Adjustment Data

MAZDA - 626 - 2.5i V6 24V Xerxes - KL

Engine (general)

Item	Values	Units
Engine code	KL	
Capacity	2497	(cc)
Idle speed	650 ± 50	(rpm)
Valve clearance		
Hydraulic		
Compression pressure		
Normal	14.3	(bar)
Minimum	10	(bar)
Oil pressure	3.4 - 5.0/3000	(bar / rpm)
Fuel system (make & type)	Mitsubishi EGI	
Firing order	1-2-3-4-5-6	
Timing stroboscopic (before TDC)	10 ± 1/650	(° / rpm)
Ignition-coil resistance, primary	0.58 - 0.86	(ohms)
Ignition-coil resistance, secondary	11500 - 18500	(ohms)
Spark plugs (make & type)	NGK/ZFR5F-11 Bosch FR7LCX	
Spark-plug gap	1.0 - 1.1	(mm)
Fuel-pump pressure	6.5	(bar)
Injection pressure / system pressure	2.9	(bar)
CO exhaust gas	< 0.5	(%)
CO2	14.5 - 16.0	(%)
HC	100	(ppm)
O2	0.1 - 0.5	(%)
Lambda	0.97 - 1.03	
Lambda change (Delta Lambda)	0.03	
Oil temperature during test	60	(°C)
Fast-idle speed	2500-2800	(rpm)
CO at fast-idle speed	< 0.3	(%)

Cooling system

Item	Values	Units
Cap pressure	0.75 - 1.05	(bar)
Thermostat opens at	80 - 84	(°C)
Fan on at	100	(°C)

Electrical

Item	Values	Units
Battery	65	(Ah)
Alternator	90	(A)

Brakes

Item	Values	Units
Disc thickness, front, min.	22.0	(mm)
Disc thickness, rear, min.	8.0	(mm)

Steering and wheel alignment

Item	Values	Units
Toe-in, front	17' ± 17'	(°)
Camber, front	-36' ± 45'	(°)
Castor, front	2° 37' ± 45'	(°)
K.P.I., front	15 ± 04'	(°)
Toe-in, rear	17' ± 17'	(°)
Camber, rear	-07' ± 45'	(°)

Wheels and tyres

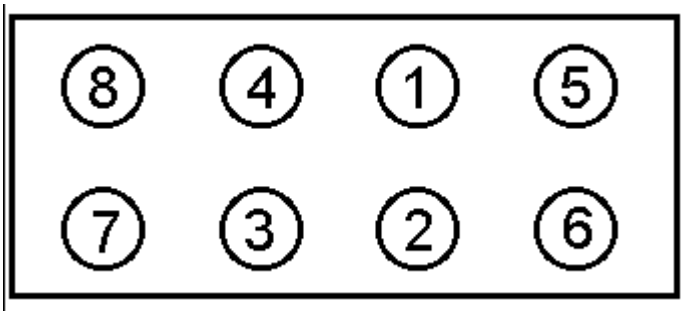
Item	Values	Units
Tyre size	205/55R14	
Front tyre pressure	2.2	(bar)
Rear tyre pressure	1.8	(bar)

Capacities

Item	Values	Units
Engine sump, incl. filter	4.0	(l)
Manual transmission		
Gearbox refill	2.7	(l)
Automatic transmission		
Gearbox refill	8.8	(l)
Cooling system	7.5	(l)
Air-conditioner refrigerant	700	(g)
Air-conditioner compressor oil	175	(ml)

Torque settings

Item	Values	Units
Cylinder head		



Stage 1	23 - 26	(Nm)
Stage 2	90°	(°)
Stage 3	90°	(°)
Front hub	236 - 318	(Nm)

Rear hub	117 - 235	(Nm)
Wheel nuts	88 - 117	(Nm)
Spark plugs	15 - 22	(Nm)

CANISTER PURGE SOLENOID

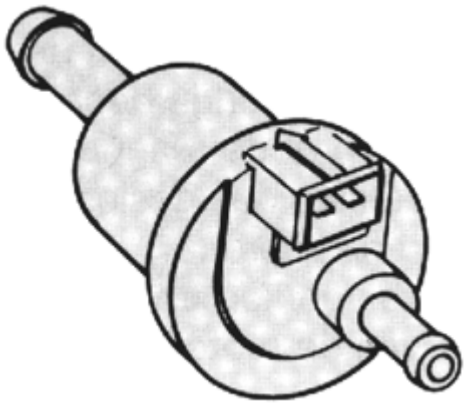
Function

The evaporative gases produced in the fuel tank are absorbed by the activated charcoal in the carbon canister. As The purge control solenoid valve opens these gases are delivered to the intake manifold for combustion purposes. The purge control solenoid valve is controlled by the control unit. The control unit operates this valve during the time the lambda control loop is active.

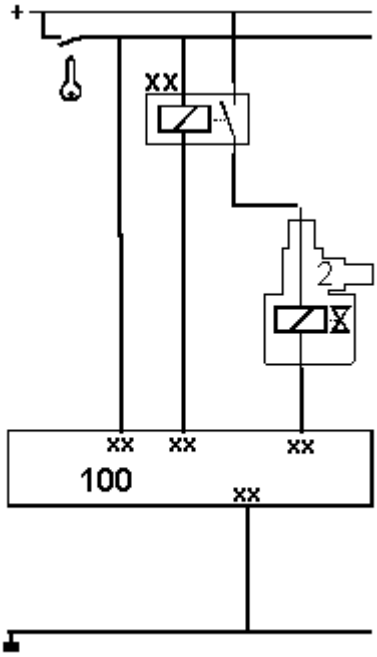
Specifications

RESISTANCE:

resistance:	± 50 ohms
supply voltage:	12 Volts
current:	± 250 mA



Electrical control



Most solenoids are normally closed. This means that the connection between the canister and the intake manifold is closed. The solenoid has a connector with two terminals. On one of those terminals is connected to the battery voltage. This supply-voltage is often switched with a relay. The other terminal leads directly to the control unit. The current through the solenoid is switched on during the time the control unit connects this terminal to ground. The voltage on this terminal is during this time 0 Volts. During the time the solenoid is switched off, the voltage on this terminal is 12 Volts. Some motormanagement systems control the amount gases delivered to the intake manifold switching the solenoid on and of with a certain duty cycle. In this case the duty-cycle depends on engine RPM and engine load.

Electrical diagnosis

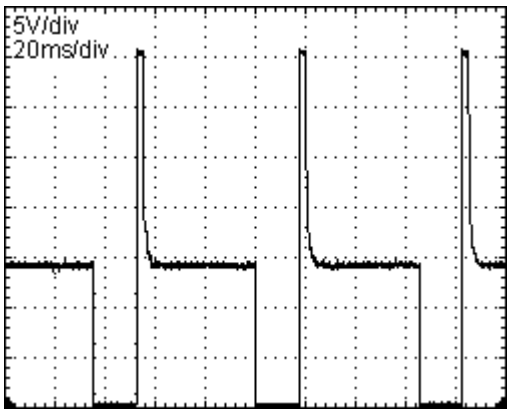
STATIC

General

- To perform this measurements the relay switching the power to the solenoid should be closed. Short circuit the switch in the relay if necessary.

Measurements

- Measure the voltage on the control unit. Use the pin which switches the solenoid.



result: **12 V**

- solenoid and wiring are electrically OK

0 V

- check the relay switching the power to the solenoid
- check the wiring between the relay and the solenoid
- check the solenoid resistance
- check the wiring between the solenoid and the control unit
- check the control unit

Lubricants and Fluids

MAZDA - 626 - 2.5i V6 24V Xerxes - KL

Engine		
Motor oil API SG	Below 0 °C	SAE 5W-30
Motor oil API SG	Above -25 °C	SAE 10W-30
Cooling system		
Coolant	All temperatures	
Manual transmission		
Gear oil API GL-4	All temperatures	SAE 75W-90
Gear oil API GL-5	All temperatures	SAE 75W-90
Gear oil API GL-4	Above 5 °C	SAE 80W-90
Gear oil API GL-5	Above 5 °C	SAE 80W-90
Automatic transmission		
ATF Dexron II	All temperatures	
ATF M-III	All temperatures	
Transfer box		
Gear oil API GL-5	Above -20 °C	SAE 90
Gear oil API GL-5	Below -20 °C	SAE 80W
Differential, rear (4x4)		
Gear oil API GL-5	Above -20 °C	SAE 90
Gear oil API GL-5	Below -20 °C	SAE 80W
Power steering		
ATF Dexron II	All temperatures	
ATF M-III	All temperatures	
Brakes system		
Brake fluid DOT 3	All temperatures	

Capacities

MAZDA - 626 - 2.5i V6 24V Xerxes - KL

Item	Values	Units
Engine sump, incl. filter	4.0	(l)
Manual transmission		
Gearbox refill	2.7	(l)
Automatic transmission		
Gearbox refill	8.8	(l)
Cooling system	7.5	(l)
Air-conditioner refrigerant	700	(g)
Air-conditioner compressor oil	175	(ml)

153. dual ram valve

Function

The solenoid determines which inlet manifold is used to let the air enter the engine. Depending on the engine rpm the long or short inlet manifold will be chosen or a combination of these.

Environmental Data

MAZDA - 626 - 2.5i V6 24V Xerxes - KL

Item	Values	Units
Engine code	KL	
Idle speed	650 ± 50	(rpm)
Fuel system (make & type)	Mitsubishi EGI	
Timing stroboscopic (before TDC)	10 ± 1/650	(° / rpm)
Fuel-pump pressure	6.5	(bar)
Injection pressure / system pressure	2.9	(bar)
CO exhaust gas	< 0.5	(%)
CO2	14.5 - 16.0	(%)
HC	100	(ppm)
O2	0.1 - 0.5	(%)
Lambda	0.97 - 1.03	
Lambda change (Delta Lambda)	0.03	
Oil temperature during test	60	(°C)
Fast-idle speed	2500-2800	(rpm)
CO at fast-idle speed	< 0.3	(%)

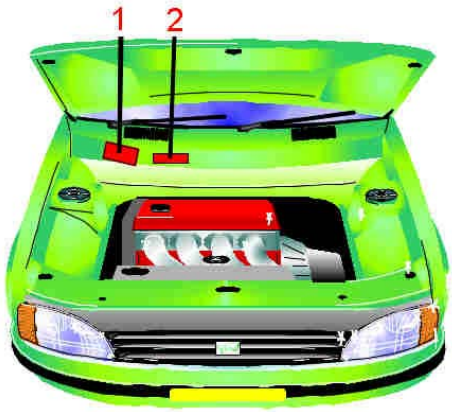
ID Location

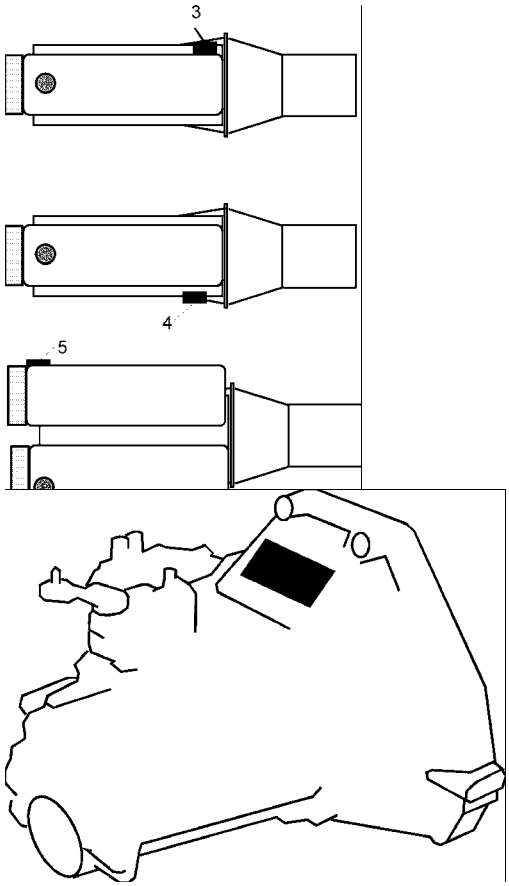
MAZDA - 626 - 2.5i V6 24V Xerxes - KL

1 Identification plate
2 VIN

3 Engine code B3 / B5 / B6 / PN
4 Engine code BP / FP / FS
5 Engine code 6-cylinder

6 Manual transmission code





IGNITION MODULE

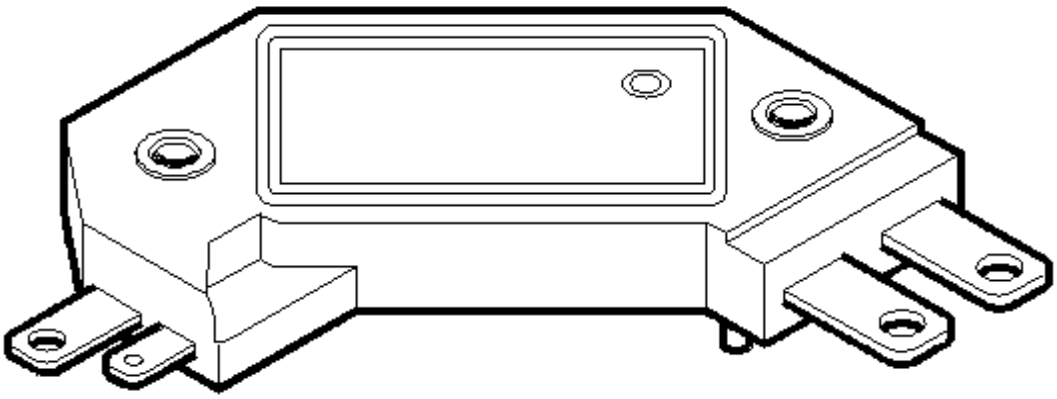
Function

The ignition module switches the current through the primary ignition coil on and off. The ignition module charges the ignition coil during the time the current is switched on. The moment the ignition module switches the current 'off' the ignition coil induces an induction voltage which causes the spark.

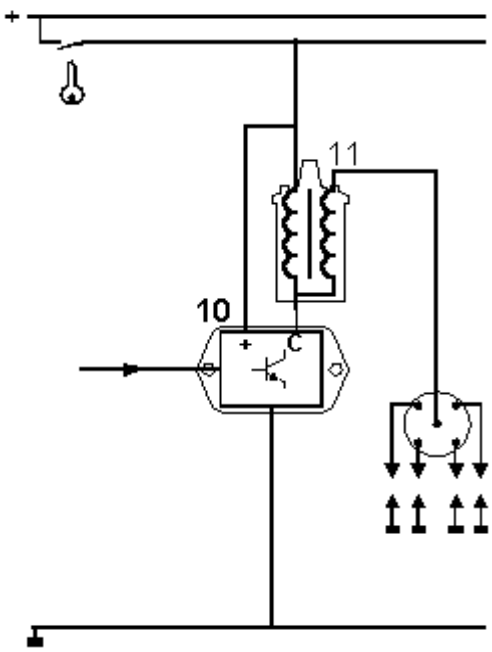
An ignition module switches the current on and off according to an input signal. This input is delivered by the control unit. On older systems the input signal is delivered by an inductive, Hall or opto-coupled sensor mounted in the distributor.

Specifications

resistance	-
supply voltage	-



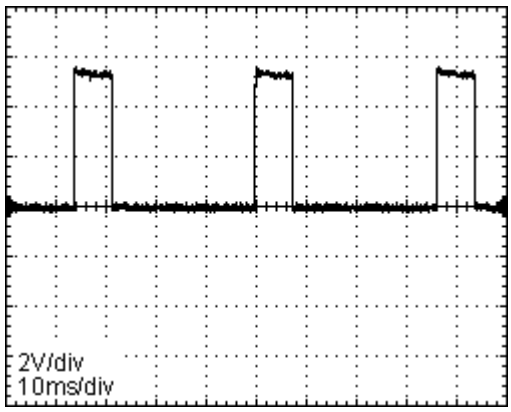
Electrical control



The connector of the ignition module has several terminals. The following terminals are used on common ignition modules.

- a terminal connected with the ignition coil. By this terminal the current through the ignition coil is switched on and of.
- a terminal connected with the supply voltage (12 Volts)
- a terminal connected with ground.
- terminal(s) to receive the input signal. If the input signal is delivered by an inductive sensor two terminals are needed.

The output voltage of an inductive sensor is delivered by an internal coil. This coil induces an almost sine wave output voltage. If the input signal is delivered by an Hall-sensor or opto-coupler three terminals are needed. Two of those three terminals are used to supply the sensor. The supply voltage is either 5 or 12 Volts. The third terminal receives the output signal from the sensor. The output voltage of these sensors is a square wave signal.



Addition terminals are possible. For example to send out a RPM signal to the revolution counter. Sometimes the input signal is delivered by a sensor while the ignition timing is controlled by the control unit. In this case the received input signal from the sensor is converted into a square wave signal by the ignition module and send out to the control unit. The control unit receiving this signal computes this input information and other input information from various engine parameters and sends out a new square wave signal to the ignition module. This signal is used by the ignition module to switch the current through the primary ignition coil on and off.

During the time the input signal for the ignition module is 'high' the current is switched 'on'. The moments this input signals falls to 'low' the current is switched 'off'. This moment the spark will appear

Electrical diagnosis

- Start the engine and measure (using an oscilloscope) the input signal delivered by the control unit or input sensor. The square wave signal or sine wave signal from a inductive sensor should be visible.

signal not OK:

- Disconnect the ignition module's connector and check the wiring between the ignition module and the control unit or input sensor.
- replace the ignition module if the signal appears on the disconnected connector and disappears on the connected connector.

If the output signal remains invisible the failure is not in the component.

signal OK:

- check the power supply of the ignition module.
- check the primary voltage using an ignition oscilloscope or normal oscilloscope with a suitable probe.
- check the wiring between the ignition module and the ignition coil.

The voltage should be nearly 0 Volt during the period the ignition module receives an 'high' input voltage from the sensor or control unit.

Mechanical diagnosis

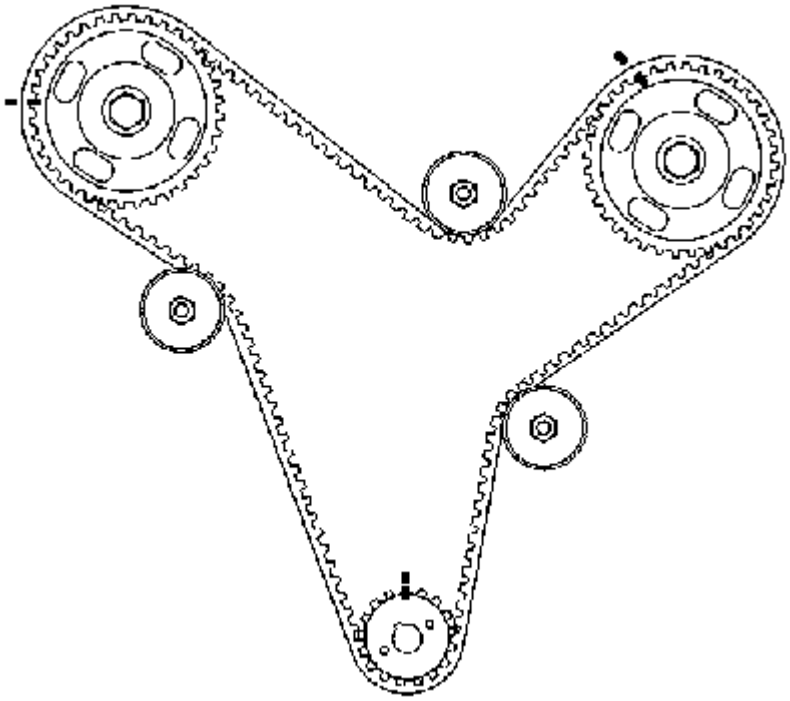
- Remove the auxiliary air valve without disconnecting the connector.
- Turn the ignition on and make sure that the valve closes as the heating element heats-up the bi-metallic strip.

Timing

MAZDA - 626 - 2.5i V6 24V Xerxes - KL

General

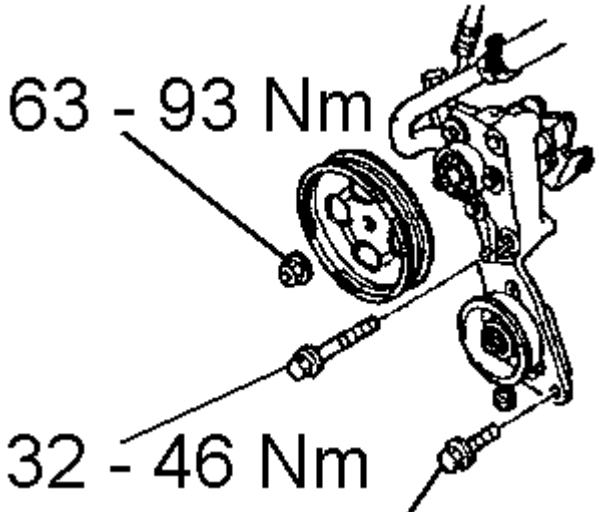
Item	Note
Always check the timing marks before timing belt removal	



Before disconnecting the battery cable, check the audio system security code

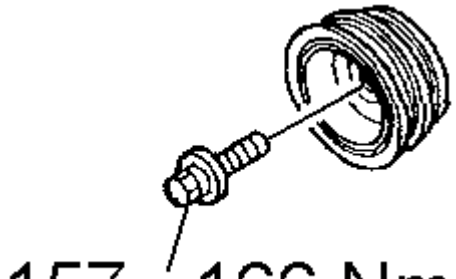
Removal

Item	Note
Disconnect the battery	
Remove the right front wheel	
Remove the engine lower covers	
Remove the ancillary drive belt	
Remove the water pump pulley	
Remove the ancillary pulley bracket	
Remove the power steering pump	

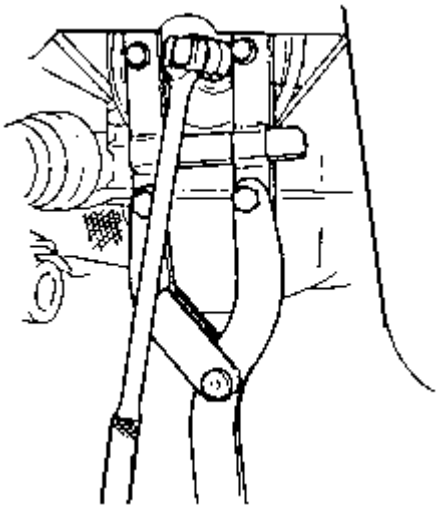


19 - 25 Nm

Remove the crankshaft pulley



Use a special tool: 49 EO11 1A1 / 49 S120 710

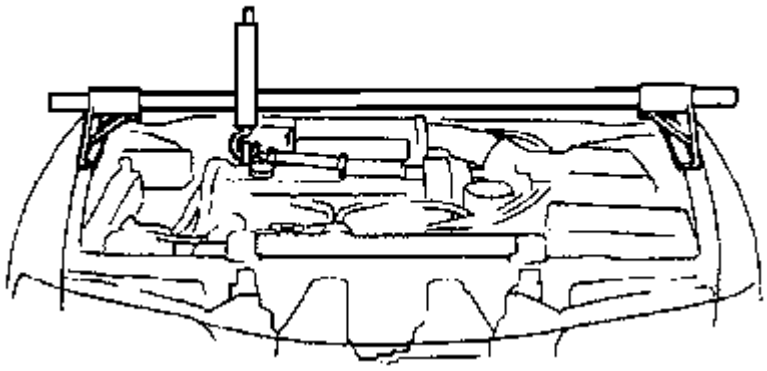


Remove the dipstick

Remove the crankshaft sensor

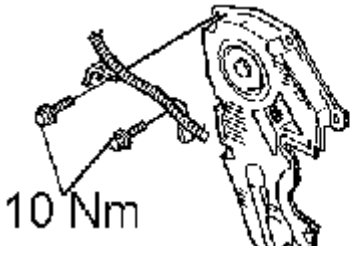
Place the wiring loom to one side

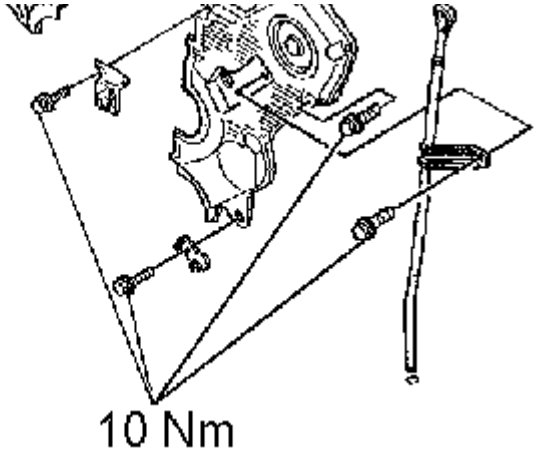
Note: Use a hoist to support the engine



Remove the engine mount

Remove all the timing-belt covers





Turn the crankshaft to TDC for cylinder 1

Align the timing marks

Remove the tensioner

Remove the idler pulley

Remove the timing belt

Check the tensioner and idler pulleys, renew if necessary

Measure the piston protrusion

If out of specification, replace with a new one 14 - 16 mm

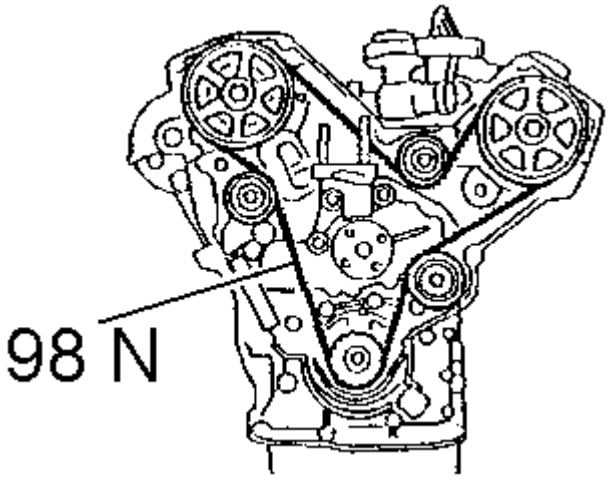
Check for leaks

Compress the tensioner

Lock the tensioner, use a locking pin

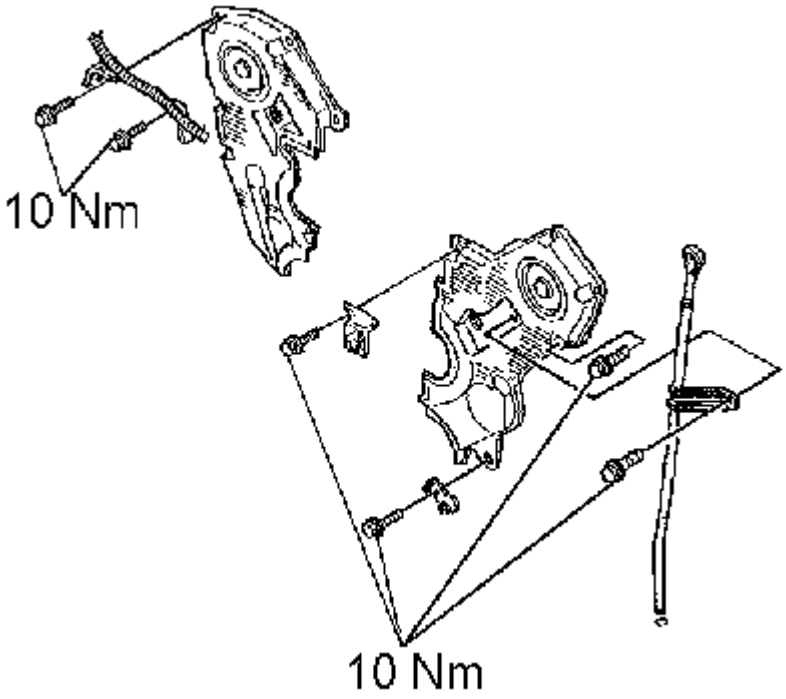
Installation

Item	**Note**
Check the timing marks	
Fit the locked tensioner	
Fit the timing belt anti-clockwise, starting at the crankshaft gearwheel	
Refit the idler pulley	32 - 46 Nm
Remove the locking pin	
Turn the engine 2 rotations by hand	
Check the timing marks	
Measure the timing belt deflection	



