
Refitting is a reverse of removal.

16 Inlet and exhaust manifolds - removal and refitting

Inlet manifold

1 Remove the throttle body assembly.
2 Drain the cooling system.
3 Disconnect the wiring connector from the fuel/air mixture temperature sensor, located on the right-hand side of the manifold.
4 Undo the nut securing the oil filler cap/breather to the side of the manifold, then release the assembly from its retaining stud and position it clear of the manifold **(see illustration)**.

15.1 Idle control stepper motor location



16.4 Oil filler/breather cap retaining nut (arrowed)

16.6 Slackening coolant hose retaining clip from front of inlet manifold - MAP sensor hose arrowed

5 Undo the bolt securing the wiring/hose support bracket to the top of the manifold and position the bracket clear of the manifold.
6 Disconnect the coolant hose and the MAP sensor vacuum hose from the front of the manifold **(see illustration)**.
7 Undo the six manifold retaining nuts and remove the manifold from the **engine**. Remove the gasket and renew it.
8 Refitting is a reverse of the removal procedure, noting the following points.

a) Ensure that the manifold and cylinder head mating surfaces are clean and dry before fitting the new gasket.
b) Ensure that all relevant hoses are reconnected to their original positions, and are securely held (where necessary) by the retaining clips.
c) On completion, refill the cooling system.

Exhaust manifold

9 Refer to Section 14 in Part B of this Chapter

17 Exhaust system - maintenance, removal and refitting

Refer to Section 14 in Part C of this Chapter.

18 Exhaust emission control system - general information and testing

General information

1 To minimise the amount of pollutants which escape into the atmosphere, a catalytic converter is incorporated into the exhaust system. The system is a "closed-loop" type, a lambda sensor in the exhaust system providing the engine management system ECU with constant feedback, thus enabling it to adjust the mixture and provide the best possible conditions for the converter to operate.
2 The lambda sensor has a built-in heating element, controlled by the ECU through the relay assembly to quickly bring the sensor's tip to an efficient operating temperature. The sensor's tip is sensitive to oxygen and sends the ECU a varying voltage depending on the amount of oxygen in the exhaust gases. If the inlet air/fuel mixture is too rich, the exhaust gases are low in oxygen, so the sensor sends a low-voltage signal. This voltage rises as the mixture weakens and the amount of oxygen in the exhaust gases rises. Peak conversion efficiency of all major pollutants occurs if the inlet air/fuel mixture is maintained at the chemically-correct ratio for the complete combustion of petrol of 14.7 parts (by weight) of air to 1 part of fuel. The sensor output voltage alters in a large step at this point, the ECU using the signal change as a reference point and correcting the **inlet** air/fuel mixture accordingly by altering the fuel injector pulse width.

Testing

3 Regular checks of the lambda sensor's operation should be performed. This can be done only by attaching Citroën diagnostic equipment to the sensor wiring and checking that the voltage varies from low to high values when the engine is running. Do not attempt to "test" any part of the system with anything other than the correct test equipment.

19 Evaporative emission control system - general information and component renewal

General information

1 To minimise the escape of unburned hydrocarbons into the atmosphere, an evaporative emissions control system is incorporated in the Magneti Marelli engine management system. The fuel tank filler cap is sealed and a charcoal canister is mounted underneath the right-hand wing to collect the petrol vapour generated in the tank when the vehicle is parked. This vapour is stored until it can be cleared from the canister (under the control of the engine management system ECU, via the purge control valve) into the inlet tract, to be burned by the engine during normal combustion.
2 To ensure that the engine runs correctly when it is cold and/or idling, and to protect the catalytic converter from the effects of an over-rich mixture, the purge control valve is not opened by the ECU until the engine has warmed up. The valve solenoid is then modulated on and off to allow the stored vapour to pass into the inlet tract.
3 If the system is thought to be faulty, disconnect the hoses from the charcoal canister and purge control valve and check that they are clear by blowing through them. If the purge control valve or charcoal canister are thought to be faulty, they must be renewed.

Charcoal canister - removal and refitting

4 Disconnect the battery negative terminal.
5 Chock the rear wheels, then jack up the front of the vehicle and support it on axle stands (see "*Jacking and vehicle support*"). Remove the right-hand front roadwheel.
6 Release the retaining clip(s) and disconnect the hoses from the canister.
7 Undo the retaining screw(s) and/or release the retaining clips (as applicable), then free the canister assembly from its retaining bracket and remove it from underneath the wheel arch.
8 Refitting is a reverse of the removal procedure. Ensure that the hoses are correctly routed and securely reconnected.

Purge valve - removal and refitting

9 Disconnect the battery negative terminal.
10 Disconnect the wiring connector from the purge valve, situated just behind the alternator.
11 Disconnect the inlet and outlet hoses, then remove the valve from the engine compartment.
12 Refitting is a reverse of the removal procedure. Ensure that the inlet and outlet hoses are securely reconnected.