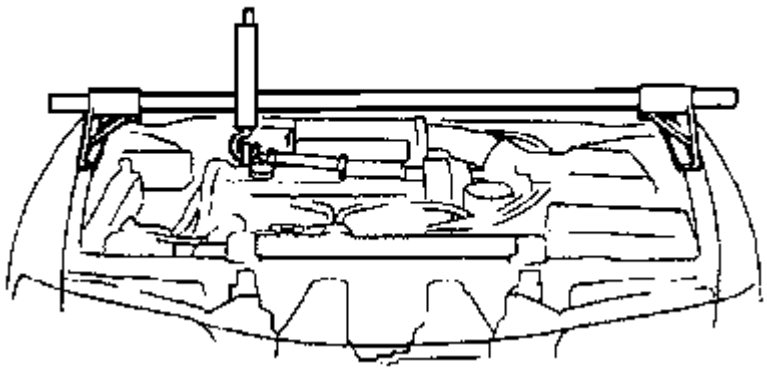
The tension is set at a deflection of: 6 - 8 mm / 98 N

Refit the timing belt covers



Refit the engine mount

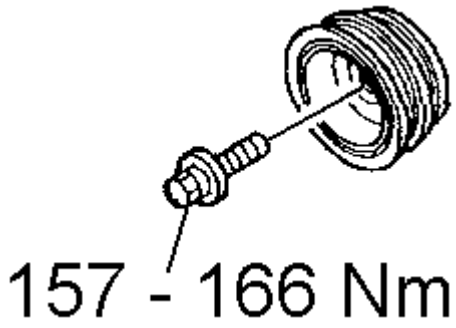
Remove the hoist



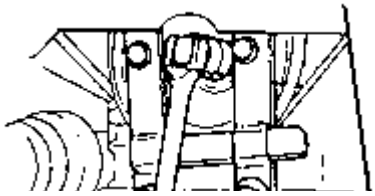
Remove the dipstick

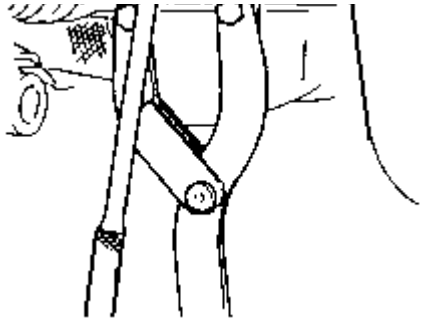
Fit the crankshaft sensor

Refit the crankshaft pulley 157 - 166 Nm

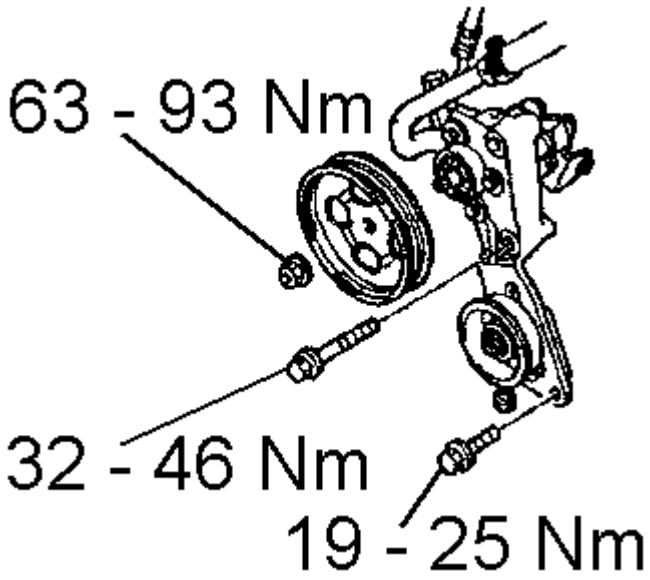


Use a special tool: 49 E011 1A1 / 49 S120 710





Refit the power steering pump



Refit the water pump pulley

Fit the ancillary drive belt

Refit the engine lower covers

Refit the right front wheel

Reconnect the battery earth cable

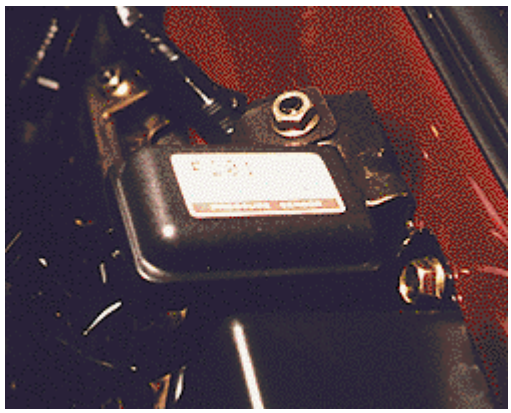
Torque settings

Item	Note
Tensioner:	19 - 25 Nm
Crankshaft pulley:	157 - 166 Nm
Water pump pulley:	10 Nm
Idler pulley:	32 - 46 Nm

Special tools

Item	Note
Engine hoist:	49 G017 5AO
Crankshaft pulley:	49 EO11 1A1 / 49 S120 710

51. absolute pressure sensor



Function

The absolute pressure sensor measures the atmospheric pressure.

Specifications

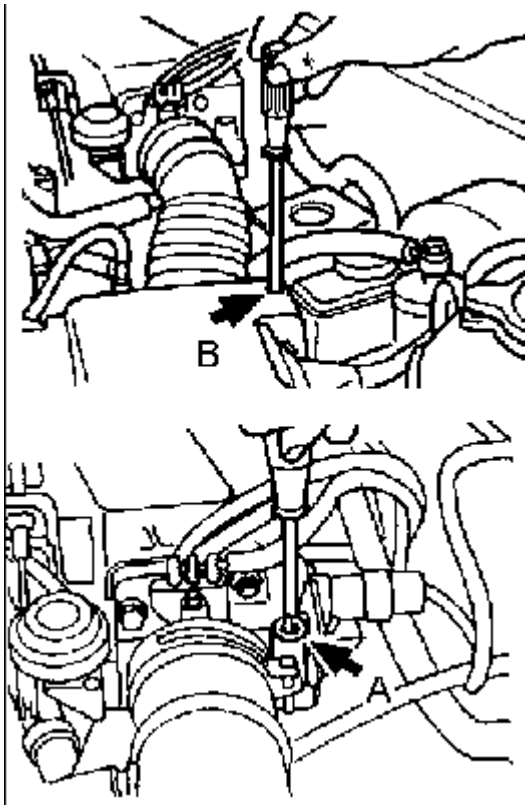
supply voltage: 5 V
output voltage sea level: 3.5 - 4.5 V
output voltage at 2000m: 2.5 - 3.5 V

Adjustment Data

MAZDA - 626 - 2.0i 8V - FE

Engine (general)

Item	Values	Units
Engine code	FE	
Capacity	1998	(cc)
Idle speed	850 - 900	(rpm)
Automatic	900 - 950	(rpm)
Valve clearance		
Hot		
Inlet	0.30	(mm)
Exhaust	0.30	(mm)
Compression pressure		
Normal	13.0	(bar)
Minimum	9.1	(bar)
Oil pressure	1.5 - 2.5/1000	(bar / rpm)
Fuel system (make & type)	EGI	
Fuel system (make & type)	EGI	
Adjustment screws (A = idle speed B = CO)		



Firing order	1-3-4-2	
Timing stroboscopic (before TDC)	6 ± 1/850	(° / rpm)
Start	0 ± 2/125	(° / mmHg)
End	18 - 22/300	(° / mmHg)
Start	0 ± 2/1000	(° / rpm)
End	16 - 20/5800	(° / rpm)

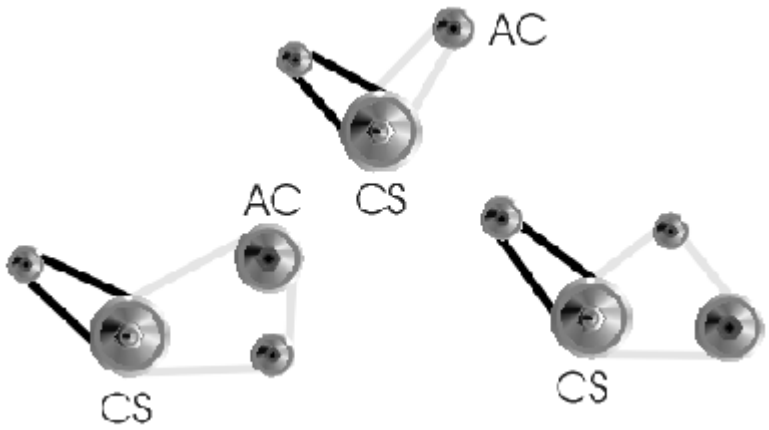
Ignition-coil resistance, primary	1.04 - 1.27	(ohms)
Ignition-coil resistance, secondary	7100 - 9700	(ohms)
Spark plugs (make & type)	NGK/BPR6E-11	
Spark-plug gap	1.0 - 1.1	(mm)
Fuel-pump pressure	4.5 - 6.0	(bar)
Injection pressure / system pressure	2.04 - 2.8	(bar)
CO exhaust gas	< 0.5	(%)
CO2	13 - 16	(%)
HC	300	(ppm)
O2	0.5 - 2.0	(%)
Lambda	0.97 - 1.03	
Lambda change (Delta Lambda)	0.02	
Oil temperature during test	60	(°C)
Fast-idle speed	2500 - 2800	(rpm)
CO at fast-idle speed	< 0.3	(%)
Closed-loop test at: (rpm)	600 - 1000	(rpm)

Cooling system

Item	Values	Units
Cap pressure	0.75 - 1.05	(bar)
Thermostat opens at	86 - 90	(°C)
Fan on at	97	(°C)

Belt layout

Item	Values	Units
Drawing		



Electrical

Item	Values	Units
Battery	60	(Ah)
Alternator	70	(A)

Brakes

Item	Values	Units

Disc thickness, front, min.	22.0	(mm)
Drum diameter, rear, max.	201.5	(mm)

Steering and wheel alignment

Item	Values	Units
Toe-in, front	18' ± 18'	(°)
Camber, front	17' ± 45'	(°)
Castor, front	1° 13' ± 45'	(°)
K.P.I., front	12° 47'	(°)
Toe-in, rear	0 ± 18'	(°)
Camber, rear	-30' ± 45'	(°)

Wheels and tyres

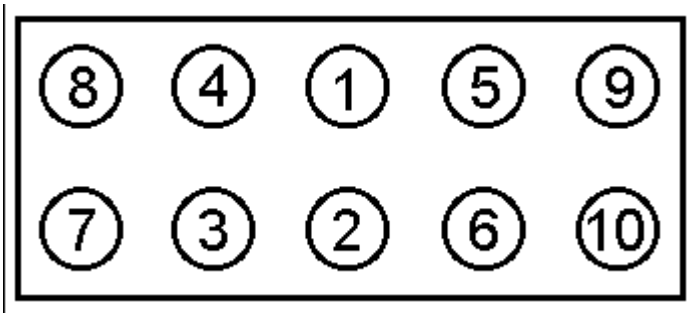
Item	Values	Units
Tyre size	185/70R14	
Front tyre pressure	2.0	(bar)
Rear tyre pressure	2.0	(bar)

Capacities

Item	Values	Units
Engine sump, incl. filter	3.8	(l)
Manual transmission		
Gearbox refill	3.35	(l)
Automatic transmission		
Gearbox refill	6.2 - 6.8	(l)
Cooling system	7.5	(l)

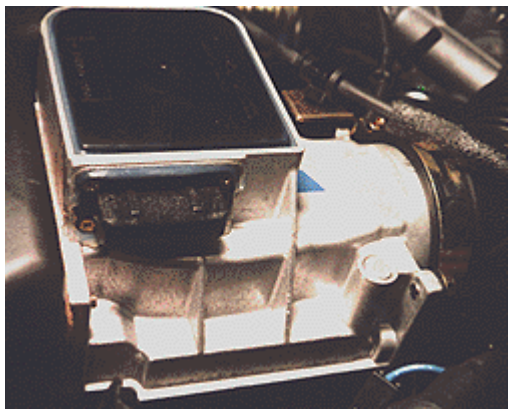
Torque settings

Item	Values	Units
Cylinder head		



Stage 1	20 - 26	(Nm)
Stage 2	50 - 56	(Nm)
Stage 3	80 - 86	(Nm)
Front hub	235 - 319	(Nm)
Rear hub	98 - 117	(Nm)
Wheel nuts	88 - 118	(Nm)
Spark plugs	15 - 23	(Nm)

30. airflow meter



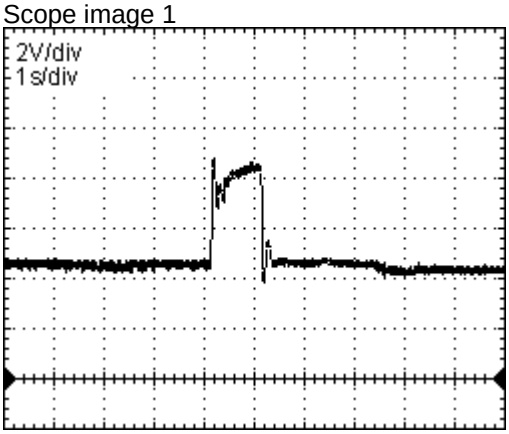
Function

The airflow meter uses an air temperature sensor and a movable vane connected to a potentiometer, which return a signal to the control unit, proportional to the temperature and volume of air entering the engine. When air enters the engine, the airflow meter closes the fuel-pump contact, activating the fuel pump.

Specifications

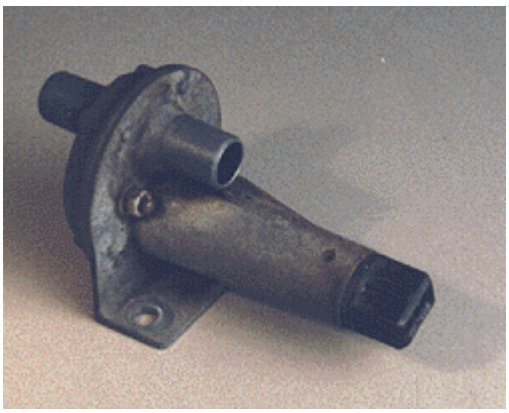
supply voltage: 12 V
output voltage: 0 - 12 V
resistance air temperature sensor: 2,000 - 3,000 ohms / 20°C
waveform information: output signal during acceleration

Scope image 1



Pins to ground: 2E

9. auxiliary valve



Extra Info

Function

The auxiliary air valve supplies additional air to the inlet system, which increases engine rpm during a cold start. The valve consists of an electrically heated bi-metallic strip, which closes the by-pass airflow as temperature rises.

Specifications

supply voltage: 12 V
resistance heater element: 35 - 45 ohms

AUXILAIRY AIR VALVE

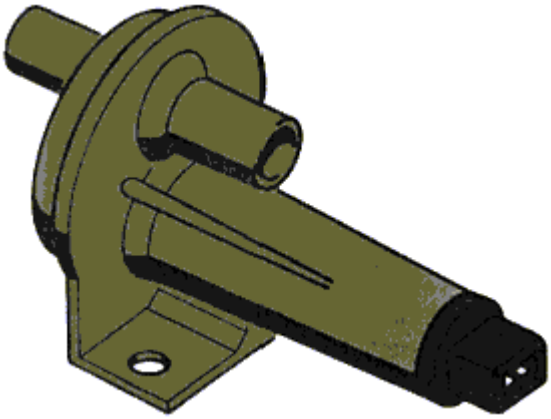
Function

The auxiliary air valve supplies the engine with an addition amount of air during the warm up phase. The auxiliary air valve is located in a tube bypassing the throttle. The valve consists of an electrically heated bi-metallic strip which closes an air by-pass. The air by-pass closes as the temperature rises.

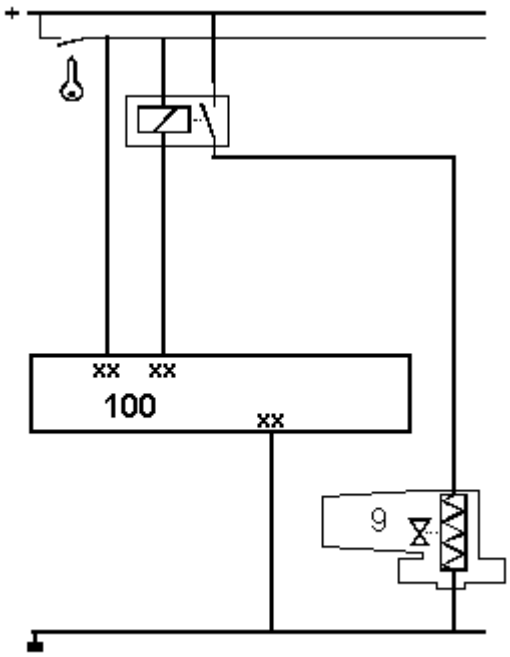
The bi-metallic strip is heated up by an electrical heating element and by the engine temperature.

Specifications

resistance heating element	± 30 - 50 ohms
supply voltage	12 Volts



Electrical control



The auxiliary air valve has a connector with two terminals. One of those terminals is continuously connected with ground. The other terminal is connected with a relay switching the power to the heating element.

Electrical diagnosis

STATIC

- disconnect the connector.

- check the if the supply voltage exists on one of the two terminals of the connector.
- check if continuity exists between the other terminal of the connector and ground.
- check the resistance of the heating element.

Mechanical diagnosis

- Remove the auxiliary air valve without disconnecting the connector.
- Turn the ignition on and make sure that the valve closes as the heating element heats-up the bi-metallic strip.

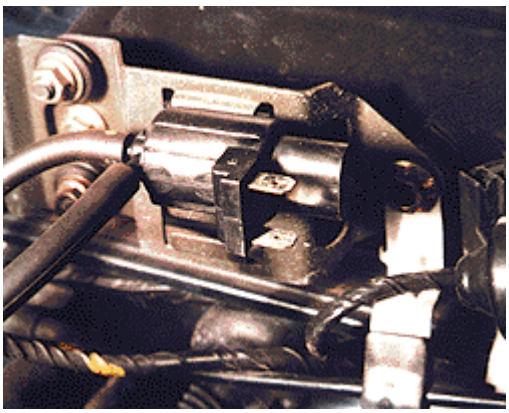
Engine code FE 8V

MAZDA - FE 8V

Compression			
Compression ratio	8.6	: 1	
Compression pressure	11.5	bar	
Idle speed	800 - 850	1/min	
Exhaust gas emissions			
CO content at idle speed	1.5 - 2.5	vol. %	
Thermostat opening temperature	86 *	°C	
Valve timing			
Intake opens	16	°	**before TDC**
Intake closes	54	°	**after BDC**
Outlet opens	54	°	**before BDC**
Outlet closes	16	°	**after TDC**
Valve clearance			
Condition			**hot**
Intake	0.30	mm	
Outlet	0.30	mm	
Firing order	1-3-4-2		
Ignition timing, static / dynamic	6 ± 1	°	**before TDC**

* Data from secondary source; No manufacturer's information

2. canister purge solenoid



Extra Info

Function

The evaporative canister is equipped with a purge solenoid valve. The control unit switches the solenoid on or off. This controls the amount of vapour purged into the inlet manifold.

Specifications

supply voltage: 12 V
resistance: 30 - 40 ohms

Diagnosis

Check connector(s): Inspect the connector(s) and if necessary clean or fix them to make sure the connection is good.
Check resistance:
Turn ignition off. Remove connector from solenoid.
Measure resistance between the two pins of the solenoid. Compare with specified resistance. Alternatively, check solenoid function by applying battery voltage to its pins. The solenoid should "click".
Check supply voltage:
Turn ignition off. Remove connector from solenoid.
Start the engine and measure voltage between one connector terminal and the negative terminal of the battery. Check the second terminal. One of the two should equal battery voltage. If not check wiring and, if present, fuse(s) and relay.

Check connection to ECU:
Turn ignition off. Remove connector from solenoid and ECU.
Measure the resistance between one of the two connector terminals and the corresponding terminal in the ECU connector. Check the other terminal. One of the two should be < 1 ohm. If not check wiring.

CANISTER PURGE SOLENOID

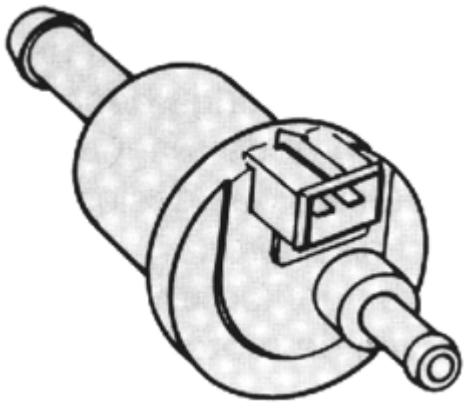
Function

The evaporative gases produced in the fuel tank are absorbed by the activated charcoal in the carbon canister. As The purge control solenoid valve opens these gases are delivered to the intake manifold for combustion purposes. The purge control solenoid valve is controlled by the control unit. The control unit operates this valve during the time the lambda control loop is active.

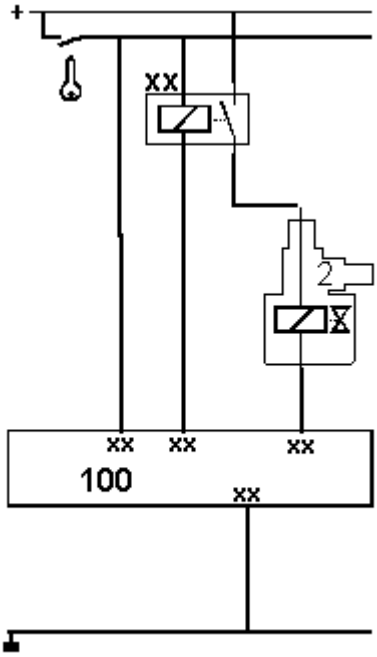
Specifications

RESISTANCE:

resistance:	± 50 ohms
supply voltage:	12 Volts
current:	± 250 mA



Electrical control



Most solenoids are normally closed. This means that the connection between the canister and the intake manifold is closed. The solenoid has a connector with two terminals. On one of those terminals is connected to the battery voltage. This supply-voltage is often switched with a relay. The other terminal leads directly to the control unit. The current through the solenoid is switched on during the time the control unit connects this terminal to ground. The voltage on this terminal is during this time 0 Volts. During the time the solenoid is switched off, the voltage on this terminal is 12 Volts. Some motormanagement systems control the amount gases delivered to the intake manifold switching the solenoid on and of with a certain duty cycle. In this case the duty-cycle depends on engine RPM and engine load.

Electrical diagnosis

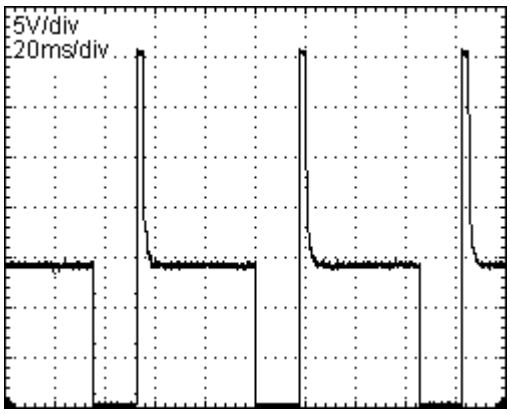
STATIC

General

- To perform this measurements the relay switching the power to the solenoid should be closed. Short circuit the switch in the relay if necessary.

Measurements

- Measure the voltage on the control unit. Use the pin which switches the solenoid.



result: **12 V**

- solenoid and wiring are electrically OK

0 V

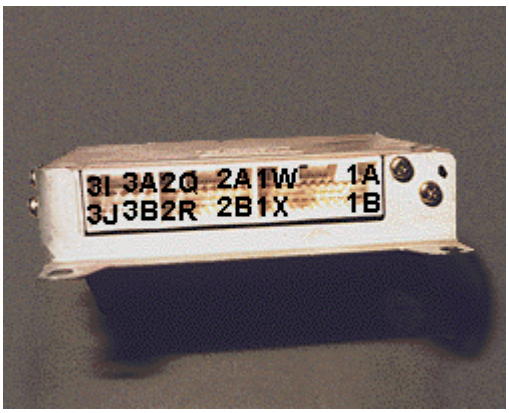
- check the relay switching the power to the solenoid
- check the wiring between the relay and the solenoid
- check the solenoid resistance
- check the wiring between the solenoid and the control unit
- check the control unit

Capacities

MAZDA - 626 - 2.0i 8V - FE

Item	Values	Units
Engine sump, incl. filter	3.8	(l)
Manual transmission		
Gearbox refill	3.35	(l)
Automatic transmission		
Gearbox refill	6.2 - 6.8	(l)
Cooling system	7.5	(l)

100. control unit



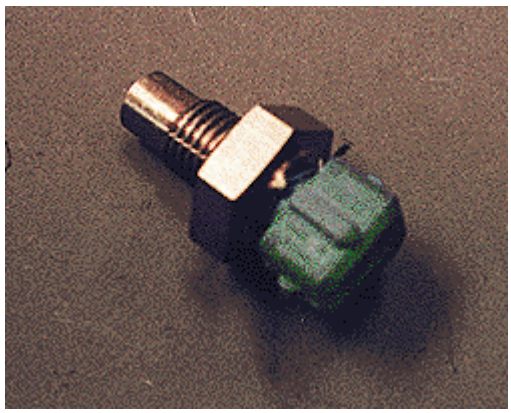
Function

The control unit receives signals from sensors that monitor various engine operating parameters. The control unit generates output signals to provide optimal air/fuel ratio and idle speed control.

Diagnosis

Check connector(s): Inspect the connector(s) and if necessary clean or fix them to make sure the connection is good.
When you suspect the control unit is faulty, make sure all sensors and actuators function properly, and that signals from other control unit(s) are received properly. Next check the supply voltage and ground connections of the control unit:
Turn ignition off. Remove ECU connector.
Locate the supply voltage connections. Turn ignition on. Measure voltage between corresponding connector terminal(s) and the negative terminal of the battery. They should equal battery voltage. If not check wiring and fuse.
Turn ignition off. Locate the ground connections. Measure resistance between corresponding connector terminal(s) and the negative terminal of the battery. They should be < 1 ohm.

42. coolant temperature sensor

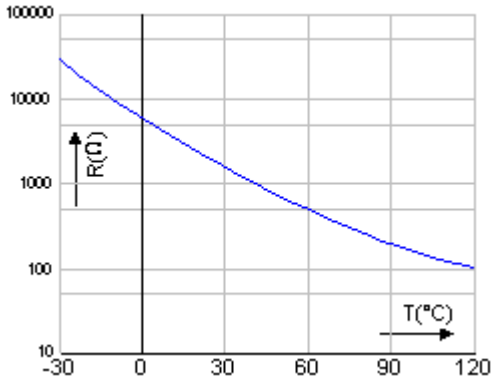


Function

The coolant temperature sensor is a temperature-sensitive resistor. Low temperature causes high resistance while high temperature causes low resistance. The control unit determines the temperature by monitoring the voltage across the sensor.

Specifications

supply voltage: 5 V (connector disconnected)
resistance: 2,000 - 3,000 ohms / 20°C
resistance: 200 - 300 ohms / 90°C



Diagnosis

Check connector(s): Inspect the connector(s) and if necessary clean or fix them to make sure the connection is good.
Check resistance:
Turn ignition off. Remove connector from sensor.
Measure resistance between both pins of the sensor. Compare with specified resistance.
Check supply voltage:
Turn ignition off. Remove connector from sensor.
Turn ignition on and measure voltage between both connector terminals and the negative terminal of the battery. One should be 5 V. If not check wiring then check ECU.
Check connection to ECU:
Turn ignition off. Remove connectors from sensor and ECU.
Measure the resistance between supply voltage connector terminal and the corresponding terminal in the ECU connector. It should be < 1 ohm. If not check wiring.
Check ground:
Check in schematic if ground connection is connected to a direct ground or to the ECU. When it is connected directly to ground: Turn ignition off. Remove connector from sensor and measure resistance between ground connector terminal and the negative terminal of the battery. It should be < 1 ohm. If not check wiring. When it is connected to the ECU: Turn ignition off. Remove connector from sensor and ECU. Measure resistance between ground connector terminal and the corresponding terminal in the ECU connector. It should be < 1 ohm. If not check wiring.

190. coolant temperature switch

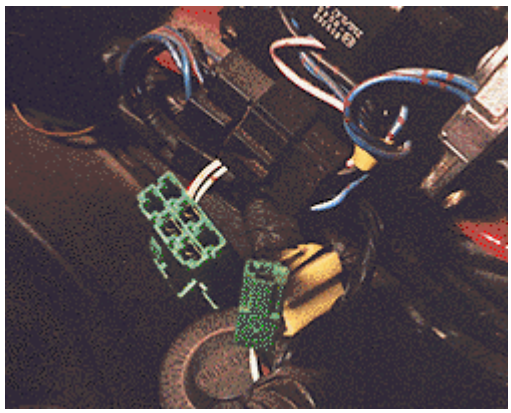
Function

The coolant temperature switch returns a signal to the control unit at temperatures above 17°C.

Specifications

the temperature switch closes at 17°C.

83. diagnostic connector



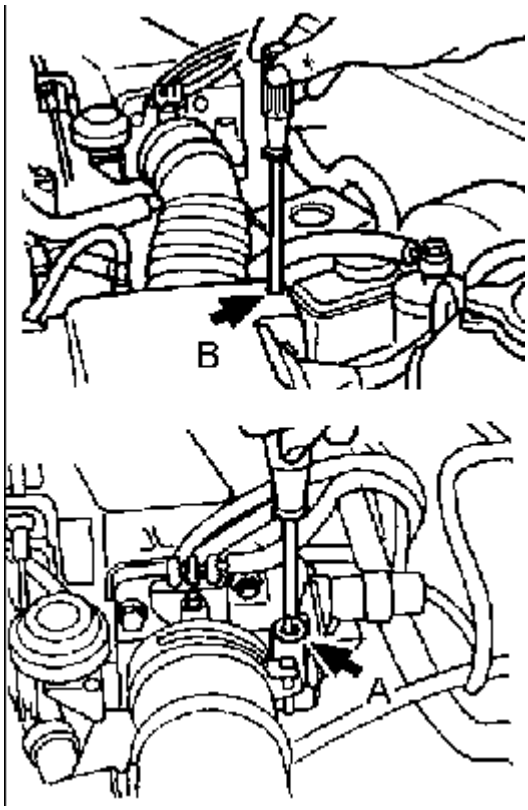
Function

This connector is used to communicate with the control unit.

Environmental Data

MAZDA - 626 - 2.0i 8V - FE

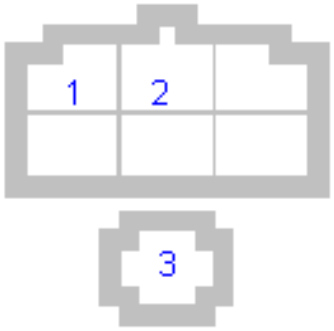
Item	Values	Units
Engine code	FE	
Idle speed	850 - 900	(rpm)
Automatic	900 - 950	(rpm)
Fuel system (make & type)	EGI	
Fuel system (make & type)	EGI	
Adjustment screws (A = idle speed B = CO)		



Timing stroboscopic (before TDC)	6 ± 1/850	(° / rpm)
Start	0 ± 2/125	(° / mmHg)
End	18 - 22/300	(° / mmHg)
Start	0 ± 2/1000	(° / rpm)
End	16 - 20/5800	(° / rpm)
Fuel-pump pressure	4.5 - 6.0	(bar)
Injection pressure / system pressure	2.04 - 2.8	(bar)
CO exhaust gas	< 0.5	(%)
CO2	13 - 16	(%)
HC	300	(ppm)
O2	0.5 - 2.0	(%)
Lambda	0.97 - 1.03	
Lambda change (Delta Lambda)	0.02	
Oil temperature during test	60	(°C)
Fast-idle speed	2500 - 2800	(rpm)
CO at fast-idle speed	< 0.3	(%)

Closed-loop test at: (rpm)	600 - 1000	(rpm)

Error codes



Diagnostic plug

Diagnostic plug (green, 6-pin):
1 = Datalink LED tester (green/black wire)
2 = positive battery terminal (+B, red/brown wire)
Diagnostic plug (green, 1-pin):
3 = activation error codes

Read-out

-Connect LED tester to positive battery terminal (+B) and diagnostic-plug terminal 1.
-Connect terminal 3 (diagnostic plug, green, 1-pin) to ground.
-Turn ignition on.
-LED will light for 3 to 5 seconds.
-Error codes will appear on LED tester.

Reset

-Turn ignition off.
-Disconnect negative terminal of the battery.
-Depress brake pedal for at least 2 seconds.
-Connect negative terminal of the battery.
-Turn ignition on and wait at least 6 seconds.
-Start and warm up the engine. Let the engine run for 3 minutes at 2500-3000 rpm.
-Verify that no error codes are displayed.

Signal

-Digit 1 (tens position): Light pulse 1.2 seconds long, 0.4 seconds pause in-between.
-Pause 1.6 seconds light-off.
-Digit 2 (units position): Light pulse 0.4 seconds long, 0.4 seconds pause in-between.
-Pause 4.0 seconds light-off.

Error codes

01 Ignition pulse no signal.
08 Airflow meter, open or short circuit.
09 Coolant temperature sensor, open or short circuit.
10 Air temperature sensor, open or short circuit.
12 Throttle position sensor, open or short circuit.
14 Absolute pressure sensor (inside ECU), open or short circuit.
15 Oxygen sensor, lean signal for longer than 120 seconds, engine speed is higher than 1500 rpm, warm engine.
17 Oxygen sensor signal does not change for 20 seconds, engine speed is higher than 1500 rpm.
25 Increased fuel pressure solenoid, open or short circuit.
26 Canister purge solenoid, open or short circuit.
28 EGR purge solenoid.
34 Idle speed control solenoid (C) open or short circuit.
35 Idle speed control solenoid (B) open or short circuit.

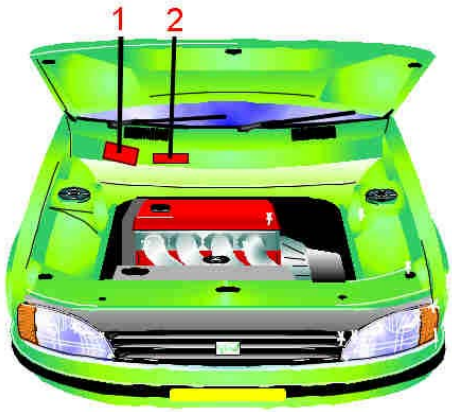
ID Location

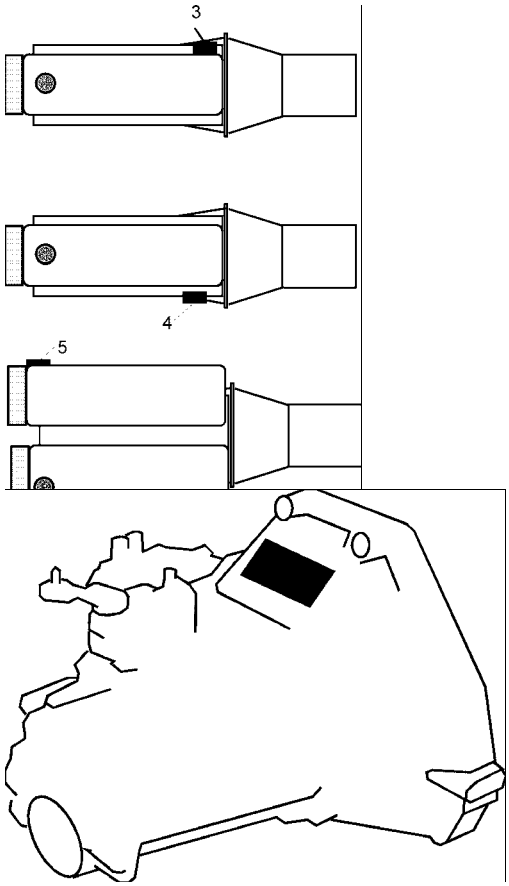
MAZDA - 626 - 2.0i 8V - FE

1 Identification plate
2 VIN

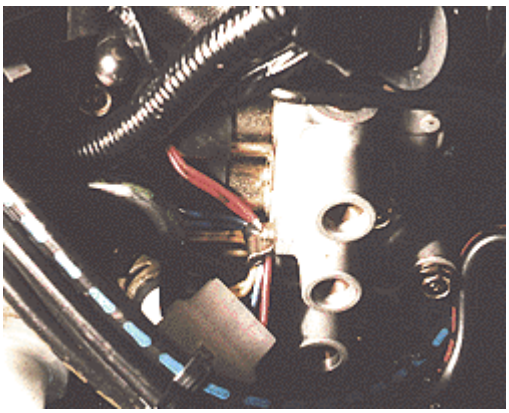
3 Engine code B3 / B5 / B6 / PN
4 Engine code BP / FP / FS
5 Engine code 6-cylinder

6 Manual transmission code





6. idle speed control valve



Extra Info

Function

The idle speed control valve regulates the by-pass airflow.

Specifications

supply voltage: 12 V
resistance coil with red wires: 30 - 35 ohms
resistance coil with blue wires: 30 - 35 ohms
resistance coil with yellow wires: 20 - 25 ohms

IDLE SPEED CONTROL VALVE

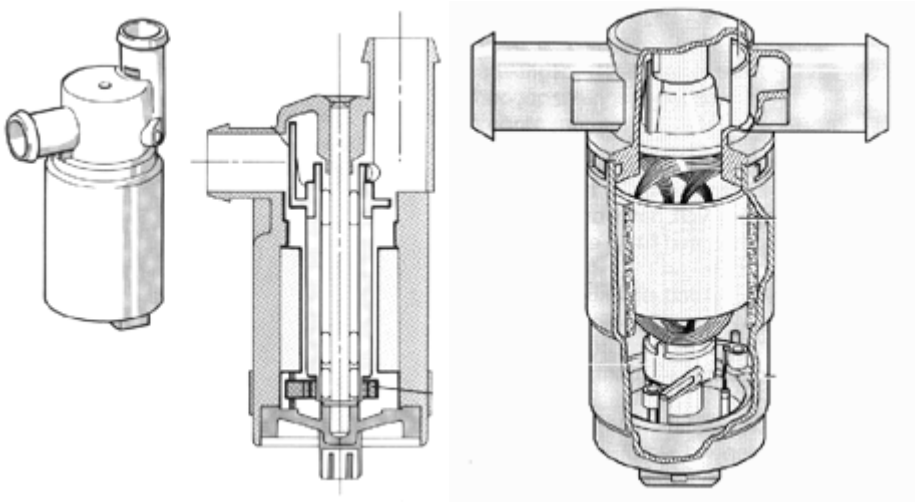
Function

The idle control valve is located in a tube bypassing the throttle. The control unit controls this device to ensure stable idling in all operating conditions.

Specifications

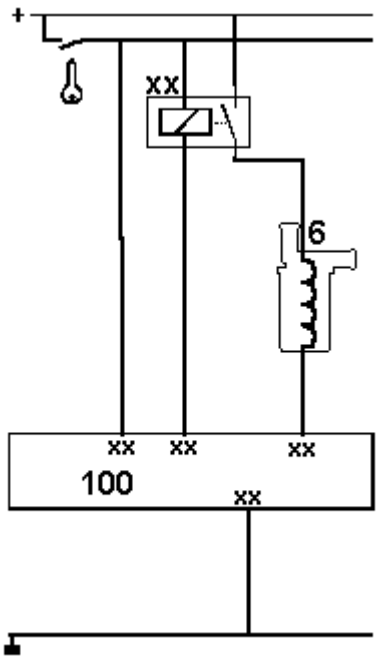
resistance coil(s):	± 20 ohms
supply voltage:	12 Volts

A rotary slide valve attached to the armature is turned to open the air bypass until the desired idle speed is obtained. The position of the armature is controlled by the force of an internal spring opposing the force of a solenoid (types with to terminals) or controlled by two solenoids energised alternately which exerts opposing forces on the armature (types with three terminals).



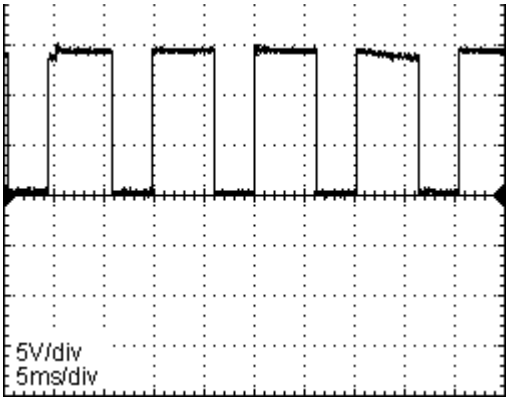
Electrical control

Types with two terminals



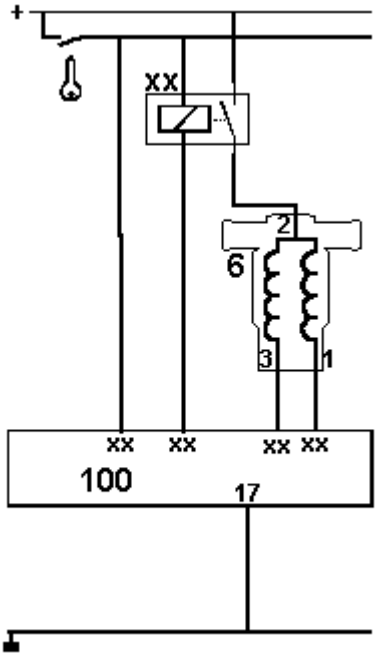
As a current flows through the coil the armature is turned against the spring force. As the current increases the airflow and the idle speed increases. If the current through the coil is switched off due to a mall functioning system, the valve is forced into a position which results in a (too) high idle speed.

The idle control valve has a connector with two terminals. On one of those terminals is connected to the battery voltage. This supply-voltage is often switched with a relay. The other terminal leads directly to the control unit. The current through the coil is switched on during the time the control unit connects this terminal to ground. The voltage on this terminal is during this time 0 Volts. During the time the current through the coil is switched off, the voltage on this terminal is 12 Volts.

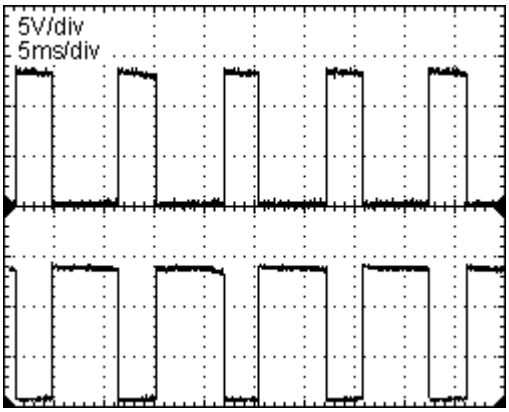


The control unit controls the current through the coil switching the current on and off with a certain duty cycle. The current increases as the duty-cycle increases. The duty cycle varies between approx. 35% (valve closed) and 85% (valve opened). Nominal idle speed is obtained when slightly open.

Three terminal types



The two coils inside this type of idle speed control valve are connected with the supply voltage using one common terminal. The other two terminals lead directly to the control unit. The control unit switches the current through the solenoid on and off alternately with a duty cycle between 35 and 85%.



Electrical diagnosis

STATIC

- To perform this measurements the relay switching the power to the idle control valve should be closed. Short circuit the switch in the relay if necessary.

  Measurements:

  Disconnect the connector and

DYNAMIC TESTS THREE TERMINAL TYPES

- Remove the idle control valve but leave the electrical connections in place. Fully open or close the rotating plunger. Switch on the ignition.

measure the resistance of the coil(s). The nominal value is app. 20 ohms.

- Check the relay switching the power to the idle control valve
- Check the wiring between the relay and the idle control valve
- Check the wiring between the idle control valve and the control unit
- Check the control unit

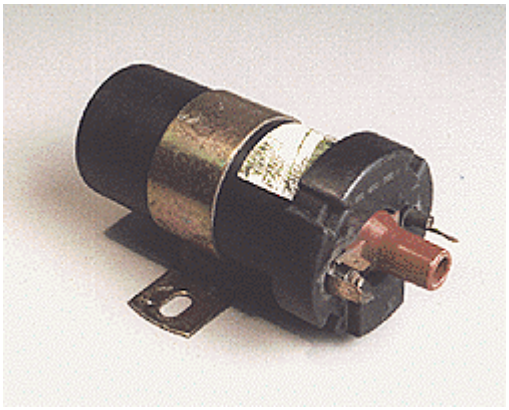
result:

- Switch on the ignition. The rotating plunger must move to a position equivalent to app. 50% opening, and remain there.

Mechanical diagnosis

- Check the air chamber on air leakage.
- Check engine on air leaks into the intake system.
- Remove the idle control valve. The plunger should rotate or move easily. Clean if necessary.

11. ignition coil



Extra Info

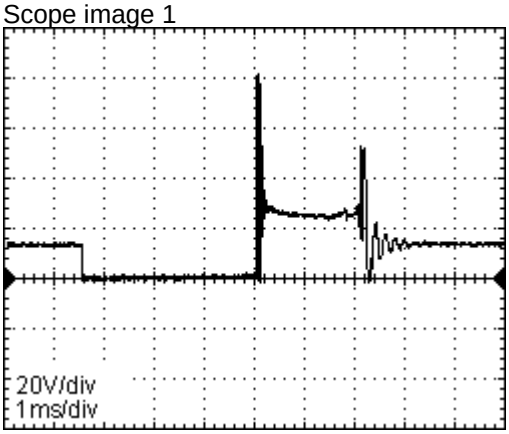
Function

The ignition coil stores energy when current is passed through the coil primary. When the current is switched off a high voltage is induced in the coil secondary.

Specifications

supply voltage: 12 V
resistance primary coil: 0.5 - 2.0 ohms
resistance secondary coil: 7,000 - 10,000 ohms
waveform information: engine running at idle

Scope image 1



Diagnosis

Check connector(s): Inspect the connector(s) and if necessary clean or fix them to make sure the connection is good.
Check resistance primary coil:
Turn ignition off. Remove connectors from ignition coil.
Measure resistance between supply voltage connector pin and primary switching connector pin of the ignition coil.
Compare with specified resistance.
Check resistance secondary coil:
Turn ignition off. Remove connectors from ignition coil.
Measure resistance between central lead terminal and primary switching connector pin. Compare with specified resistance.
Check supply voltage:
Turn ignition off. Remove connectors from ignition coil.
Turn ignition on and measure voltage between supply voltage connector terminal and the negative terminal of the battery. It should equal battery voltage. If not check wiring and, if present, fuse(s) and relay.
Check connection to ignition module:
Turn ignition off. Remove connector from ignition coil and ignition module.
Turn ignition on and measure resistance between primary switching connector terminal and corresponding terminal in ignition module connector. It should be < 1 ohm. If not check wiring.
Check ignition signal:
Connect oscilloscope to the ignition module pin corresponding to the primary switching wire of the ignition coil and ground. Start the engine and compare to the scope image shown.

IGNITION COIL

Function

The ignition coil transforms the battery voltage into the high voltage needed to create a spark.

The ignition coil consists of an electromagnet (the primary coil) and a high voltage coil (secondary coil).

By switching the current through the primary coil on, a magnetic field is induced. The moment the current is switched of, the magnetic field suddenly disappears.

This change of magnetic field creates an induction voltage in the secondary coil, high enough to ionise the mixture. The ionised mixture is a conductor and a current flows through the spark plug.

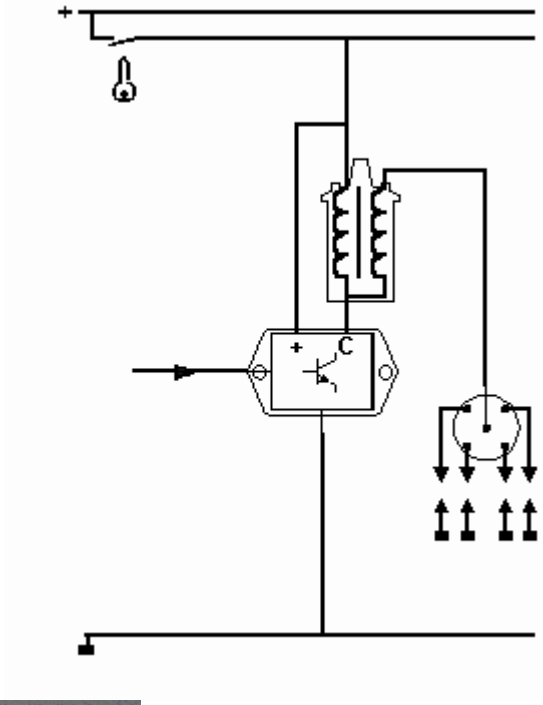
Specifications

RESISTANCE:	
primary:	± 0,3 - 2 ohms
secondary	± 5k - 20k ohms
supply voltage:	12 V
current limited at:	± 7A

Systems with a distributor

Ignition coils used in combination with a distributor consists of one primary and one secondary coil.

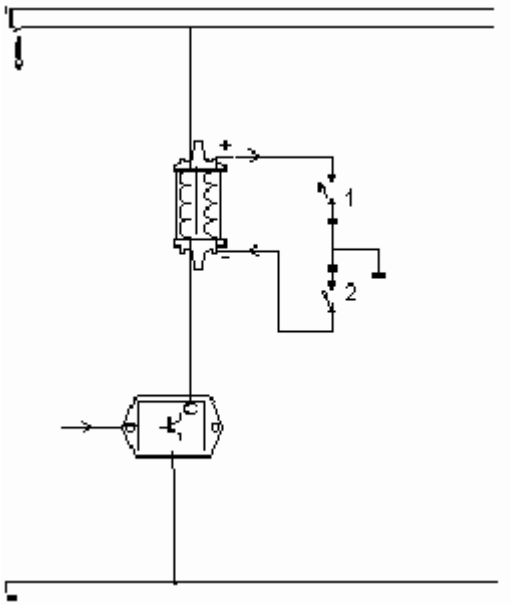
The high voltage, induced in the secondary coil is connected to one of the spark plugs



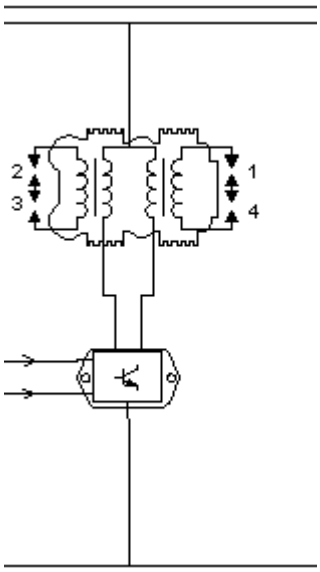
selected by the distributor.

Wasted spark ignition coils

The secondary coil has two ends. In a normal ignition coil one of those ends delivers the high
The other end is connected to either the positive (15) or the negative (1) terminal of the prir
In a wasted spark ignition coil both ends are connected to a spark plug. Therefore both spark
will spark at the same time.

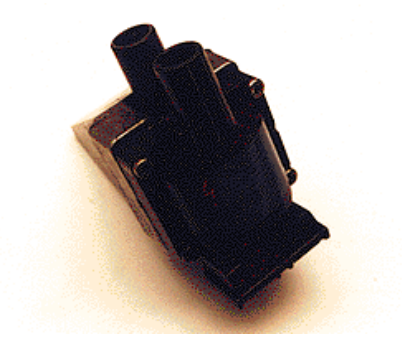


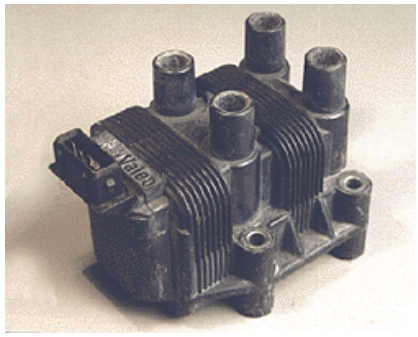
wasted spark ignition coil on 2- cylinder 4-stroke engine



a wasted spark ignition coil on a 4- cylinder 4-str

To supply the four spark plugs of an 4 cylinder engine, two ignition coils are needed. The pic
below (left) shows an ignition coil for two spark plugs. The ignition coil in the right picture
incorporates two of those. This ignition coil supplies four spark plugs.

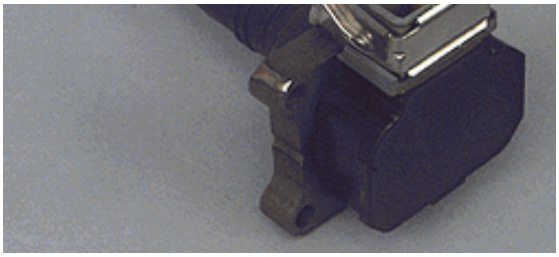


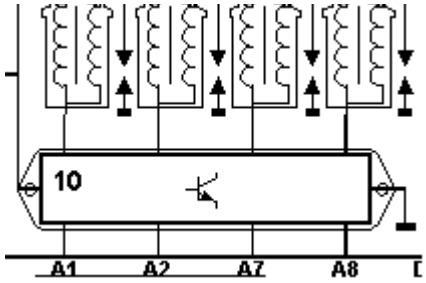


Sequential ignition

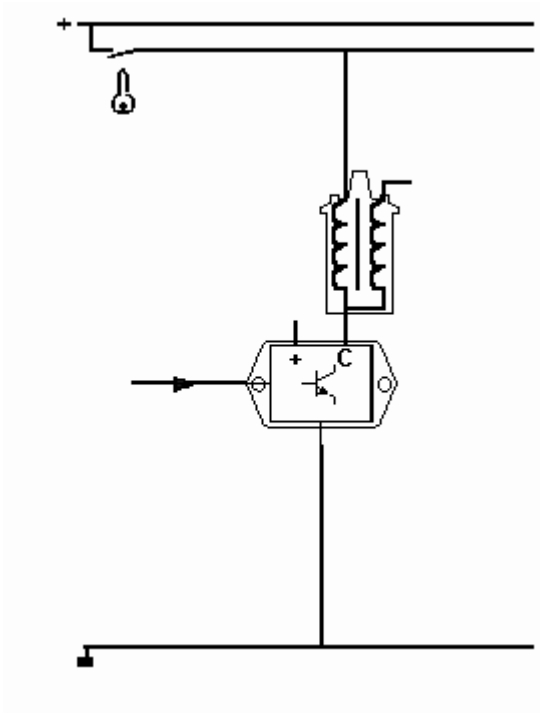
Sequential ignition systems are distributor less ignition systems using one ignition coil per
cylinder.

Each ignition coil is controlled by the control unit individually.





Electrical control



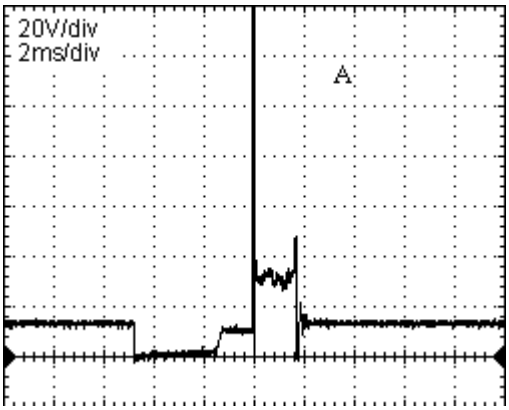
A current through the primary coil induces a magnetic field. The moment the current is switched of, the magnetic field suddenly disappears. This change of magnetic field induces an induction voltage and causes a spark.

The amperage before switching the current off should be high enough to create a high change of magnetic field the moment the current is switched off.

Therefore the current through the primary coil is controlled electronically.

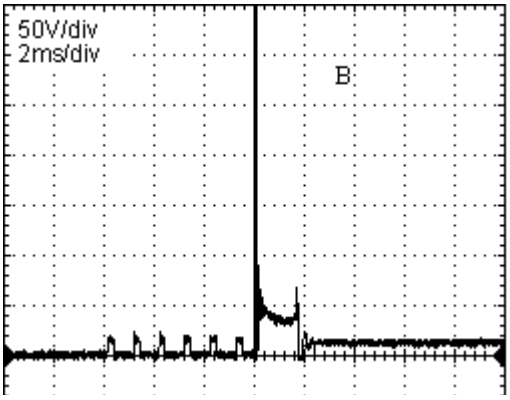
The ignition module is supplied with a current limited circuit. Using this in combination with a low resistance ignition coil the amperage does not depend on the battery voltage.

During the time the current is switched off, the voltage over the ignition module is 12 Volts. The moment the current is switched on, the voltage drops to 0 Volts. From this moment on the current increases until the limiting value is reached.



The oscilloscope images A and B gives you an example of the primary voltage measured on two different current limiting circuits.

By increasing the voltage over the ignition module, the voltage over the primary coil decreases. This causes a limited current in oscilloscope image A.



The ignition module in oscilloscope image B switches the current on and off to limit the current.

Electrical diagnosis

STATIC

To perform this measurements the ignition should be switched on.

Measurements:

- Measure the primary and secondary resistance of the ignition coil.
- Measure the voltage on the positive terminal of the ignition module.

The voltage should be equal to the battery voltage.

result: **Voltage is lower than battery voltage.**

- disconnect positive terminal and repeat measurement

result: **Voltage is equal to battery voltage.**

- check primary resistance of the ignition coil
- check ignition module
- check wiring between ignition module and ignition module.

result **Voltage is still lower than battery voltage.**

- check ignition lock
- check wiring between ignition lock and ignition coil

DYNAMIC

Start the engine and measure the primary voltage using an oscilloscope.

result: **0 V**

- check power supply.

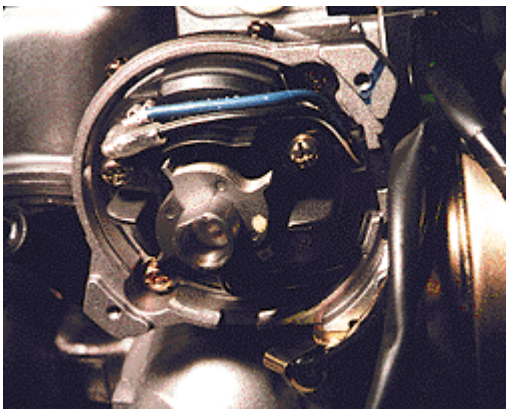
12 V

- check ignition module

Mechanical diagnosis

Not available for this subject !

10. ignition module



Extra Info

Function

The ignition module receives its input signal from the magnetic pickup sensor and switches the current through the coil primary circuit on and off.

Specifications

supply voltage: 12 V

IGNITION MODULE

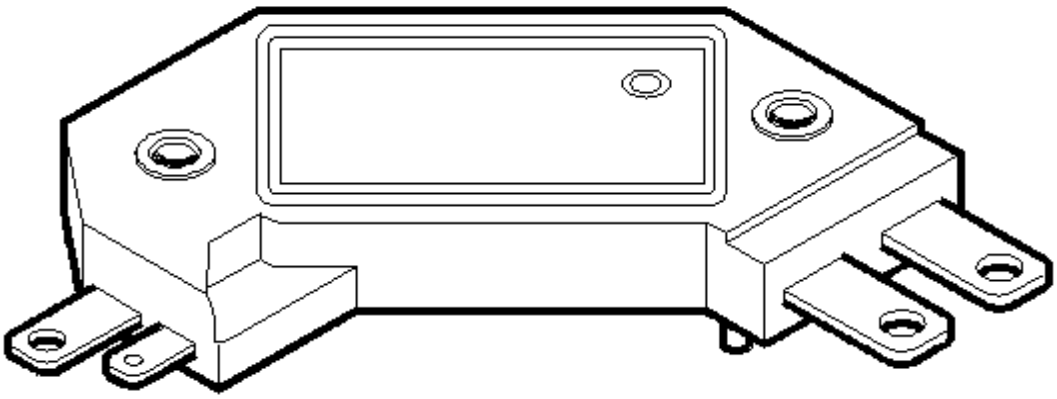
Function

The ignition module switches the current through the primary ignition coil on and off. The ignition module charges the ignition coil during the time the current is switched on. The moment the ignition module switches the current 'off' the ignition coil induces an induction voltage which causes the spark.

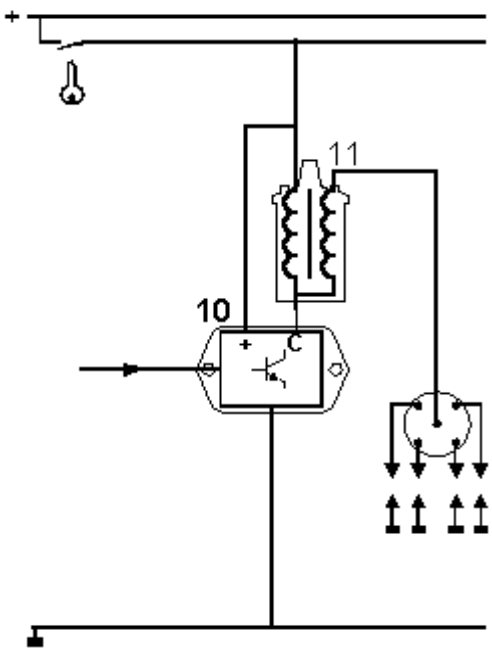
An ignition module switches the current on and off according to an input signal. This input is delivered by the control unit. On older systems the input signal is delivered by an inductive, Hall or opto-coupled sensor mounted in the distributor.

Specifications

resistance	-
supply voltage	-



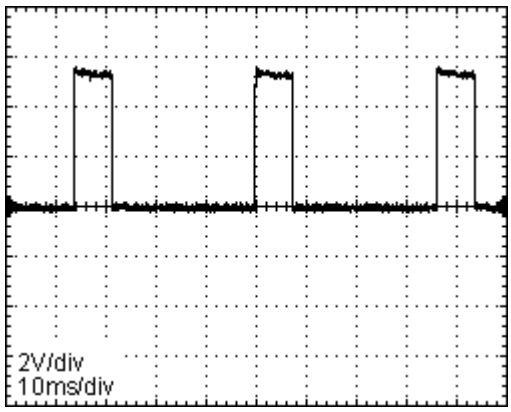
Electrical control



The connector of the ignition module has several terminals. The following terminals are used on common ignition modules.

- a terminal connected with the ignition coil. By this terminal the current through the ignition coil is switched on and of.
- a terminal connected with the supply voltage (12 Volts)
- a terminal connected with ground.
- terminal(s) to receive the input signal. If the input signal is delivered by an inductive sensor two terminals are needed.

The output voltage of an inductive sensor is delivered by an internal coil. This coil induces an almost sine wave output voltage. If the input signal is delivered by an Hall-sensor or opto-coupler three terminals are needed. Two of those three terminals are used to supply the sensor. The supply voltage is either 5 or 12 Volts. The third terminal receives the output signal from the sensor. The output voltage of these sensors is a square wave signal.



Addition terminals are possible. For example to send out a RPM signal to the revolution counter. Sometimes the input signal is delivered by a sensor while the ignition timing is controlled by the control unit. In this case the received input signal from the sensor is converted into a square wave signal by the ignition module and send out to the control unit. The control unit receiving this signal computes this input information and other input information from various engine parameters and sends out a new square wave signal to the ignition module. This signal is used by the ignition module to switch the current through the primary ignition coil on and off.

During the time the input signal for the ignition module is 'high' the current is switched 'on'. The moments this input signals falls to 'low' the current is switched 'off'. This moment the spark will appear

Electrical diagnosis

- Start the engine and measure (using an oscilloscope) the input signal delivered by the control unit or input sensor. The square wave signal or sine wave signal from a inductive sensor should be visible.

signal not OK:

- Disconnect the ignition module's connector and check the wiring between the ignition module and the control unit or input sensor.
- replace the ignition module if the signal appears on the disconnected connector and disappears on the connected connector.

If the output signal remains invisible the failure is not in the component.

signal OK:

- check the power supply of the ignition module.
- check the primary voltage using an ignition oscilloscope or normal oscilloscope with a suitable probe.
- check the wiring between the ignition module and the ignition coil.

The voltage should be nearly 0 Volt during the period the ignition module receives an 'high' input voltage from the sensor or control unit.

Mechanical diagnosis

- Remove the auxiliary air valve without disconnecting the connector.
- Turn the ignition on and make sure that the valve closes as the heating element heats-up the bi-metallic strip.

167. increased fuel pressure solenoid

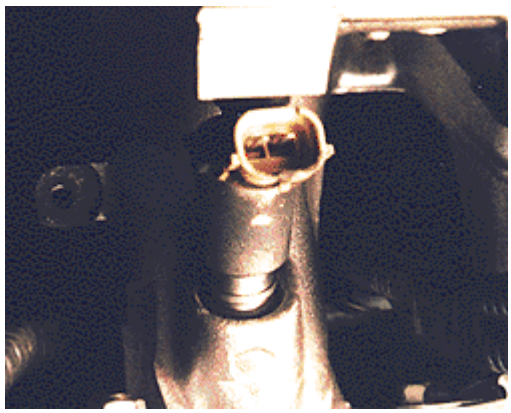
Function

The vacuum solenoid (P.R.C.) regulates the connection between the fuel pressure regulator and the inlet manifold vacuum. The vacuum solenoid is activated by the control unit at air temperatures above 20°C, at engine speeds below 1500 rpm, and with the idle switch closed.

Specifications

supply voltage: 12 V
resistance: 35 - 45 ohms

1. injector



Extra Info

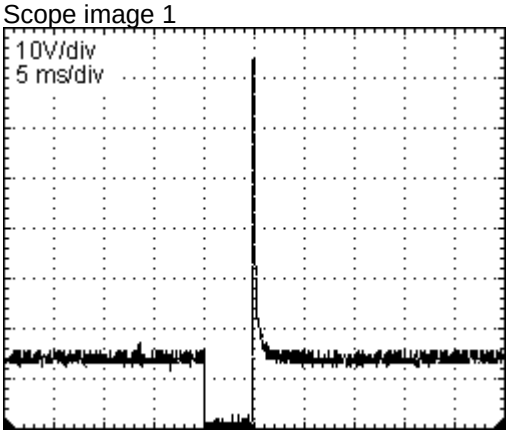
Function

A fuel injector is an electrically operated solenoid valve which is powered by the control unit. The fuel injector injects fuel into the inlet manifold.

Specifications

supply voltage: 12 V
resistance: 13 - 17 ohms
waveform information: engine running at idle

Scope image 1



Pins to ground: 3C, 3E

Diagnosis

Check connector(s): Inspect the connector(s) and if necessary clean or fix them to make sure the connection is good.
Check resistance:
Turn ignition off. Remove connector(s) from injector(s). Measure resistance between the two pins of the injector. Compare with specified resistance.
Check supply voltage:
Turn ignition off. Remove connector(s) from injector(s). Crank the engine and measure voltage between one connector terminal and the negative terminal of the battery. Check the second terminal, one of the two should equal battery voltage. If not check wiring and, if present, fuse(s) and relay or power supply control unit.
Check connection to ECU:
Turn ignition off. Remove connector(s) from injector(s) and ECU. Measure the resistance between one of the two connector terminals and the corresponding terminal in the ECU connector. Check the other terminal. One of the two should be < 1 ohm. If not check wiring.
Check injector activation:
Connect oscilloscope to one of the signal wire pin(s) of the ECU and ground. Start or crank the engine and compare to the scope image shown.

INJECTOR

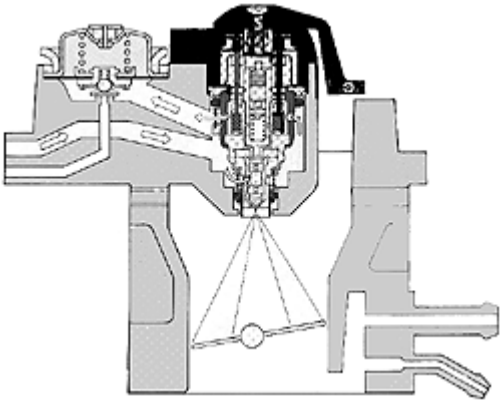
Function

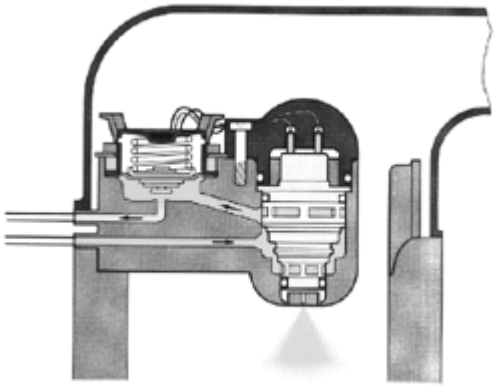
Injectors are electronically operated electromagnetic valves. Using the injectors the control unit is able to inject an exact quantity of fuel. Adding this quantity of fuel to the air, a mixture with the demanded air/fuel ratio is created. Depending on the kind of motormanagement system either one injector per cylinder (multipoint systems) or one injector for all cylinders (singlepoint systems) are used.

Specifications

RESISTANCE:	
high impedance:	± 15 ohms
low impedance:	± 0,5 - 2,5 ohm
flow:	± 50 - 200
gr/minsupply voltage:	1- 12 Volts
current:	± 0,75Amps

Single-point systems





Single-point fuel injection systems use one central placed injector to create the required air/fuel ratio. The injector is mounted in the throttle-body and injects the fuel on top of the throttle. The fuel is delivered by a fuel pump and kept at a constant level by the fuel pressure regulator mounted on the throttle body. The fuel pressure on single-point systems is usually between 0,6 and 1,2 bars.

Multipoint systems

Multipoint fuel injection systems use one injector for each cylinder. The injectors are mounted in the intake manifold. The fuel is injected in the direction of the inlet valves. The fuel is delivered by a fuel pump. The pressure difference between the air pressure in the intake manifold and the fuel pressure is kept at a constant level by the fuel pressure regulator. Therefore the fuel pressure regulator increases the fuel pressure as the intake manifold pressure increases. The fuel pressure on multipoint systems is usually between 2 and 3 bars. The fuel pressure regulator is mounted on the fuel rail.

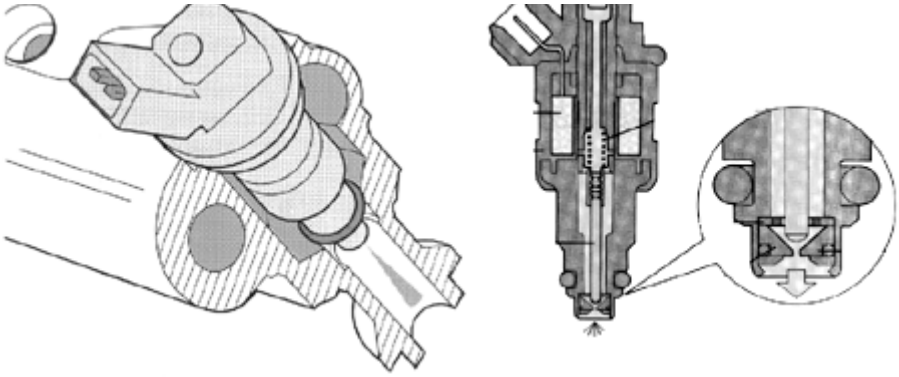
Sequential fuel injection

Sequential fuel injection is a method used by multipoint systems to control the air/fuel ratio and the injection timing per cylinder. Each injector of a sequential injection system is controlled by the control unit individually..

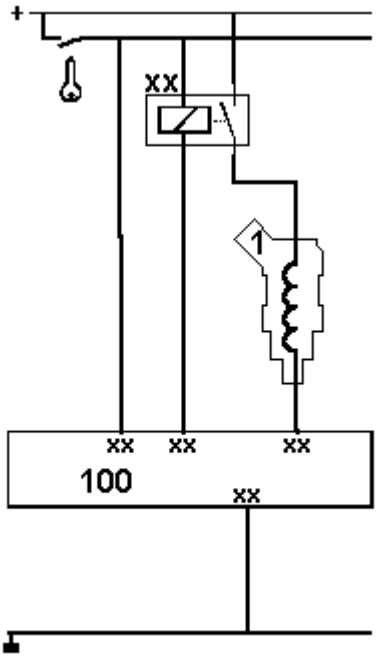
Bottom- and top-feed injectors

The injector fuel inlet can be at the

top or at the bottom. Bottom-feed injectors are often used on singlepoint injection systems while top-feed injectors more often are used as multipoint injectors.



Electrical control

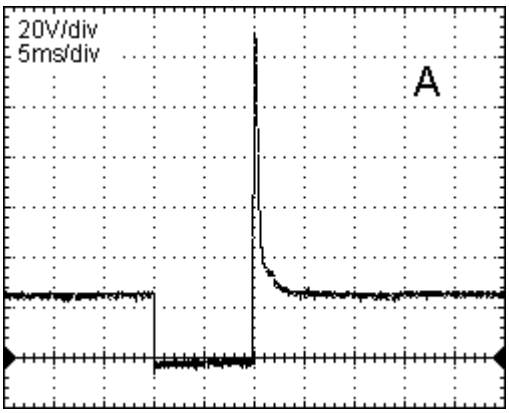


The electrical behaviour of an injector is determined by the coil inside. As a current flows through the coil the injector needle is pulled up against the spring force which courses the fuel to be injected. Two types of injector coils are used. The resistance of a normal coil is approximate 15 ohms. Other injection systems use low resistance coils (approximate 1-2,5 ohms).

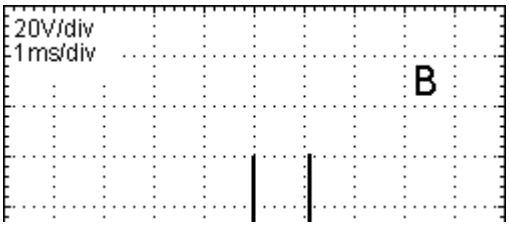
Low impedance injector can be switched on in two different ways:

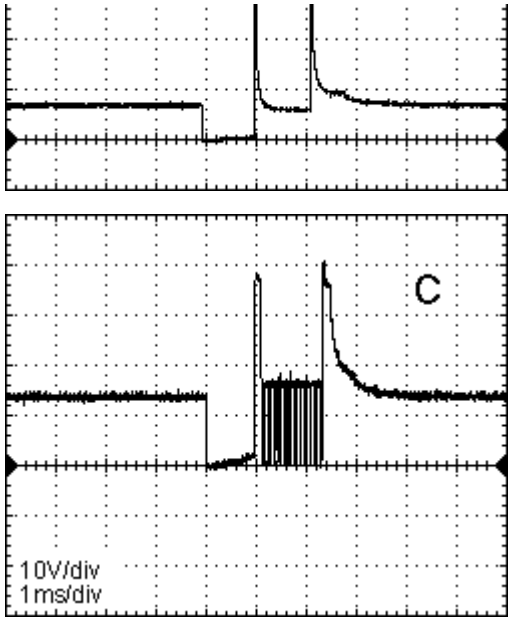
- using an extra external resistance to limit the current
- using a current limiting circuit inside the control unit.

An injector has an electrical connector with two pins. On one of those pins is connected with the battery voltage. This supply-voltage is often switched to the injector using a relay. The other pin leads directly to the control unit. The current through the injector is switched on during the period the control unit connects this pin to ground. The voltage on this pin is during this time 0 Volts. During the period the injector is not switched on, the voltage on the pin is 12 Volts



Oscilloscope image A shows the voltage signal measured on an high impedance injector or low impedance injector with external resistance.





Oscilloscope images B and C show two different current limiting circuits used on low impedance injectors.

Electrical diagnosis

STATIC

- To perform this measurements the relay switching the power to the injector(s) should be closed. Short circuit the switch in the relay if necessary. Perform the tests on one injector at the time. Disconnect parallel switched injectors.

  Measurements

  Measure the voltage on the control unit. Use the pin which switches the injector current.

result: **12 V**

- injector and wiring are electrically OK

0 V

- check the relay switching the power to the injector(s)
- check the wiring between the relay and the injector
- check the injector resistance
- check the wiring between the injector and the control unit
- check the control unit

DYNAMIC

- Connect all injectors. Start the engine and measure using an oscilloscope the voltage on the control unit's pin switching the injector current.

result: **0 V**

- perform static tests.

12 V

- control unit does not switch the injector(s).

Mechanical diagnosis

- check fuel system pressure
- check injectors on leakage and pollution
- bottom-feed injectors: check the seal between the injector and the throttle body
- multipoint systems: disconnect the hose between the fuel pressure regulator and the intake manifold. No fuel should leak out of the fuel pressure regulator.

Lubricants and Fluids

MAZDA - 626 - 2.0i 8V - FE

Engine		
Motor oil API SG	Below 0 °C	SAE 5W-30
Motor oil API SG	Above -25 °C	SAE 10W-30
Cooling system		
Coolant	All temperatures	
Manual transmission		
Gear oil API GL-4	All temperatures	SAE 75W-90
Gear oil API GL-5	All temperatures	SAE 75W-90
Gear oil API GL-4	Above 5 °C	SAE 80W-90
Gear oil API GL-5	Above 5 °C	SAE 80W-90
Automatic transmission		
ATF Dexron II	All temperatures	
ATF M-III	All temperatures	
Transfer box		
Gear oil API GL-5	Above -20 °C	SAE 90
Gear oil API GL-5	Below -20 °C	SAE 80W
Differential, rear (4x4)		
Gear oil API GL-5	Above -20 °C	SAE 90
Gear oil API GL-5	Below -20 °C	SAE 80W
Power steering		
ATF Dexron II	All temperatures	
ATF M-III	All temperatures	
Brakes system		
Brake fluid DOT 3	All temperatures	

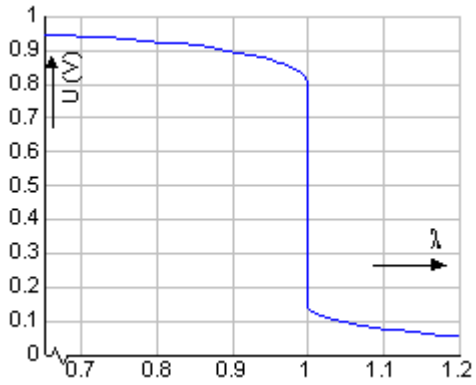
37. oxygen sensor

Function

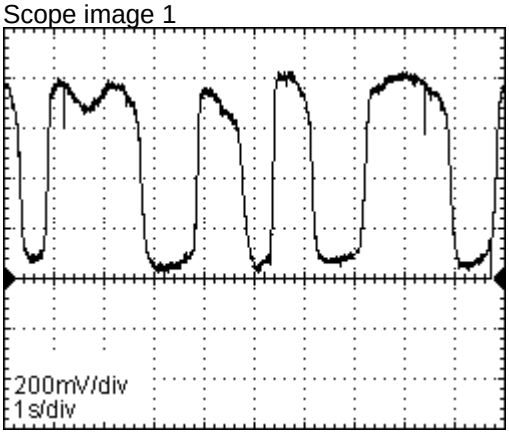
The oxygen sensor is exposed to exhaust gas flow. It monitors the oxygen content of the exhaust gases. A low oxygen content (rich mixture) increases the output voltage of the sensor. In this way a constantly updated air/fuel ratio is returned to the control unit.

Specifications

output voltage: 200 - 850 mV
waveform information: hot engine running at idle



Scope image 1



Pins to ground: 2D

47. power-steering pressure switch

Function

The power-steering pressure switch detects reduced pressure in the steering circuit and returns a signal to the control unit, which increases the idle speed.

Specifications

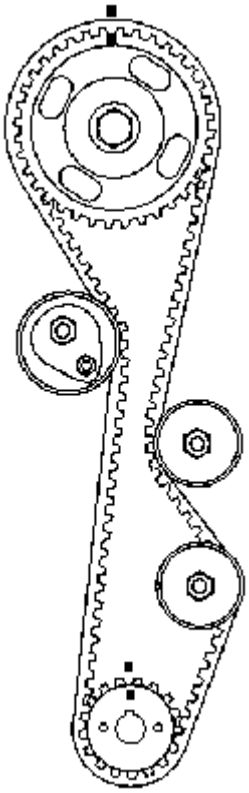
switch is normally open

Timing

MAZDA - 626 - 2.0i 8V - FE

General

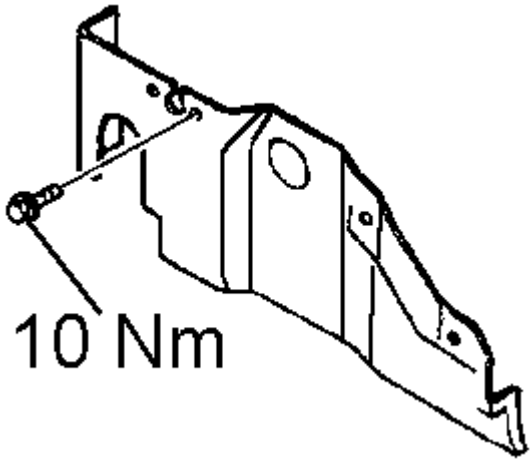
Item	Note
Always check the timing marks before timing belt removal	



Before disconnecting the battery cable, check the audio system security code

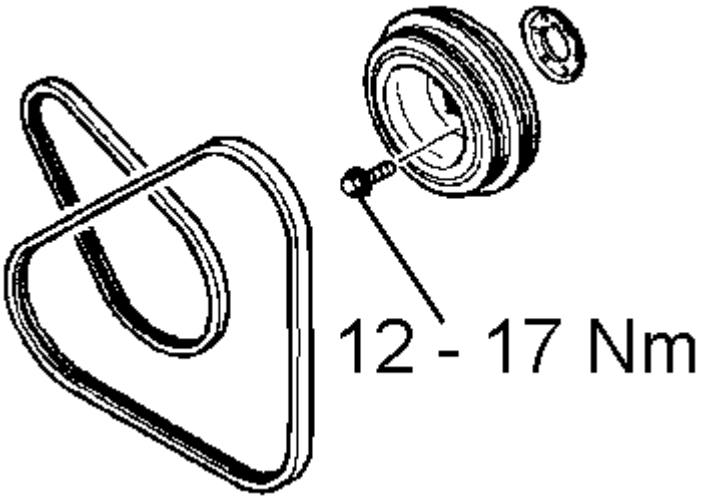
Removal

Item	Note
Disconnect the battery	
Disconnect the spark-plug leads	
Remove the spark plugs	
Remove the lower cover	

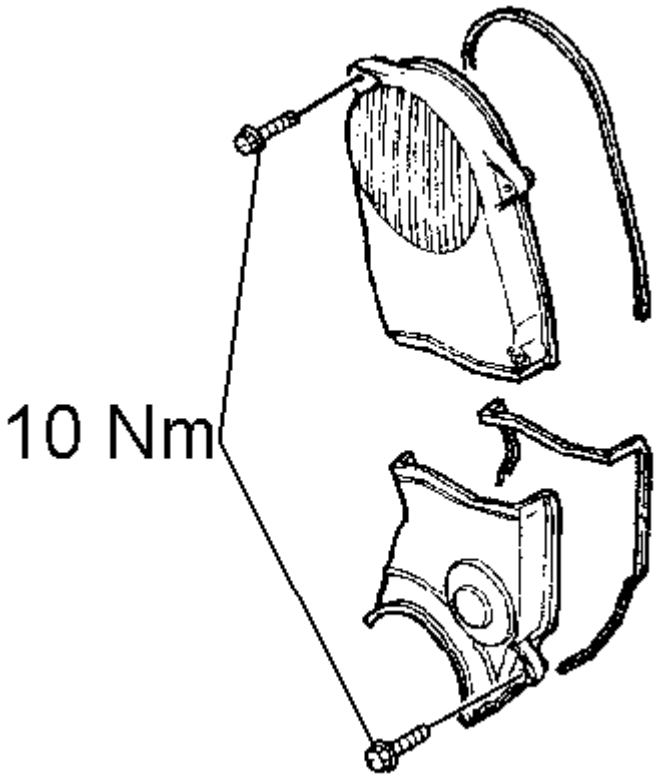


Remove the ancillary drive belt

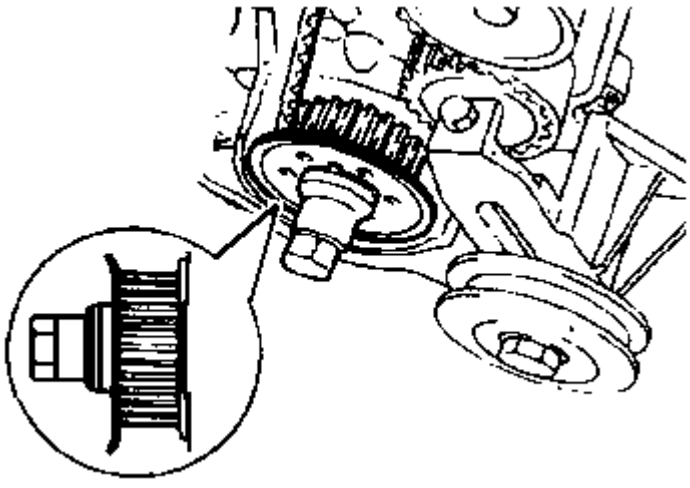
Remove the crankshaft pulley



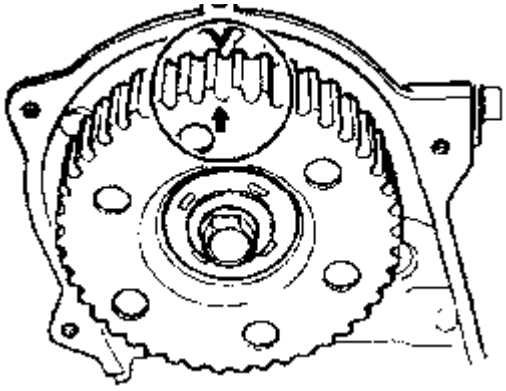
Remove the timing-belt covers

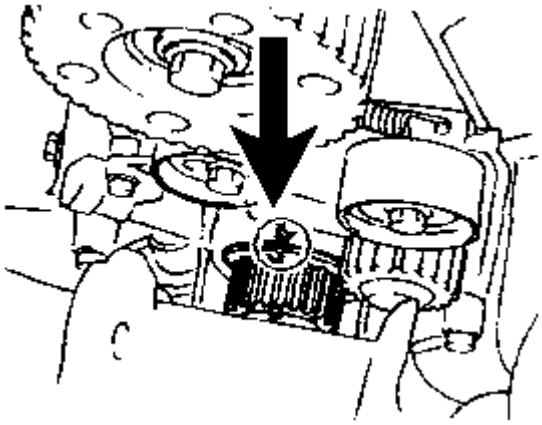


Remove the guide plates

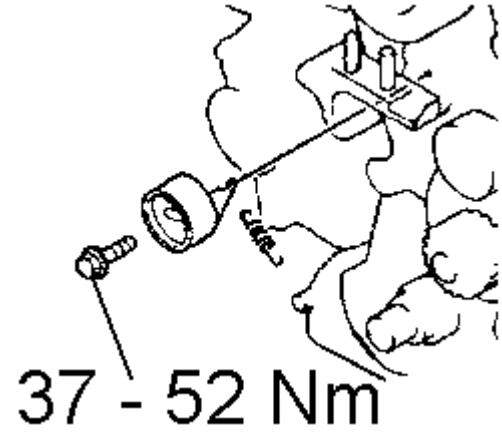


Align the timing marks





Loosen the tensioner



Push the tensioner pulley away from the timing belt

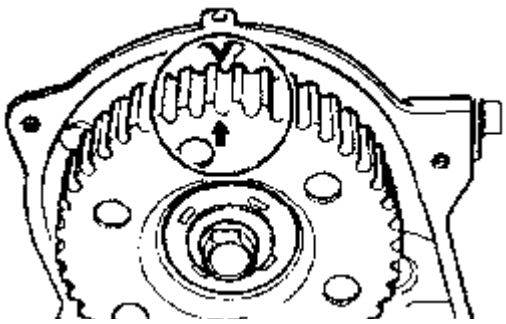
Tighten the tensioner

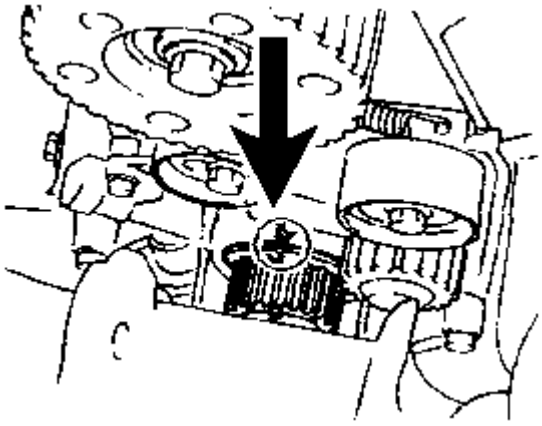
Remove the timing belt

Installation

Item	**Note**

Check the timing marks





Fit the timing belt

Turn the engine 2 rotations by hand

Check the timing marks

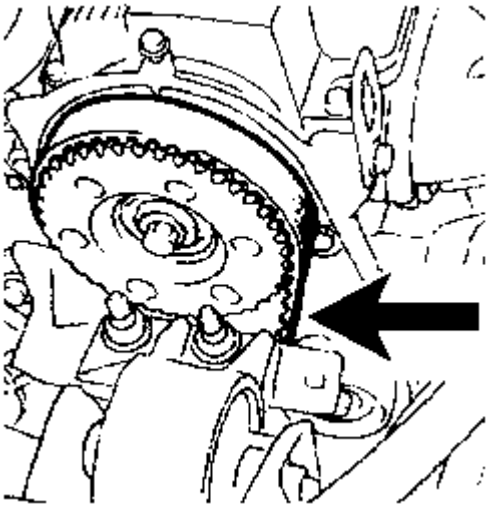
Loosen the tensioner

Tighten the tensioner	37 - 52 Nm

Turn the engine 2 rotations by hand

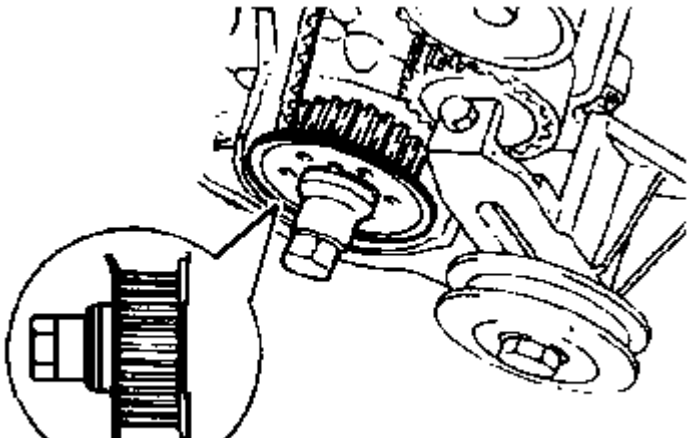
Check the timing marks again

Measure the timing belt deflection	98 N

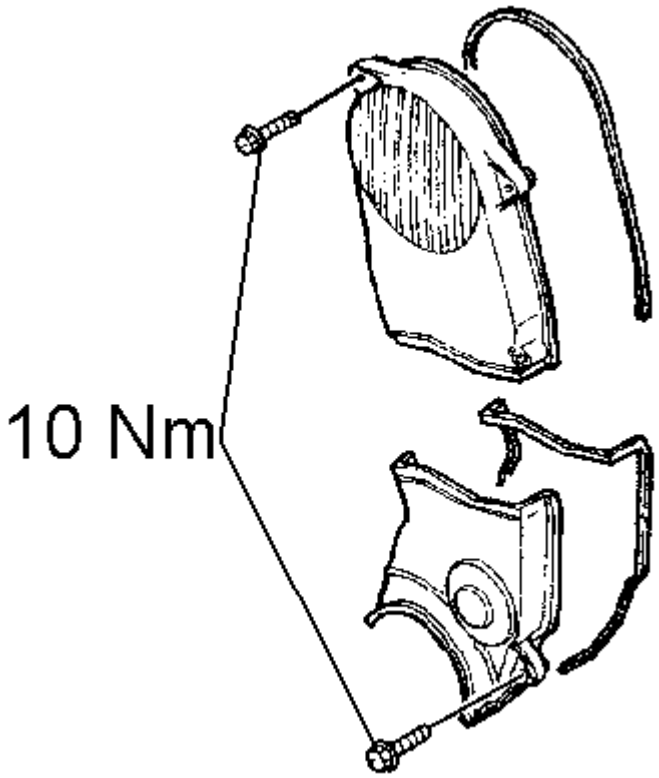


The tension is set at a deflection of:	5.5 - 6.5 mm

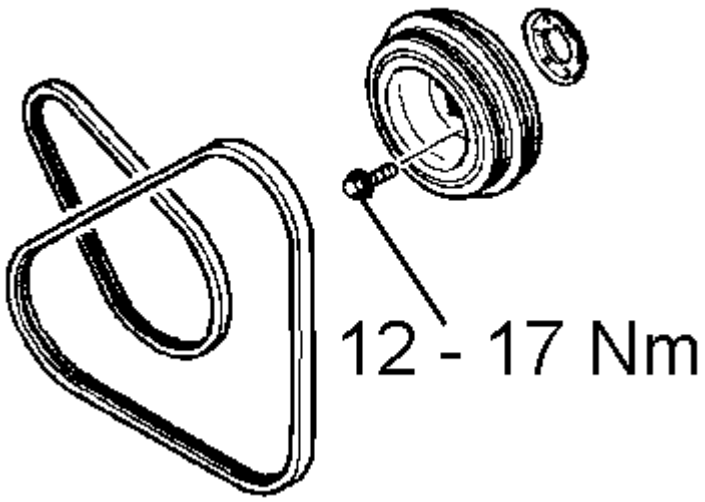
Refit the timing belt guide plates



Refit the timing belt covers

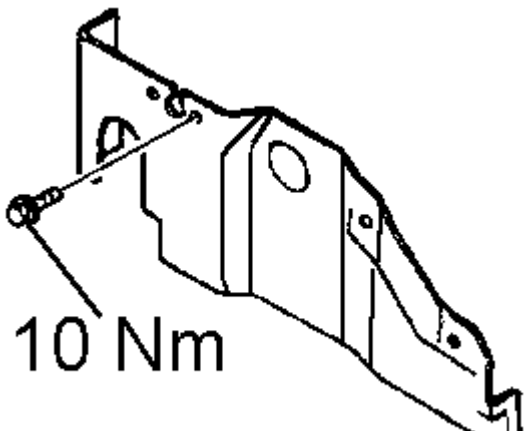


Refit the crankshaft pulley



Fit the ancillary drive belt

Refit the engine lower covers



Refit the spark plugs

Refit the spark plug leads

Reconnect the battery earth cable

Torque settings

Item	Note
Tensioner	37 - 52 Nm
Crankshaft pulley:	12 - 17 Nm
Spark plugs:	15 - 23 Nm

Special tools

Item	Note
Special tools are not required	

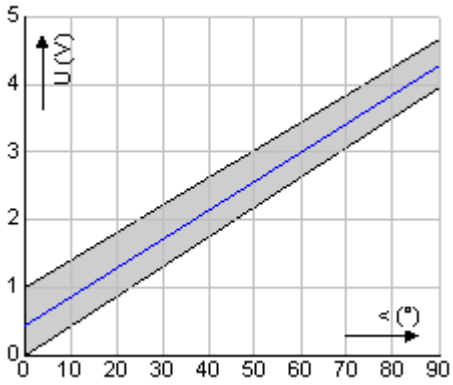
34. throttle position sensor with idle switch

Function

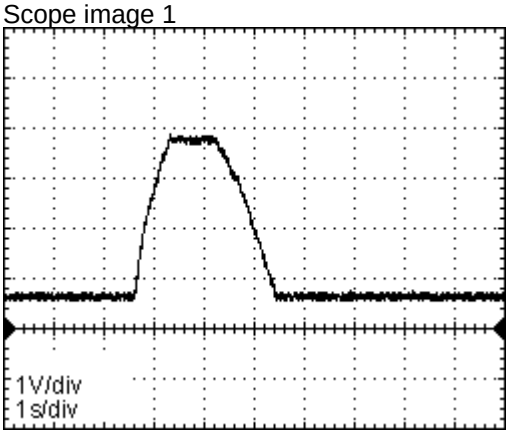
The throttle position sensor measures the angle of the throttle shaft using a potentiometer. The idle switch in the position sensor is closed when the throttle is fully closed.

Specifications

supply voltage: 5 V
output voltage: 0 - 5 V
waveform information: output signal while opening throttle.

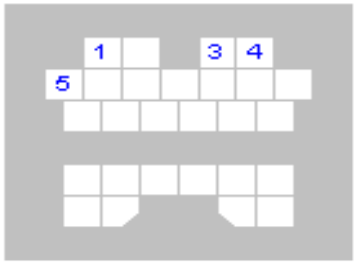


Scope image 1



Pins to ground: 2G

Error codes



Diagnostic plug

Diagnostic plug:
1 = Datalink LED tester (FEN)
3 = activation error codes (TEN)
4 = positive battery terminal (+B)
5 = ground

Read-out

-Connect LED tester to positive battery terminal and diagnostic-plug terminal 1.
-Connect diagnostic-plug terminal 3 to ground.
-Turn ignition on.
-Error codes will appear on LED tester.

Reset

-Turn ignition off.
-Disconnect negative terminal of the battery.
-Depress brake pedal for at least 5 seconds.
-Connect negative terminal of the battery.
-Verify that no error codes are displayed.

Signal

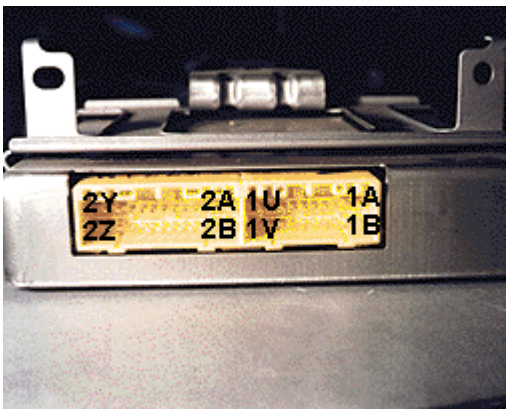
-Digit 1 (tens position): Light pulse 1.2 seconds long, 0.4 seconds pause in-between.
-Pause 1.6 seconds light-off.
-Digit 2 (units position): Light pulse 0.4 seconds long, 0.4 seconds pause in-between.
-Pause 4.0 seconds light-off.

Error codes

02 Opto-coupler no signal (Ne).
03 Opto-coupler no signal (G).
06 Vehicle speed sensor, no signal.
08 Mass airflow meter, open or short circuit.
09 Coolant temperature sensor, open or short circuit.
11 Air temperature sensor, open or short circuit.
12 Throttle position sensor, open or short circuit.
14 Absolute pressure sensor (inside ECU), open or short circuit.
15 Oxygen sensor, lean signal for longer than 75 seconds, engine speed is higher than 1500 rpm, warm engine.
17 Oxygen sensor signal does not change for 40 seconds, engine speed is higher than 1500 rpm.
25 Increased fuel pressure solenoid, open or short circuit.
26 Canister purge solenoid, open or short circuit.
28 EGR purge solenoid, open or short circuit.
34 Idle speed control valve (ISC) open or short circuit.
55 No ATX signal at 40 km/h or higher.
56 Thermosensor (ATX), open or short circuit.
60 Shift valve 1-2 (ATX), open or short circuit.
61 Shift valve 2-3 (ATX), open or short circuit.
62 Shift valve 3-4 (ATX), open or short circuit.

63 Lock-up solenoid (ATX), open or short circuit.
64 Shift timing valve 3-2 (ATX), open or short circuit.
65 Lock-up solenoid (ATX), open or short circuit.
66 Pressure switch (ATX), open or short circuit.
67 Fan relay (low temperature) open or short circuit.
68 Fan relay (high temperature) open or short circuit.
69 Coolant temperature sensor cooling fan, open or short circuit.

100. control unit



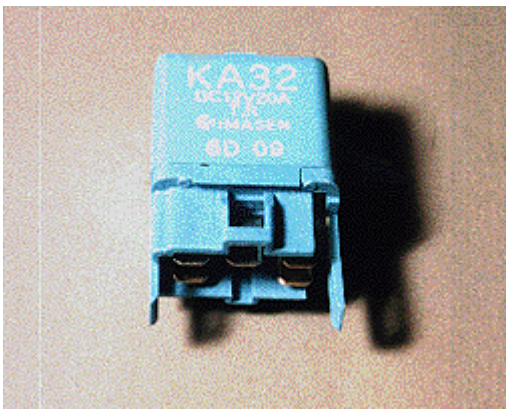
Function

The control unit receives signals from sensors that monitor various engine operating parameters. The control unit generates output signals to provide optimal air/fuel ratio, idle speed control and ignition timing.

Diagnosis

Check connector(s): Inspect the connector(s) and if necessary clean or fix them to make sure the connection is good.
When you suspect the control unit is faulty, make sure all sensors and actuators function properly, and that signals from other control unit(s) are received properly. Next check the supply voltage and ground connections of the control unit:
Turn ignition off. Remove ECU connector.
Locate the supply voltage connections. Turn ignition on. Measure voltage between corresponding connector terminal(s) and the negative terminal of the battery. They should equal battery voltage. If not check wiring and fuse.
Turn ignition off. Locate the ground connections. Measure resistance between corresponding connector terminal(s) and the negative terminal of the battery. They should be < 1 ohm.

92. relay



Function

A relay is an electrically operated power supply switch, switching supply voltage to the component(s) of the engine management system.

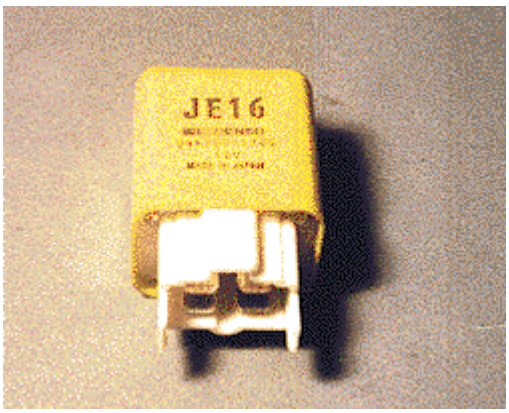
Specifications

single normally opened relay.

Diagnosis

Check connector(s): Inspect the connector(s) and if necessary clean or fix them to make sure the connection is good.
Check relay:
Turn ignition off. Remove relay from relay box.
Connect the input of the coil to battery voltage and the output of the coil to ground. The relay should click. If not replace relay.
Check the switch of the relay. Measure the resistance between the input of the switch and the output. When switch is closed the resistance should be < 1 ohm. When switch is open, the resistance should be infinite. If not replace relay.
Check supply voltage:
Turn ignition off. Remove relay from relay box.
Turn ignition on. Connect a circuit tester between the input terminal of the coil or the input terminal of the switch in the relay box and the negative terminal of the battery. Both times the tester should light up. If not check wiring and if present fuse(s), second relay and inertia switch.
Check connection to ECU:
Turn ignition off. Remove relay from relay box and remove connector from ECU.
Measure the resistance between the output terminal of the coil in the relay box and the corresponding terminal in the ECU connector. It should be < 1 ohm. If not check wiring.
Check signal from ECU:
Measure voltage between the output terminal of the coil and the positive terminal of the battery. Crank the engine. It should equal battery voltage. If not check ECU.

90. main relay



Function

Switches power to sensors, actuators and / or control unit.

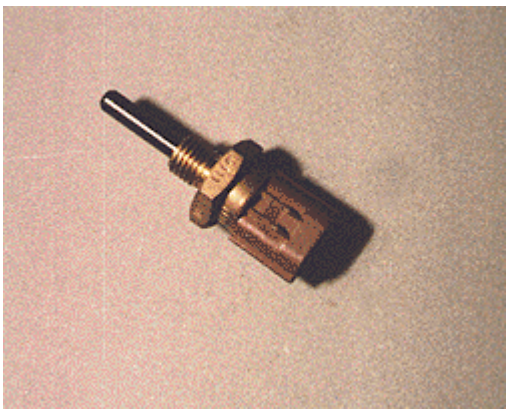
Specifications

single normally opened relay.
colour relay: yellow

Diagnosis

Check connector(s): Inspect the connector(s) and if necessary clean or fix them to make sure the connection is good.
Check relay:
Turn ignition off. Remove relay from relay box.
Connect the input of the coil to battery voltage and the output of the coil to ground. The relay should click. If not replace relay.
Check the switch of the relay. Measure the resistance between the input of the switch and the output(s). When coil connected the resistance should be < 1 ohm. When coil disconnected resistance should be infinite. If not replace relay.
Check supply voltage:
Turn ignition off. Remove relay from relay box.
Turn ignition on. Connect a circuit tester between the input terminal of the coil or between the input terminal of the switch in the relay box and the negative terminal of the battery. The tester should light up. If not check wiring and, if present, fuse(s) and second relay.
Check connection to ECU:
Turn ignition off. Remove relay from relay box and remove connector from ECU.
Measure the resistance between the output terminal(s) of the switch in the relay box and the corresponding terminal(s) in the ECU connector. It should be < 1 ohm. If not check wiring.
Check connection to ground:
Turn ignition off. Remove relay from relay box. Measure the resistance between the output terminal of the coil and the negative battery terminal. It should be < 1 ohm. If not check wiring.

43. air temperature sensor

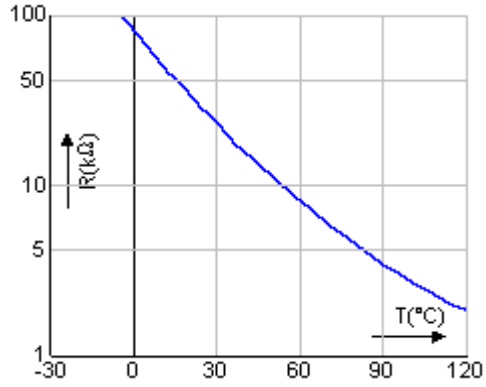


Function

The air temperature sensor is a temperature-sensitive resistor. Low temperature causes high resistance while high temperature causes low resistance. The control unit determines the temperature by monitoring the voltage across the sensor.

Specifications

supply voltage: 5 V
resistance: 35,000 - 40,000 ohms / 20°C
resistance: 1,900 - 2,500 ohms / 100°C



CANISTER PURGE SOLENOID

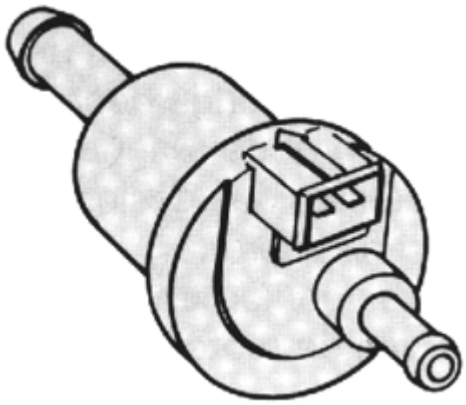
Function

The evaporative gases produced in the fuel tank are absorbed by the activated charcoal in the carbon canister. As The purge control solenoid valve opens these gases are delivered to the intake manifold for combustion purposes. The purge control solenoid valve is controlled by the control unit. The control unit operates this valve during the time the lambda control loop is active.

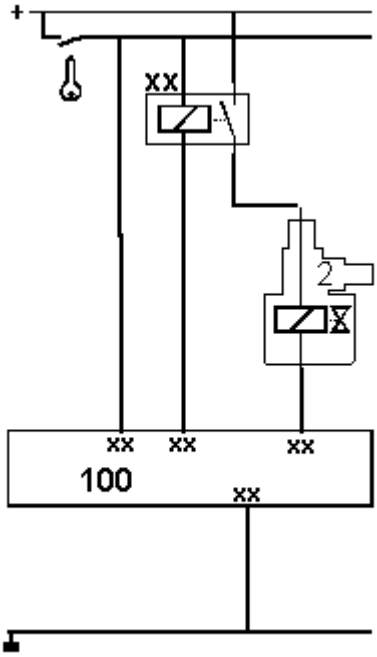
Specifications

RESISTANCE:

resistance:	± 50 ohms
supply voltage:	12 Volts
current:	± 250 mA



Electrical control



Most solenoids are normally closed. This means that the connection between the canister and the intake manifold is closed. The solenoid has a connector with two terminals. On one of those terminals is connected to the battery voltage. This supply-voltage is often switched with a relay. The other terminal leads directly to the control unit. The current through the solenoid is switched on during the time the control unit connects this terminal to ground. The voltage on this terminal is during this time 0 Volts. During the time the solenoid is switched off, the voltage on this terminal is 12 Volts. Some motormanagement systems control the amount gases delivered to the intake manifold switching the solenoid on and of with a certain duty cycle. In this case the duty-cycle depends on engine RPM and engine load.

Electrical diagnosis

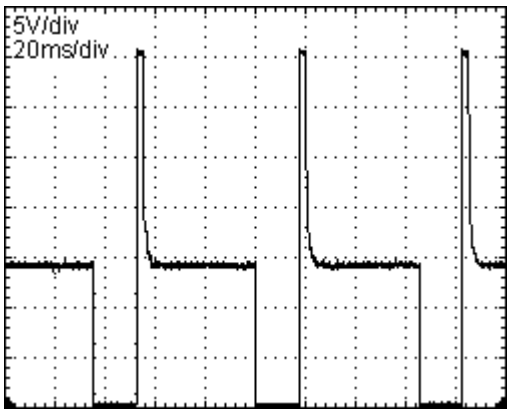
STATIC

General

- To perform this measurements the relay switching the power to the solenoid should be closed. Short circuit the switch in the relay if necessary.

Measurements

- Measure the voltage on the control unit. Use the pin which switches the solenoid.



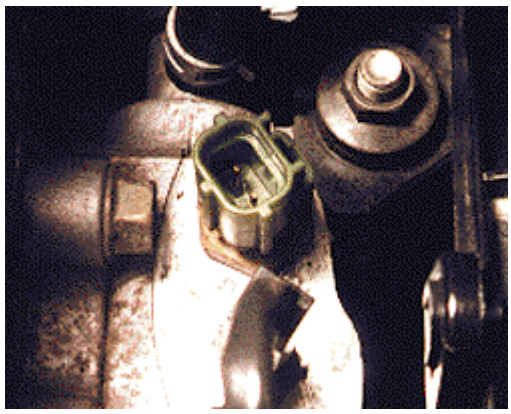
result: **12 V**

- solenoid and wiring are electrically OK

0 V

- check the relay switching the power to the solenoid
- check the wiring between the relay and the solenoid
- check the solenoid resistance
- check the wiring between the solenoid and the control unit
- check the control unit

42. coolant temperature sensor

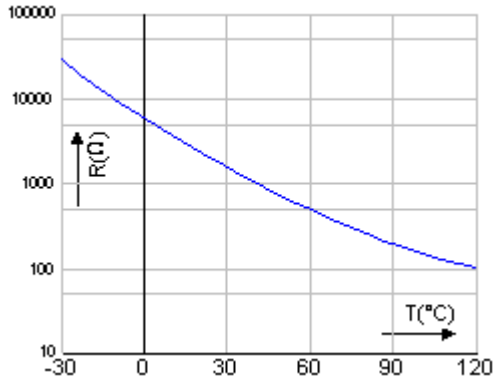


Function

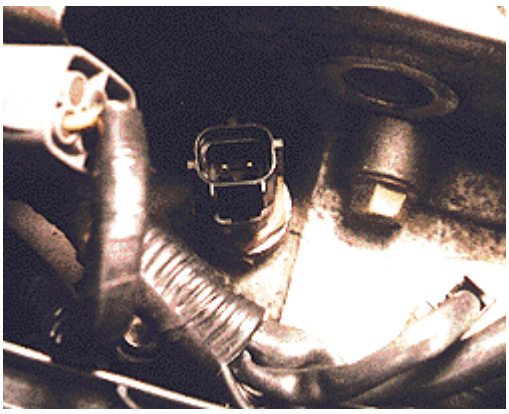
The coolant temperature sensor is a temperature-sensitive resistor. Low temperature causes high resistance while high temperature causes low resistance. The control unit determines the temperature by monitoring the voltage across the sensor.

Specifications

supply voltage: 5 V (connector disconnected)
resistance: 2,000 - 3,000 ohms / 20°C
resistance: 200 - 300 ohms / 90°C



186. coolant temperature sensor fan



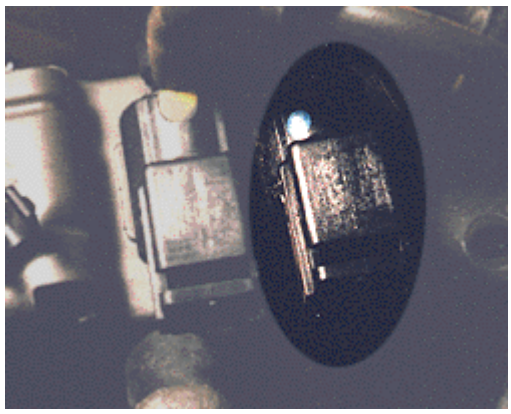
Function

The coolant temperature sensor is a temperature-sensitive resistor. Low temperature causes high resistance while high temperature causes low resistance. The control unit determines the temperature by monitoring the voltage across the sensor and switches the cooling fan on or off.

Specifications

supply voltage: 5 V
resistance: 1,700 - 1,840 ohms / 91°C
1,420 - 1,530 ohms / 97°C
1,030 - 1,110 ohms / 108°C

23. EGR purge solenoid



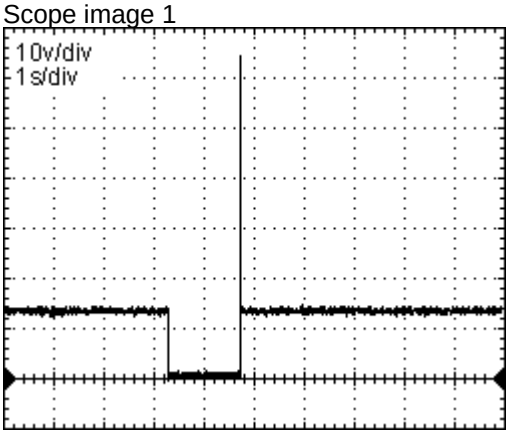
Function

The EGR purge solenoid controls the vacuum at the EGR valve. The EGR purge solenoid is controlled by the control unit.

Specifications

supply voltage: 12 V
resistance: 35 - 45 ohms

Scope image 1



Pins to ground: 2S

Diagnosis

Check connector(s): Inspect the connector(s) and if necessary clean or fix them to make sure the connection is good.
Check resistance:
Turn ignition off. Remove connector from solenoid.
Measure resistance between the two pins of the solenoid. Compare with specified resistance. Alternatively, check solenoid function by applying battery voltage to its pins. The solenoid should "click".
Check supply voltage:
Turn ignition off. Remove connector from solenoid.
Turn ignition on, start or crank the engine and measure voltage between one connector terminal and the negative terminal of the battery. Check the second terminal. One of the two should equal battery voltage. If not check wiring and, if present, relay or power supply unit and fuse(s).
Check connection to ECU:
Turn ignition off. Remove connectors from solenoid and ECU.
Measure the resistance between one of the two connector terminals and the corresponding terminal in the ECU connector. Check the other terminal. One of the two should be < 1 ohm. If not check wiring.
Check solenoid activation:
Connect oscilloscope to signal pin of the ECU and ground. Start the engine and compare to the scope image shown.

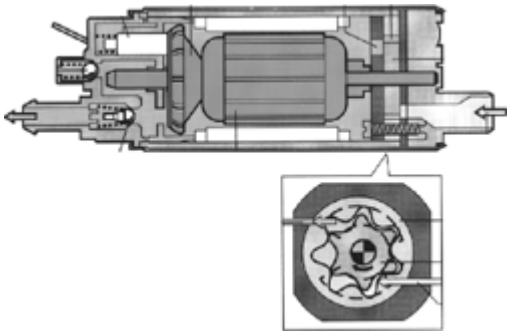
FUEL PUMP

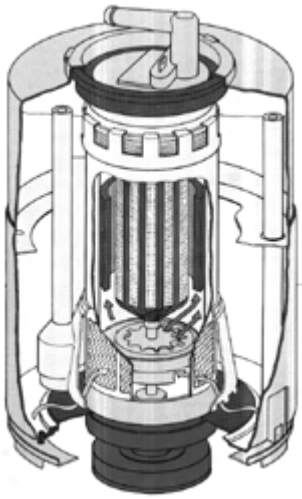
Function

The fuel pump is an electrically operated pump which lifts the fuel from the fuel tank and pumps it under pressure through a filter to the fuel rail or throttle body. The fuel runs along the injector(s) and returns to the tank via the fuel pressure regulator. Some systems use two pumps. The fuel lift pump inside the tank and the fuel pressure pump outside the tank.

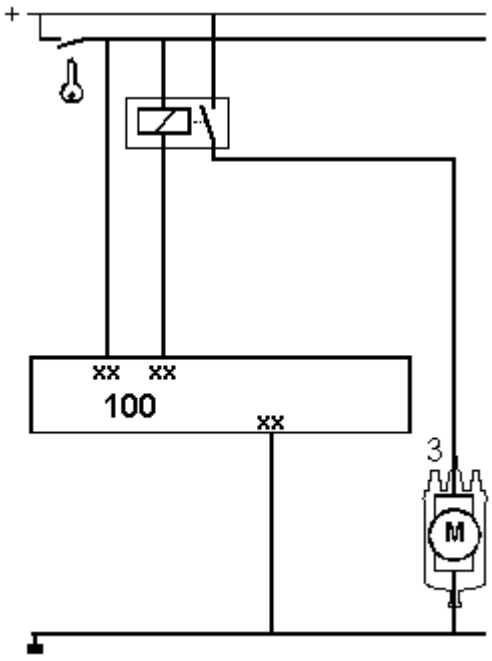
Specifications

pump pressure:	± 0,25 - 6 bars
system pressure:	± 0,6 - 1,1 bar (single-point) ± 2 - 3,5 bar (multi-point)
flow:	± 50 - 100 l/h
supply voltage:	12 Volts
current:	± 5A





Electrical control



The fuel pump is operated by a relay. The conditions the relay is closed are.

- during several seconds after switching on the ignition
- during the time the system receives RPM pulses.

The fuel pump relay is often controlled by the control unit.

The relay coil has two terminals. On one of those terminals is connected with the battery voltage. The other terminal leads directly to the control unit.

The current through the relay coil is switched on during the time the control unit connects this pin to ground. The voltage on this pin is during this time 0 Volts. During the time the relay is not switched on, the voltage on the pin is 12 Volts.

Electrical diagnosis

STATIC

General

- Turn the ignition switch "on"
- Listen to the fuel pump operating sound. The fuel pump should operate for several seconds after the ignition switch is turned "on"

Power supply

- To perform this measurements the relay switching the power to the fuel-pump should be closed. Short circuit the switch in the relay if necessary.

Measurements

- Disconnect the fuel pump connector. Measure the voltage over the fuel pump terminals in the connector. The voltage should be 12 Volts.

result: **12 V**

- replace the fuel pump

0 V

- check ground circuit
- check the wiring between the relay and the pump
- check the relay switching the power to the pump

Mechanical diagnosis

Measurements

- To perform this measurements the relay switching the power to the fuel-pump should be closed. Short circuit the switch in the relay if necessary.
- check the fuel system pressure

result:

- check the fuel level in the tank
- check the fuel pressure regulator
- check the fuel filters
- check the fuel pump
- check the fuel return circuit to the tank

IDLE SPEED CONTROL VALVE

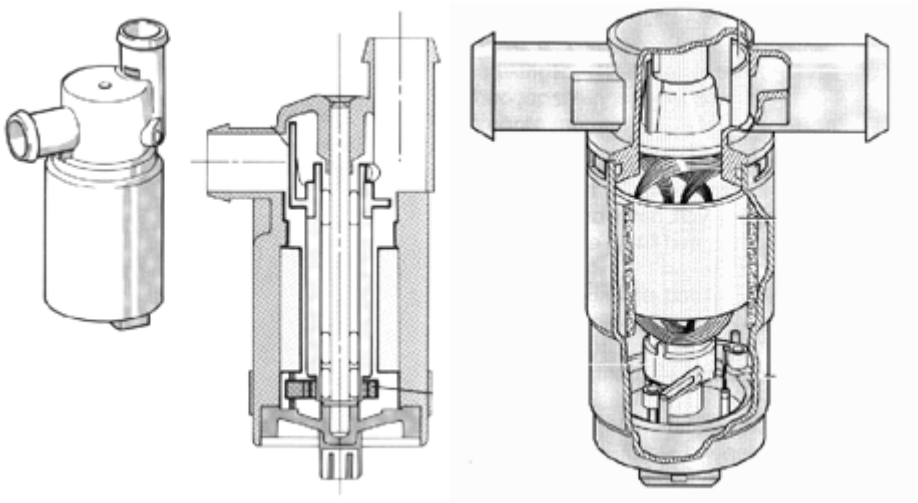
Function

The idle control valve is located in a tube bypassing the throttle. The control unit controls this device to ensure stable idling in all operating conditions.

Specifications

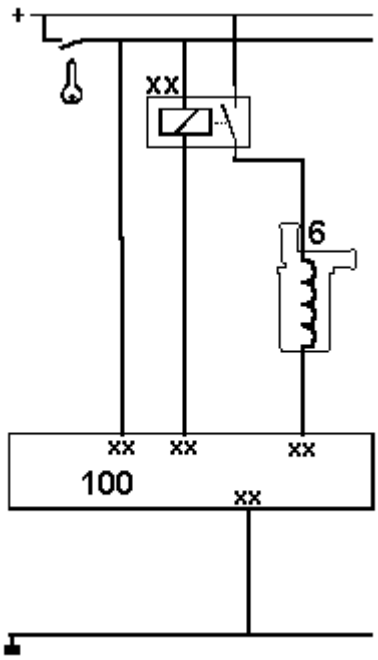
resistance coil(s):	± 20 ohms
supply voltage:	12 Volts

A rotary slide valve attached to the armature is turned to open the air bypass until the desired idle speed is obtained. The position of the armature is controlled by the force of an internal spring opposing the force of a solenoid (types with to terminals) or controlled by two solenoids energised alternately which exerts opposing forces on the armature (types with three terminals).



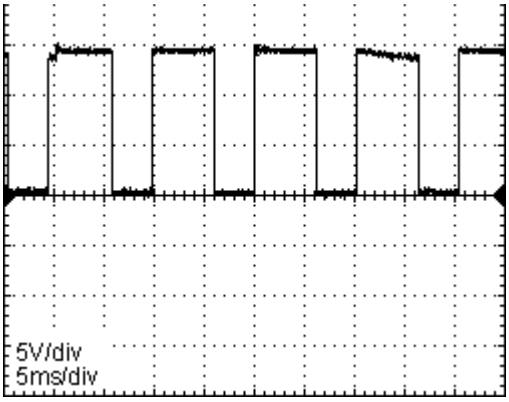
Electrical control

Types with two terminals



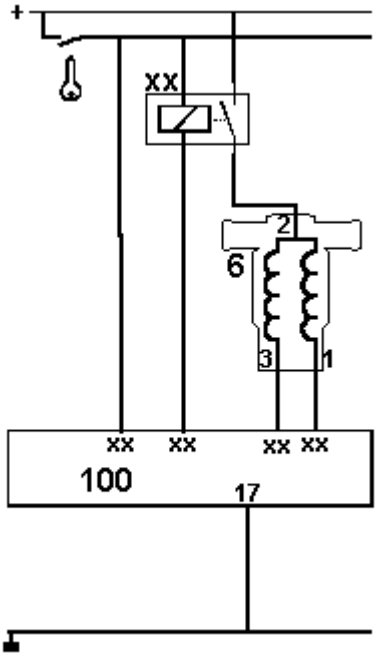
As a current flows through the coil the armature is turned against the spring force. As the current increases the airflow and the idle speed increases. If the current through the coil is switched off due to a mall functioning system, the valve is forced into a position which results in a (too) high idle speed.

The idle control valve has a connector with two terminals. On one of those terminals is connected to the battery voltage. This supply-voltage is often switched with a relay. The other terminal leads directly to the control unit. The current through the coil is switched on during the time the control unit connects this terminal to ground. The voltage on this terminal is during this time 0 Volts. During the time the current through the coil is switched off, the voltage on this terminal is 12 Volts.

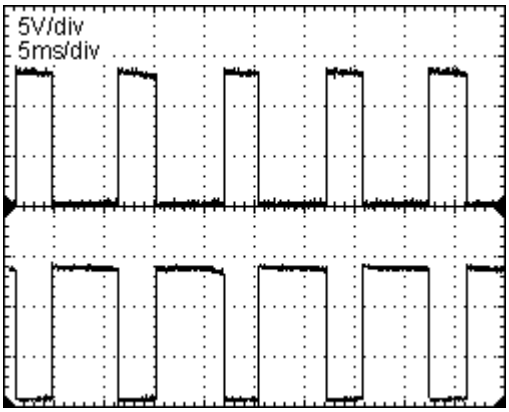


The control unit controls the current through the coil switching the current on and off with a certain duty cycle. The current increases as the duty-cycle increases. The duty cycle varies between approx. 35% (valve closed) and 85% (valve opened). Nominal idle speed is obtained when slightly open.

Three terminal types



The two coils inside this type of idle speed control valve are connected with the supply voltage using one common terminal. The other two terminals lead directly to the control unit. The control unit switches the current through the solenoid on and off alternately with a duty cycle between 35 and 85%.



Electrical diagnosis

STATIC

- To perform this measurements the relay switching the power to the idle control valve should be closed. Short circuit the switch in the relay if necessary.

  Measurements:

  Disconnect the connector and

DYNAMIC TESTS THREE TERMINAL TYPES

- Remove the idle control valve but leave the electrical connections in place. Fully open or close the rotating plunger. Switch on the ignition.

measure the resistance of the coil(s). The nominal value is app. 20 ohms.

- Check the relay switching the power to the idle control valve
- Check the wiring between the relay and the idle control valve
- Check the wiring between the idle control valve and the control unit
- Check the control unit

result:

- Switch on the ignition. The rotating plunger must move to a position equivalent to app. 50% opening, and remain there.

Mechanical diagnosis

- Check the air chamber on air leakage.
- Check engine on air leaks into the intake system.
- Remove the idle control valve. The plunger should rotate or move easily. Clean if necessary.

IGNITION COIL

Function

The ignition coil transforms the battery voltage into the high voltage needed to create a spark.

The ignition coil consists of an electromagnet (the primary coil) and a high voltage coil (secondary coil).

By switching the current through the primary coil on, a magnetic field is induced. The moment the current is switched of, the magnetic field suddenly disappears.

This change of magnetic field creates an induction voltage in the secondary coil, high enough to ionise the mixture. The ionised mixture is a conductor and a current flows through the spark plug.

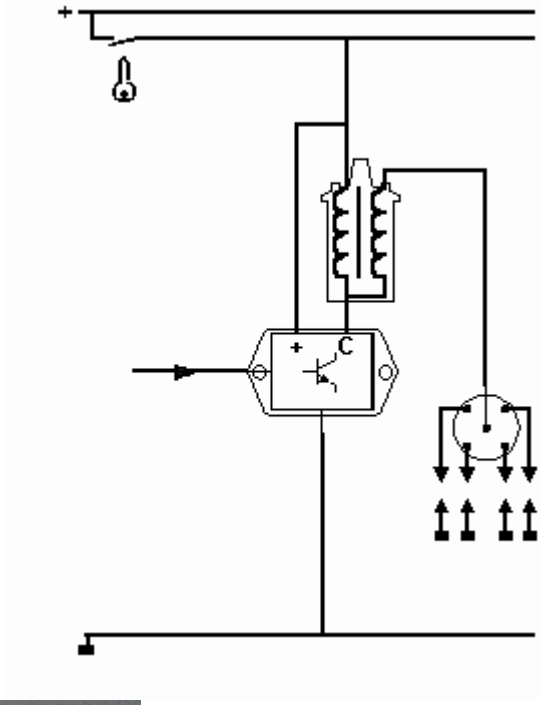
Specifications

RESISTANCE:	
primary:	± 0,3 - 2 ohms
secondary	± 5k - 20k ohms
supply voltage:	12 V
current limited at:	± 7A

Systems with a distributor

Ignition coils used in combination with a distributor consists of one primary and one secondary coil.

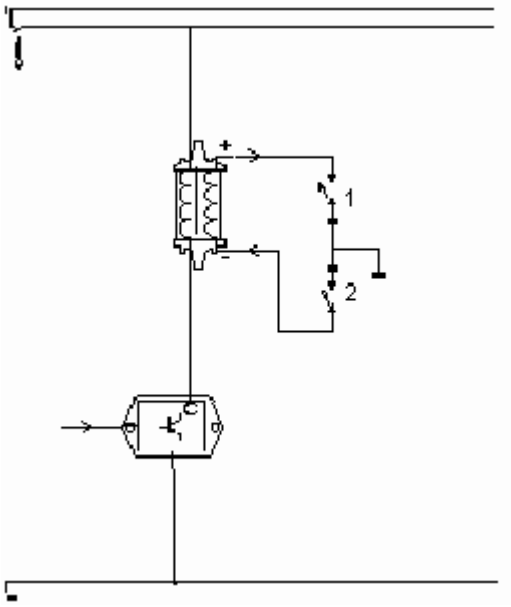
The high voltage, induced in the secondary coil is connected to one of the spark plugs



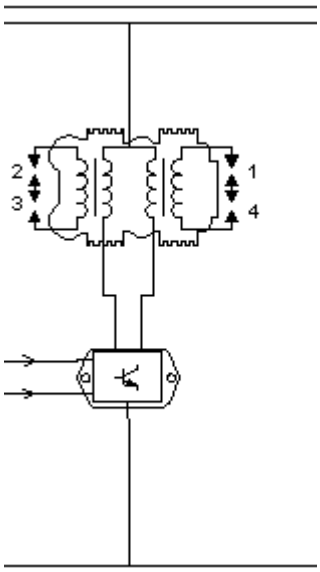
selected by the distributor.

Wasted spark ignition coils

The secondary coil has two ends. In a normal ignition coil one of those ends delivers the high
The other end is connected to either the positive (15) or the negative (1) terminal of the prir
In a wasted spark ignition coil both ends are connected to a spark plug. Therefore both spark
will spark at the same time.

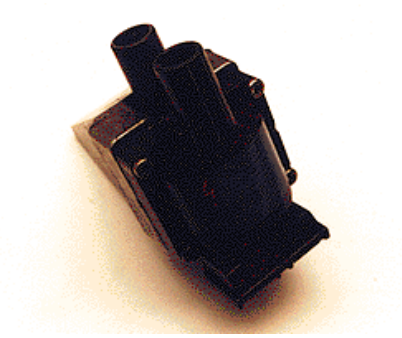


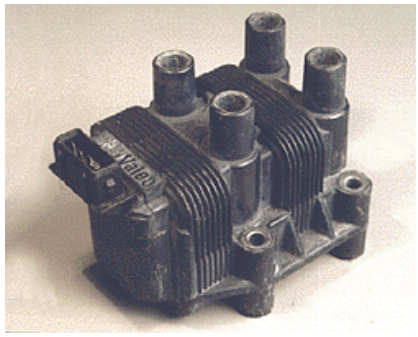
wasted spark ignition coil on 2- cylinder 4-stroke engine



a wasted spark ignition coil on a 4- cylinder 4-str

To supply the four spark plugs of an 4 cylinder engine, two ignition coils are needed. The pic
below (left) shows an ignition coil for two spark plugs. The ignition coil in the right picture
incorporates two of those. This ignition coil supplies four spark plugs.

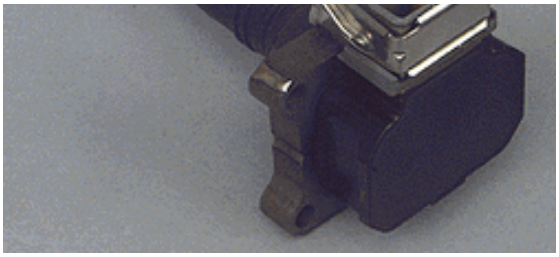


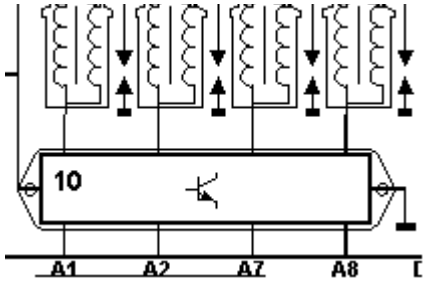


Sequential ignition

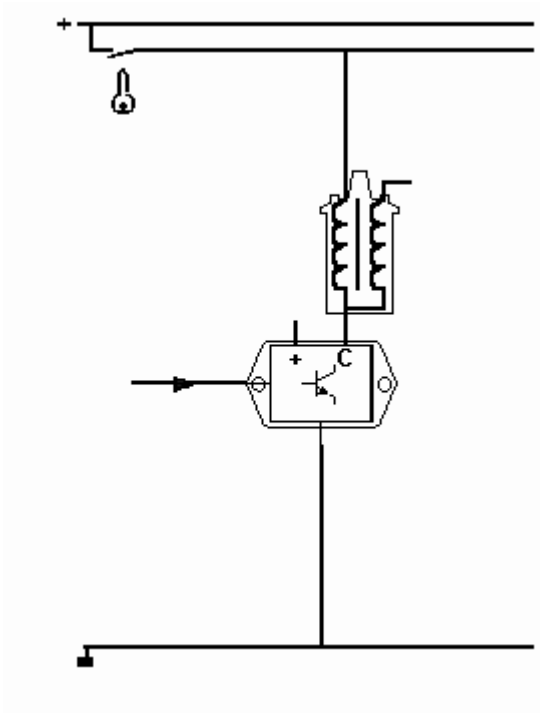
Sequential ignition systems are distributor less ignition systems using one ignition coil per
cylinder.

Each ignition coil is controlled by the control unit individually.





Electrical control



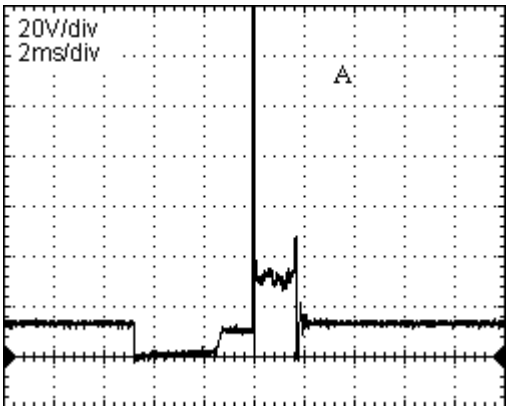
A current through the primary coil induces a magnetic field. The moment the current is switched of, the magnetic field suddenly disappears. This change of magnetic field induces an induction voltage and causes a spark.

The amperage before switching the current off should be high enough to create a high change of magnetic field the moment the current is switched off.

Therefore the current through the primary coil is controlled electronically.

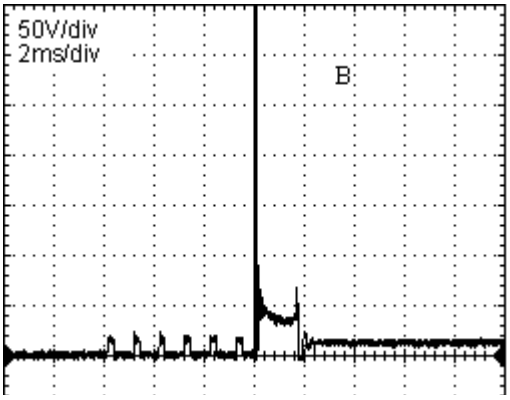
The ignition module is supplied with a current limited circuit. Using this in combination with a low resistance ignition coil the amperage does not depend on the battery voltage.

During the time the current is switched off, the voltage over the ignition module is 12 Volts. The moment the current is switched on, the voltage drops to 0 Volts. From this moment on the current increases until the limiting value is reached.



The oscilloscope images A and B gives you an example of the primary voltage measured on two different current limiting circuits.

By increasing the voltage over the ignition module, the voltage over the primary coil decreases. This causes a limited current in oscilloscope image A.



The ignition module in oscilloscope image B switches the current on and off to limit the current.

Electrical diagnosis

STATIC

To perform this measurements the ignition should be switched on.

Measurements:

- Measure the primary and secondary resistance of the ignition coil.
- Measure the voltage on the positive terminal of the ignition module.

The voltage should be equal to the battery voltage.

result: **Voltage is lower than battery voltage.**

- disconnect positive terminal and repeat measurement

result: **Voltage is equal to battery voltage.**

- check primary resistance of the ignition coil
- check ignition module
- check wiring between ignition module and ignition module.

result **Voltage is still lower than battery voltage.**

- check ignition lock
- check wiring between ignition lock and ignition coil

DYNAMIC

Start the engine and measure the primary voltage using an oscilloscope.

result: **0 V**

- check power supply.

12 V

- check ignition module

Mechanical diagnosis

Not available for this subject !

IGNITION MODULE

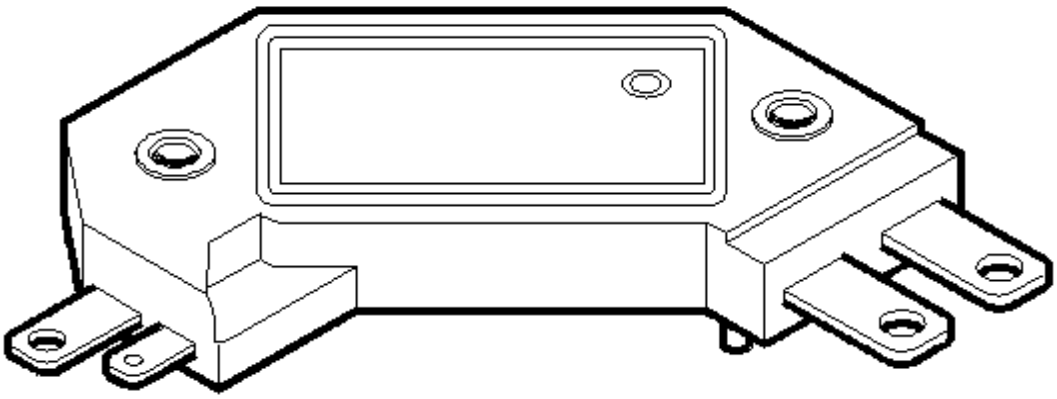
Function

The ignition module switches the current through the primary ignition coil on and off. The ignition module charges the ignition coil during the time the current is switched on. The moment the ignition module switches the current 'off' the ignition coil induces an induction voltage which causes the spark.

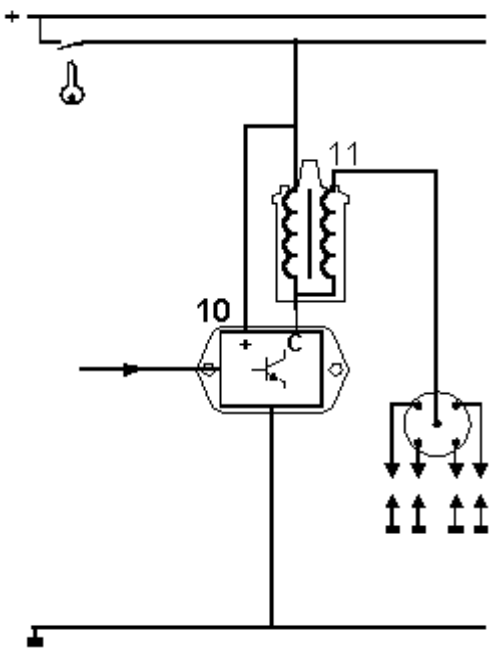
An ignition module switches the current on and off according to an input signal. This input is delivered by the control unit. On older systems the input signal is delivered by an inductive, Hall or opto-coupled sensor mounted in the distributor.

Specifications

resistance	-
supply voltage	-



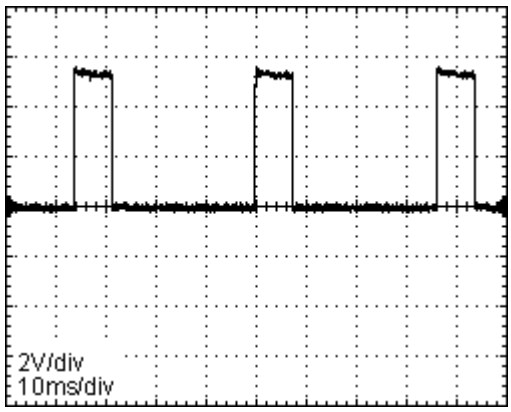
Electrical control



The connector of the ignition module has several terminals. The following terminals are used on common ignition modules.

- a terminal connected with the ignition coil. By this terminal the current through the ignition coil is switched on and of.
- a terminal connected with the supply voltage (12 Volts)
- a terminal connected with ground.
- terminal(s) to receive the input signal. If the input signal is delivered by an inductive sensor two terminals are needed.

The output voltage of an inductive sensor is delivered by an internal coil. This coil induces an almost sine wave output voltage. If the input signal is delivered by an Hall-sensor or opto-coupler three terminals are needed. Two of those three terminals are used to supply the sensor. The supply voltage is either 5 or 12 Volts. The third terminal receives the output signal from the sensor. The output voltage of these sensors is a square wave signal.



Addition terminals are possible. For example to send out a RPM signal to the revolution counter. Sometimes the input signal is delivered by a sensor while the ignition timing is controlled by the control unit. In this case the received input signal from the sensor is converted into a square wave signal by the ignition module and send out to the control unit. The control unit receiving this signal computes this input information and other input information from various engine parameters and sends out a new square wave signal to the ignition module. This signal is used by the ignition module to switch the current through the primary ignition coil on and off.

During the time the input signal for the ignition module is 'high' the current is switched 'on'. The moments this input signals falls to 'low' the current is switched 'off'. This moment the spark will appear

Electrical diagnosis

- Start the engine and measure (using an oscilloscope) the input signal delivered by the control unit or input sensor. The square wave signal or sine wave signal from a inductive sensor should be visible.

signal not OK:

- Disconnect the ignition module's connector and check the wiring between the ignition module and the control unit or input sensor.
- replace the ignition module if the signal appears on the disconnected connector and disappears on the connected connector.

If the output signal remains invisible the failure is not in the component.

signal OK:

- check the power supply of the ignition module.
- check the primary voltage using an ignition oscilloscope or normal oscilloscope with a suitable probe.
- check the wiring between the ignition module and the ignition coil.

The voltage should be nearly 0 Volt during the period the ignition module receives an 'high' input voltage from the sensor or control unit.

Mechanical diagnosis

- Remove the auxiliary air valve without disconnecting the connector.
- Turn the ignition on and make sure that the valve closes as the heating element heats-up the bi-metallic strip.

167. increased fuel pressure solenoid

Function

The vacuum solenoid (P.R.C.) regulates the connection between the fuel pressure regulator and the inlet manifold vacuum. The vacuum solenoid is activated by the control unit at air temperatures above 20°C, at engine speeds below 1500 rpm, and with the idle switch closed.

Specifications

supply voltage: 12 V
resistance: 35 - 45 ohms

INJECTOR

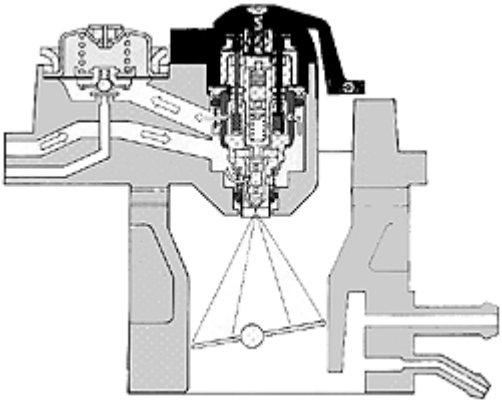
Function

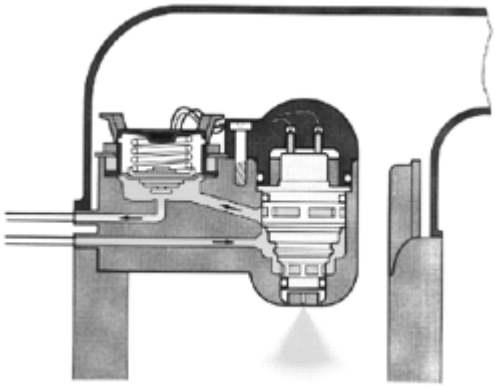
Injectors are electronically operated electromagnetic valves. Using the injectors the control unit is able to inject an exact quantity of fuel. Adding this quantity of fuel to the air, a mixture with the demanded air/fuel ratio is created. Depending on the kind of motormanagement system either one injector per cylinder (multipoint systems) or one injector for all cylinders (singlepoint systems) are used.

Specifications

RESISTANCE:	
high impedance:	± 15 ohms
low impedance:	± 0,5 - 2,5 ohm
flow:	± 50 - 200
gr/minsupply voltage:	1- 12 Volts
current:	± 0,75Amps

Single-point systems





Single-point fuel injection systems use one central placed injector to create the required air/fuel ratio. The injector is mounted in the throttle-body and injects the fuel on top of the throttle. The fuel is delivered by a fuel pump and kept at a constant level by the fuel pressure regulator mounted on the throttle body. The fuel pressure on single-point systems is usually between 0,6 and 1,2 bars.

Multipoint systems

Multipoint fuel injection systems use one injector for each cylinder. The injectors are mounted in the intake manifold. The fuel is injected in the direction of the inlet valves. The fuel is delivered by a fuel pump. The pressure difference between the air pressure in the intake manifold and the fuel pressure is kept at a constant level by the fuel pressure regulator. Therefore the fuel pressure regulator increases the fuel pressure as the intake manifold pressure increases. The fuel pressure on multipoint systems is usually between 2 and 3 bars. The fuel pressure regulator is mounted on the fuel rail.

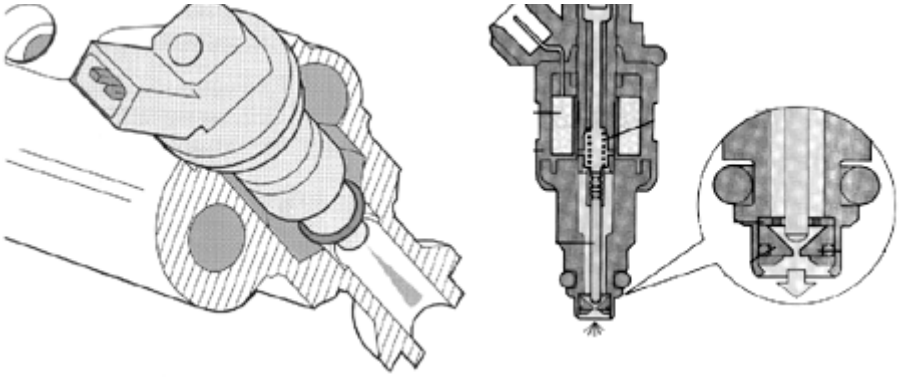
Sequential fuel injection

Sequential fuel injection is a method used by multipoint systems to control the air/fuel ratio and the injection timing per cylinder. Each injector of a sequential injection system is controlled by the control unit individually..

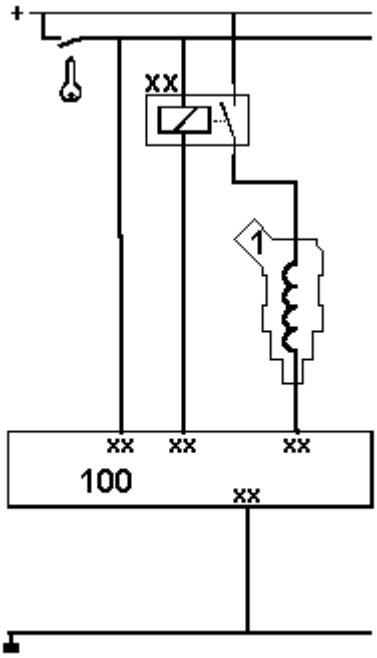
Bottom- and top-feed injectors

The injector fuel inlet can be at the

top or at the bottom. Bottom-feed injectors are often used on singlepoint injection systems while top-feed injectors more often are used as multipoint injectors.



Electrical control

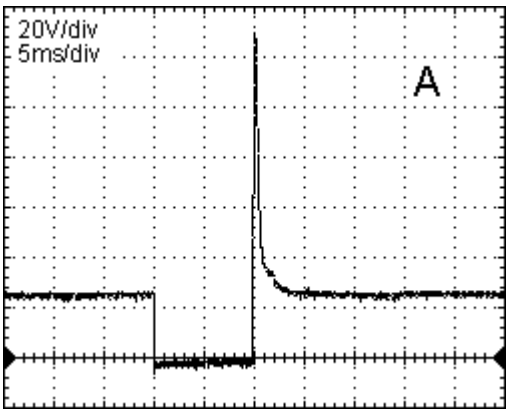


The electrical behaviour of an injector is determined by the coil inside. As a current flows through the coil the injector needle is pulled up against the spring force which courses the fuel to be injected. Two types of injector coils are used. The resistance of a normal coil is approximate 15 ohms. Other injection systems use low resistance coils (approximate 1-2,5 ohms).

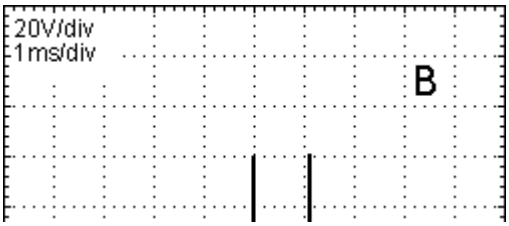
Low impedance injector can be switched on in two different ways:

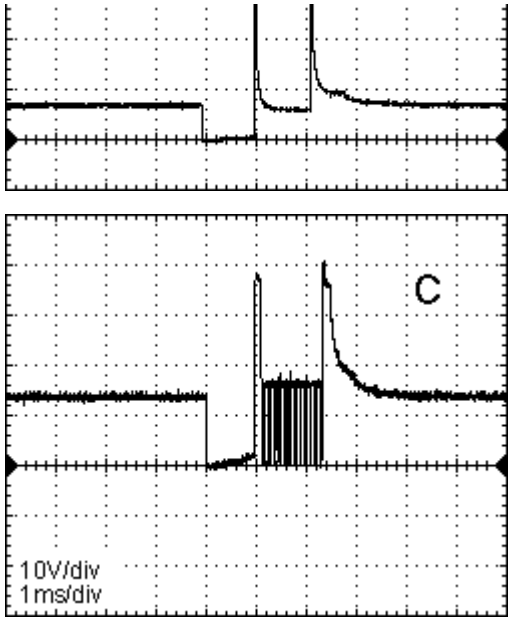
- using an extra external resistance to limit the current
- using a current limiting circuit inside the control unit.

An injector has an electrical connector with two pins. On one of those pins is connected with the battery voltage. This supply-voltage is often switched to the injector using a relay. The other pin leads directly to the control unit. The current through the injector is switched on during the period the control unit connects this pin to ground. The voltage on this pin is during this time 0 Volts. During the period the injector is not switched on, the voltage on the pin is 12 Volts



Oscilloscope image A shows the voltage signal measured on an high impedance injector or low impedance injector with external resistance.





Oscilloscope images B and C show two different current limiting circuits used on low impedance injectors.

Electrical diagnosis

STATIC

- To perform this measurements the relay switching the power to the injector(s) should be closed. Short circuit the switch in the relay if necessary. Perform the tests on one injector at the time. Disconnect parallel switched injectors.

  Measurements

  Measure the voltage on the control unit. Use the pin which switches the injector current.

result: **12 V**

- injector and wiring are electrically OK

0 V

- check the relay switching the power to the injector(s)
- check the wiring between the relay and the injector
- check the injector resistance
- check the wiring between the injector and the control unit
- check the control unit

DYNAMIC

- Connect all injectors. Start the engine and measure using an oscilloscope the voltage on the control unit's pin switching the injector current.

result: **0 V**

- perform static tests.

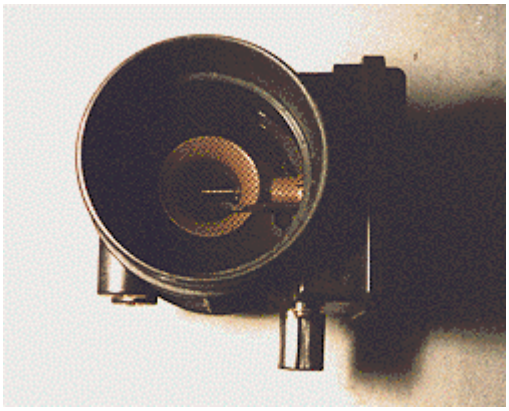
12 V

- control unit does not switch the injector(s).

Mechanical diagnosis

- check fuel system pressure
- check injectors on leakage and pollution
- bottom-feed injectors: check the seal between the injector and the throttle body
- multipoint systems: disconnect the hose between the fuel pressure regulator and the intake manifold. No fuel should leak out of the fuel pressure regulator.

31. mass airflow meter



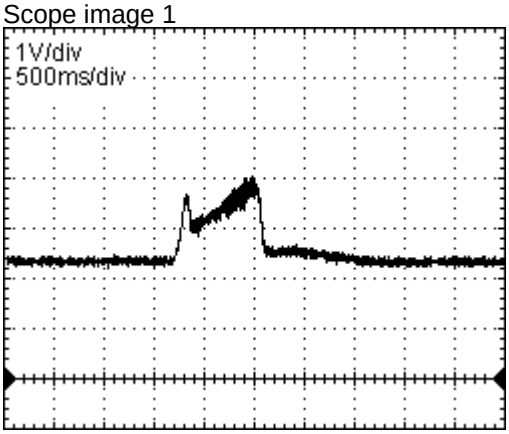
Function

The mass airflow meter uses a wire filament kept at constant temperature to measure the air mass entering the engine inlet system.

Specifications

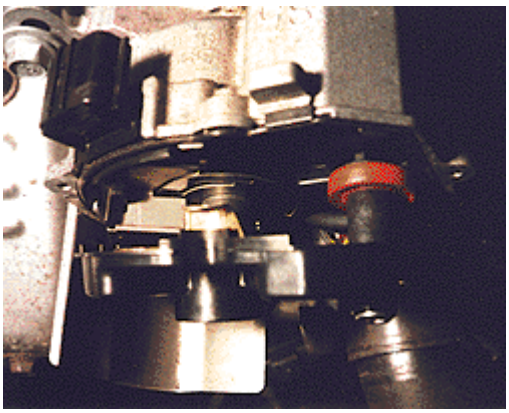
supply voltage: 12 V
output voltage: 0 - 5 V
waveform information: during acceleration

Scope image 1



Pins to ground: 2O

178. opto-coupler



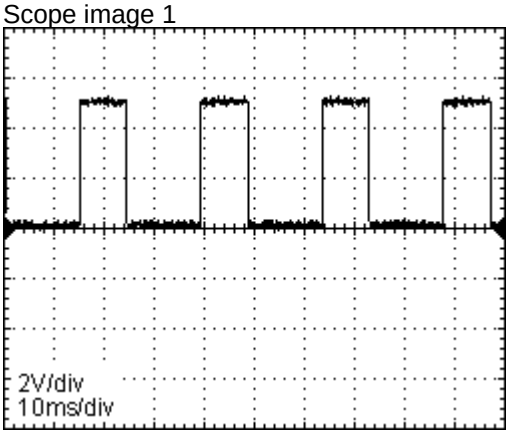
Function

The disc mounted on the rotor passes through the opto-coupler, which sends a signal to the control unit to determine TDC.

Specifications

supply voltage: 12 V
waveform information: engine running at idle

Scope image 1



Pins to ground: 2E

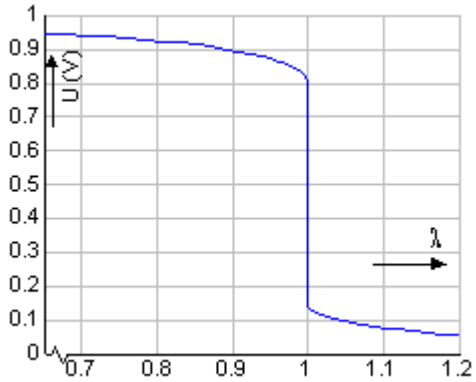
37. oxygen sensor

Function

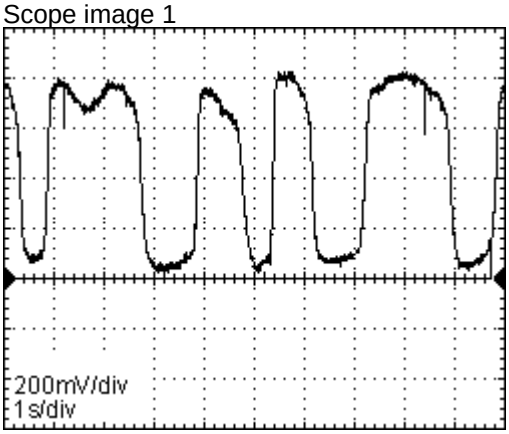
The oxygen sensor is exposed to exhaust gas flow and returns an output signal proportional to the oxygen content of the exhaust gases. A heating element maintains the sensor at constant operating temperature.

Specifications

supply voltage heating element: 12 V
resistance heating element: 4 - 40 ohms (20°C)
output voltage: 200 - 850 mV
waveform information: hot engine running at idle

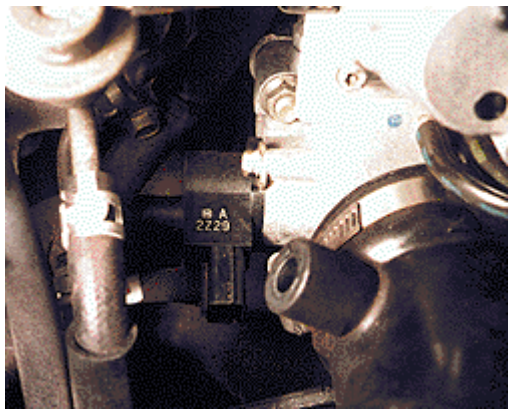


Scope image 1



Pins to ground: 2N

33. throttle position sensor

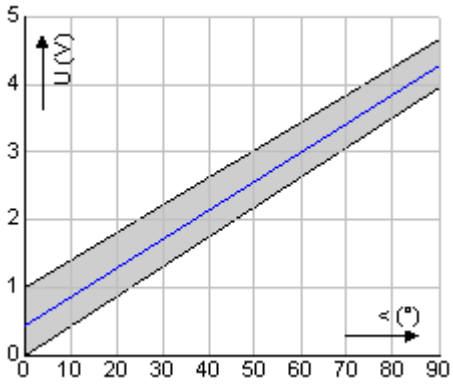


Function

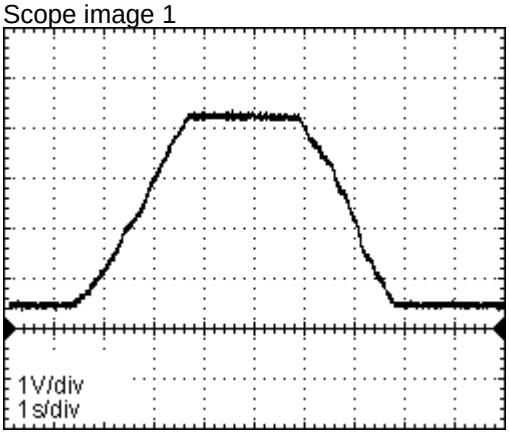
The throttle position sensor measures the angle of the throttle shaft using a potentiometer. The sensor returns a signal proportional to the throttle shaft angle.

Specifications

supply voltage: 5 V
output voltage: 0 - 5 V
waveform information: output signal while opening throttle.



Scope image 1



Pins to ground: 2M

Adjustment Data

MAZDA - 626 - 1.8i 16V - FP

Engine (general)

Item	Values	Units
Engine code	FP	
Capacity	1840	(cc)
Idle speed	725 ± 50	(rpm)
Valve clearance		
Hydraulic		
Compression pressure		
Normal	11.8	(bar)
Minimum	10	(bar)
Oil pressure	3.9 - 4.9/3000	(bar / rpm)
Fuel system (make & type)	Mitsubishi EGI	
Firing order	1-3-4-2	
Timing stroboscopic (before TDC)	12 ± 1/725	(° / rpm)
Ignition-coil resistance, primary	0.64 - 0.96	(ohms)
Ignition-coil resistance, secondary	12000 - 18000	(ohms)
Spark plugs (make & type)	NGK BKR5E-11 Denso K16PR-U11	
Spark-plug gap	1.0 - 1.1	(mm)
Fuel-pump pressure	4.4 - 5.8	(bar)
Injection pressure / system pressure	1.5	(bar)
CO exhaust gas	< 0.5	(%)
CO2	14.5 - 16.0	(%)
HC	100	(ppm)
O2	0.1 - 0.5	(%)
Lambda	0.97 - 1.03	
Lambda change (Delta Lambda)	0.03	
Oil temperature during test	60	(°C)
Fast-idle speed	2500-2800	(rpm)
CO at fast-idle speed	< 0.3	(%)

Cooling system

Item	Values	Units
Cap pressure	0.9 - 1.2	(bar)
Thermostat opens at	80 - 84	(°C)
Fan on at	97	(°C)

Electrical

Item	Values	Units
Battery	60	(Ah)
Alternator	80	(A)

Brakes

Item	Values	Units
Disc thickness, front, min.	22.0	(mm)
Disc thickness, rear, min.	8.0	(mm)

Steering and wheel alignment

Item	Values	Units
Toe-in, front	17' ± 17'	(°)
Camber, front	-36' ± 45'	(°)
Castor, front	2° 37' ± 45'	(°)
K.P.I., front	15 ± 04'	(°)
Toe-in, rear	17' ± 17'	(°)
Camber, rear	-09' ± 45'	(°)

Wheels and tyres

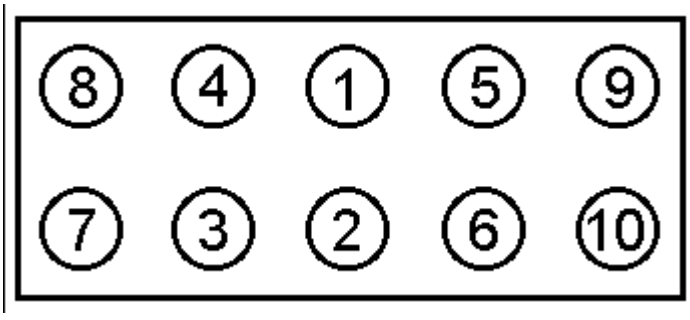
Item	Values	Units
Tyre size	185/65R14	
Front tyre pressure	2.2	(bar)
Rear tyre pressure	1.8	(bar)

Capacities

Item	Values	Units
Engine sump, incl. filter	3.5	(l)
Manual transmission		
Gearbox refill	2.7	(l)
Automatic transmission		
Gearbox refill	8.8	(l)
Cooling system	7.0	(l)
Air-conditioner refrigerant	700	(g)
Air-conditioner compressor oil	175	(ml)

Torque settings

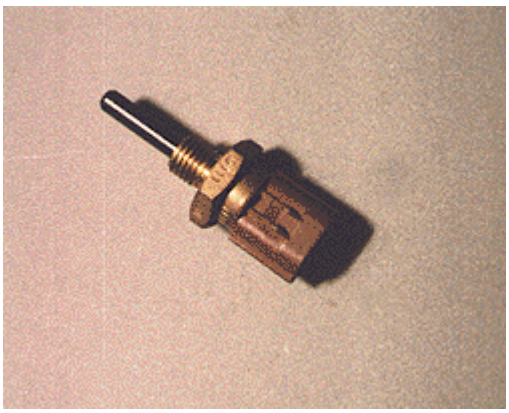
Item	Values	Units
Cylinder head		



Stage 1	17 - 22	(Nm)
Stage 2	90°	(°)
Stage 3	90°	(°)
Front hub	236 - 318	(Nm)

Rear hub	117 - 235	(Nm)
Wheel nuts	88 - 117	(Nm)
Spark plugs	15 - 22	(Nm)

43. air temperature sensor

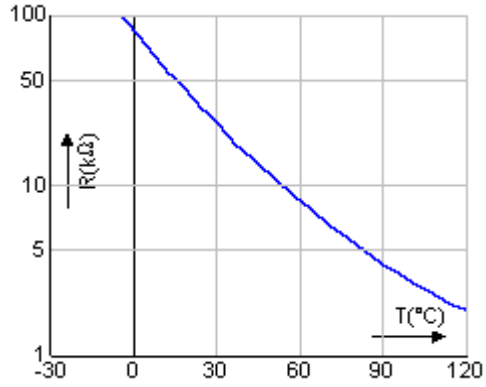


Function

The air temperature sensor is a temperature-sensitive resistor. Low temperature causes high resistance while high temperature causes low resistance. The control unit determines the temperature by monitoring the voltage across the sensor.

Specifications

supply voltage: 5 V
resistance: 35,000 - 40,000 ohms / 20°C
resistance: 1,900 - 2,500 ohms / 100°C



CANISTER PURGE SOLENOID

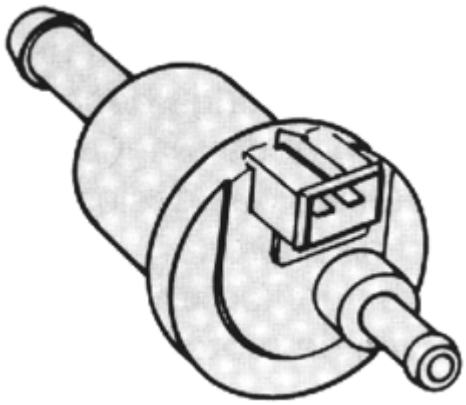
Function

The evaporative gases produced in the fuel tank are absorbed by the activated charcoal in the carbon canister. As The purge control solenoid valve opens these gases are delivered to the intake manifold for combustion purposes. The purge control solenoid valve is controlled by the control unit. The control unit operates this valve during the time the lambda control loop is active.

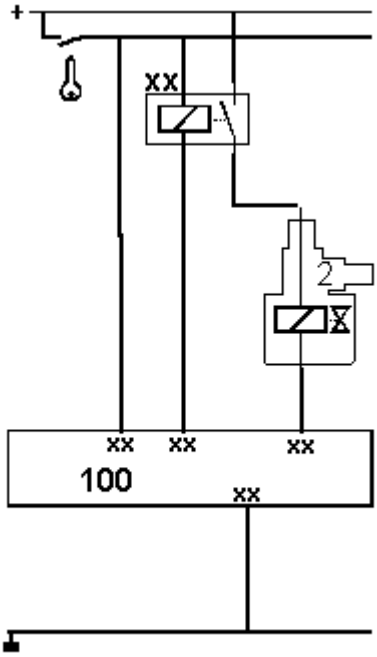
Specifications

RESISTANCE:

resistance:	± 50 ohms
supply voltage:	12 Volts
current:	± 250 mA



Electrical control



Most solenoids are normally closed. This means that the connection between the canister and the intake manifold is closed. The solenoid has a connector with two terminals. On one of those terminals is connected to the battery voltage. This supply-voltage is often switched with a relay. The other terminal leads directly to the control unit. The current through the solenoid is switched on during the time the control unit connects this terminal to ground. The voltage on this terminal is during this time 0 Volts. During the time the solenoid is switched off, the voltage on this terminal is 12 Volts. Some motormanagement systems control the amount gases delivered to the intake manifold switching the solenoid on and of with a certain duty cycle. In this case the duty-cycle depends on engine RPM and engine load.

Electrical diagnosis

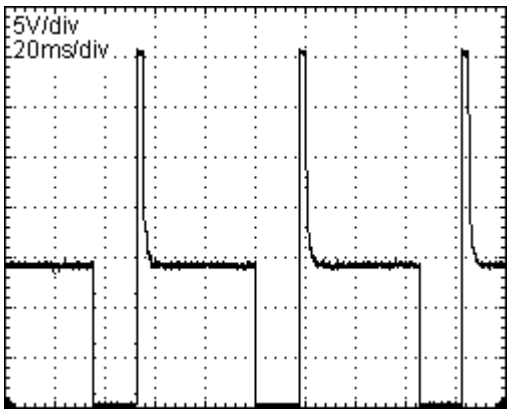
STATIC

General

- To perform this measurements the relay switching the power to the solenoid should be closed. Short circuit the switch in the relay if necessary.

Measurements

- Measure the voltage on the control unit. Use the pin which switches the solenoid.



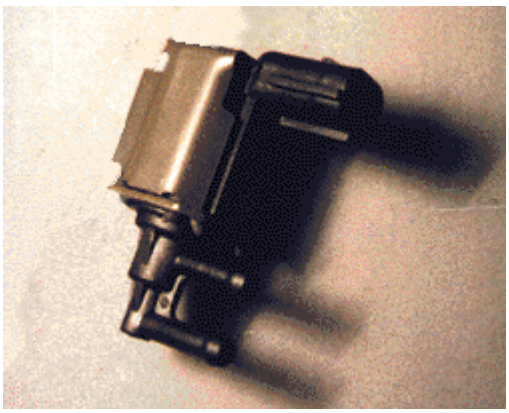
result: **12 V**

- solenoid and wiring are electrically OK

0 V

- check the relay switching the power to the solenoid
- check the wiring between the relay and the solenoid
- check the solenoid resistance
- check the wiring between the solenoid and the control unit
- check the control unit

2. canister purge solenoid



Extra Info

Function

The evaporative canister is equipped with a purge solenoid valve. The control unit switches the solenoid on or off. This controls the amount of vapour purged into the inlet manifold.

Specifications

supply voltage: 12 V
resistance: 25 - 35 ohms

Diagnosis

Check connector(s): Inspect the connector(s) and if necessary clean or fix them to make sure the connection is good.
Check resistance:
Turn ignition off. Remove connector from solenoid.
Measure resistance between the two pins of the solenoid. Compare with specified resistance. Alternatively, check solenoid function by applying battery voltage to its pins. The solenoid should "click".
Check supply voltage:
Turn ignition off. Remove connector from solenoid.
Start the engine and measure voltage between one connector terminal and the negative terminal of the battery. Check the second terminal. One of the two should equal battery voltage. If not check wiring and, if present, fuse(s) and relay.

Check connection to ECU:
Turn ignition off. Remove connector from solenoid and ECU.
Measure the resistance between one of the two connector terminals and the corresponding terminal in the ECU connector. Check the other terminal. One of the two should be < 1 ohm. If not check wiring.

Capacities

MAZDA - 626 - 1.8i 16V - FP

Item	Values	Units
Engine sump, incl. filter	3.5	(l)
Manual transmission		
Gearbox refill	2.7	(l)
Automatic transmission		
Gearbox refill	8.8	(l)
Cooling system	7.0	(l)
Air-conditioner refrigerant	700	(g)
Air-conditioner compressor oil	175	(ml)

185. clutch switch

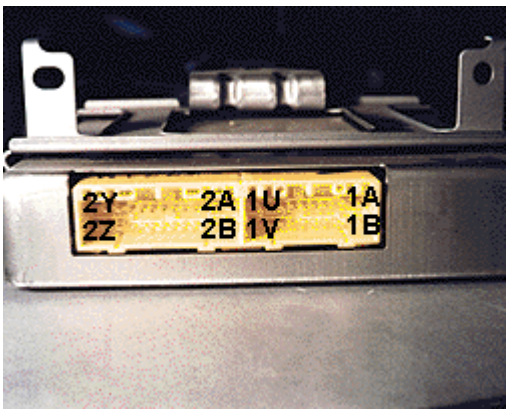
Function

The clutch switch is mounted on the clutch pedal. It returns a signal to the control unit when the pedal is depressed.

Specifications

The switch is normally closed

100. control unit



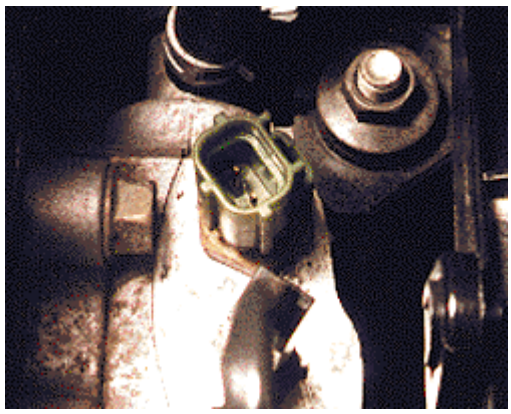
Function

The control unit receives signals from sensors that monitor various engine operating parameters. The control unit generates output signals to provide optimal air/fuel ratio, idle speed control and ignition timing.

Diagnosis

Check connector(s): Inspect the connector(s) and if necessary clean or fix them to make sure the connection is good.
When you suspect the control unit is faulty, make sure all sensors and actuators function properly, and that signals from other control unit(s) are received properly. Next check the supply voltage and ground connections of the control unit:
Turn ignition off. Remove ECU connector.
Locate the supply voltage connections. Turn ignition on. Measure voltage between corresponding connector terminal(s) and the negative terminal of the battery. They should equal battery voltage. If not check wiring and fuse.
Turn ignition off. Locate the ground connections. Measure resistance between corresponding connector terminal(s) and the negative terminal of the battery. They should be < 1 ohm.

42. coolant temperature sensor

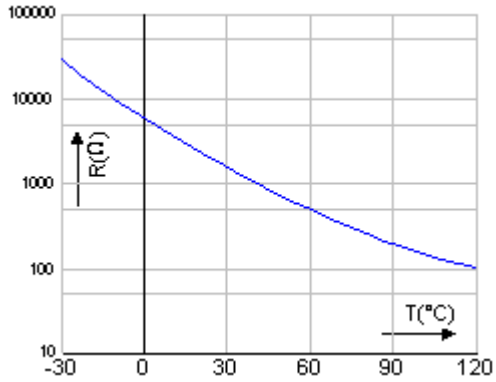


Function

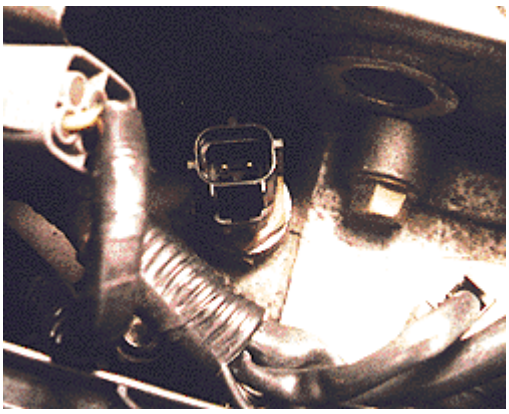
The coolant temperature sensor is a temperature-sensitive resistor. Low temperature causes high resistance while high temperature causes low resistance. The control unit determines the temperature by monitoring the voltage across the sensor.

Specifications

supply voltage: 5 V (connector disconnected)
resistance: 2,000 - 3,000 ohms / 20°C
resistance: 200 - 300 ohms / 90°C



186. coolant temperature sensor fan



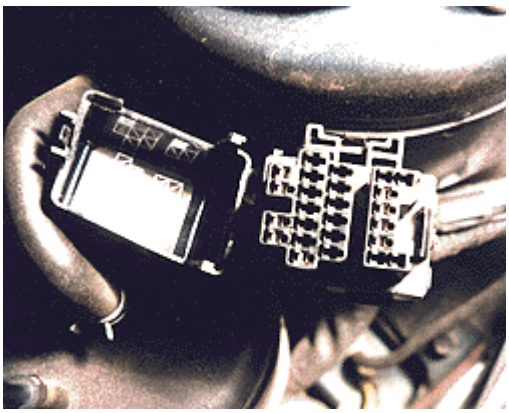
Function

The coolant temperature sensor is a temperature-sensitive resistor. Low temperature causes high resistance while high temperature causes low resistance. The control unit determines the temperature by monitoring the voltage across the sensor and switches the cooling fan on or off.

Specifications

supply voltage: 5 V
resistance: 1,700 - 1,840 ohms / 91°C
1,420 - 1,530 ohms / 97°C
1,030 - 1,110 ohms / 108°C

83. diagnostic connector



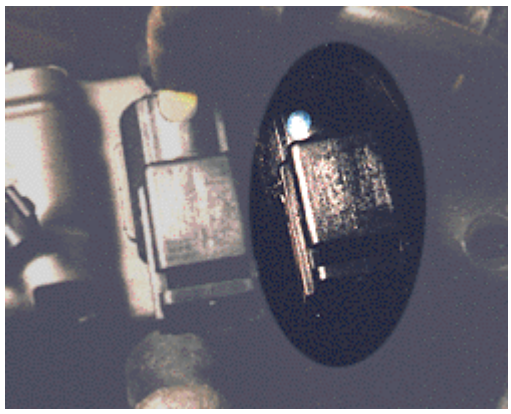
Function

This connector is used to communicate with the control unit.

Specifications

For more information on reading error codes click the error codes button on the toolbar.

23. EGR purge solenoid



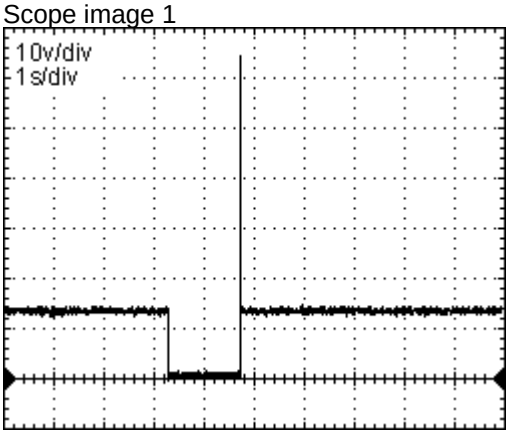
Function

The EGR purge solenoid controls the vacuum at the EGR valve. The EGR purge solenoid is controlled by the control unit.

Specifications

supply voltage: 12 V
resistance: 35 - 45 ohms

Scope image 1



Pins to ground: 2S

Diagnosis

Check connector(s): Inspect the connector(s) and if necessary clean or fix them to make sure the connection is good.
Check resistance:
Turn ignition off. Remove connector from solenoid.
Measure resistance between the two pins of the solenoid. Compare with specified resistance. Alternatively, check solenoid function by applying battery voltage to its pins. The solenoid should "click".
Check supply voltage:
Turn ignition off. Remove connector from solenoid.
Turn ignition on, start or crank the engine and measure voltage between one connector terminal and the negative terminal of the battery. Check the second terminal. One of the two should equal battery voltage. If not check wiring and, if present, relay or power supply unit and fuse(s).
Check connection to ECU:
Turn ignition off. Remove connectors from solenoid and ECU.
Measure the resistance between one of the two connector terminals and the corresponding terminal in the ECU connector. Check the other terminal. One of the two should be < 1 ohm. If not check wiring.
Check solenoid activation:
Connect oscilloscope to signal pin of the ECU and ground. Start the engine and compare to the scope image shown.

Engine code FP

MAZDA - FP

Compression			
Compression ratio	9.0	: 1	
Compression pressure	12.0 (300)	bar (/ min)	
Idle speed	725 ± 50	/ min	
Exhaust gas emissions			
CO content at idle speed	< 0.5 *	vol. %	
CO2 content at idle speed	14.5 - 16.0 *	vol. %	
HC content at idle speed	100 *	ppm	
Oil pressure		bar	
At rated power	4.0 - 5.0 (3000)	bar (/ min)	
Thermostat opening temperature	80 - 84 *	°C	
Valve timing			
Intake opens	5	°	**before TDC**
Intake closes	47	°	**after BDC**
Outlet opens	54	°	**before BDC**
Outlet closes	8	°	**after TDC**
Valve clearance	0		**hydraulic**
Firing order	1-3-4-2		
Injection timing	12 ± 1	°	**before TDC**

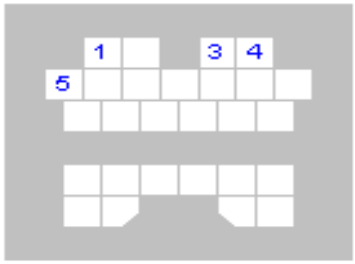
* Data from secondary source; No manufacturer's information

Environmental Data

MAZDA - 626 - 1.8i 16V - FP

Item	Values	Units
Engine code	FP	
Idle speed	725 ± 50	(rpm)
Fuel system (make & type)	Mitsubishi EGI	
Timing stroboscopic (before TDC)	12 ± 1/725	(° / rpm)
Fuel-pump pressure	4.4 - 5.8	(bar)
Injection pressure / system pressure	1.5	(bar)
CO exhaust gas	< 0.5	(%)
CO2	14.5 - 16.0	(%)
HC	100	(ppm)
O2	0.1 - 0.5	(%)
Lambda	0.97 - 1.03	
Lambda change (Delta Lambda)	0.03	
Oil temperature during test	60	(°C)
Fast-idle speed	2500-2800	(rpm)
CO at fast-idle speed	< 0.3	(%)

Error codes



Diagnostic plug

Diagnostic plug:
1 = Datalink LED tester (FEN)
3 = activation error codes (TEN)
4 = positive battery terminal (+B)
5 = ground

Read-out

-Connect LED tester to positive battery terminal and diagnostic-plug terminal 1.
-Connect diagnostic-plug terminal 3 to ground.
-Turn ignition on.
-Error codes will appear on LED tester.

Reset

-Turn ignition off.
-Disconnect negative terminal of the battery.
-Depress brake pedal for at least 5 seconds.
-Connect negative terminal of the battery.
-Verify that no error codes are displayed.

Signal

-Digit 1 (tens position): Light pulse 1.2 seconds long, 0.4 seconds pause in-between.
-Pause 1.6 seconds light-off.
-Digit 2 (units position): Light pulse 0.4 seconds long, 0.4 seconds pause in-between.
-Pause 4.0 seconds light-off.

Error codes

02 Opto-coupler no signal (Ne).
03 Opto-coupler no signal (G).
06 Vehicle speed sensor, no signal.
08 Mass airflow meter, open or short circuit.
09 Coolant temperature sensor, open or short circuit.
11 Air temperature sensor, open or short circuit.
12 Throttle position sensor, open or short circuit.
14 Absolute pressure sensor (inside ECU), open or short circuit.
15 Oxygen sensor, lean signal for longer than 75 seconds, engine speed is higher than 1500 rpm, warm engine.
17 Oxygen sensor signal does not change for 40 seconds, engine speed is higher than 1500 rpm.
25 Increased fuel pressure solenoid, open or short circuit.
26 Canister purge solenoid, open or short circuit.
28 EGR purge solenoid, open or short circuit.
34 Idle speed control valve (ISC) open or short circuit.
55 No ATX signal at 40 km/h or higher.
56 Thermosensor (ATX), open or short circuit.
60 Shift valve 1-2 (ATX), open or short circuit.
61 Shift valve 2-3 (ATX), open or short circuit.
62 Shift valve 3-4 (ATX), open or short circuit.

63 Lock-up solenoid (ATX), open or short circuit.
64 Shift timing valve 3-2 (ATX), open or short circuit.
65 Lock-up solenoid (ATX), open or short circuit.
66 Pressure switch (ATX), open or short circuit.
67 Fan relay (low temperature) open or short circuit.
68 Fan relay (high temperature) open or short circuit.
69 Coolant temperature sensor cooling fan, open or short circuit.

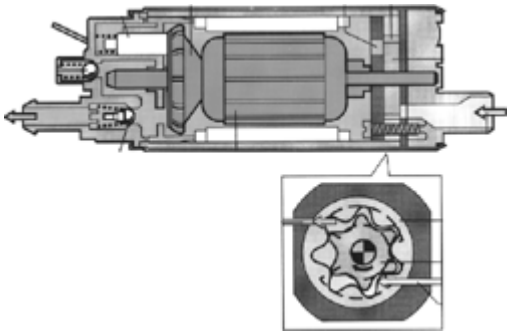
FUEL PUMP

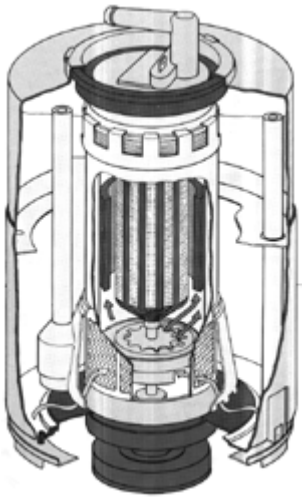
Function

The fuel pump is an electrically operated pump which lifts the fuel from the fuel tank and pumps it under pressure through a filter to the fuel rail or throttle body. The fuel runs along the injector(s) and returns to the tank via the fuel pressure regulator. Some systems use two pumps. The fuel lift pump inside the tank and the fuel pressure pump outside the tank.

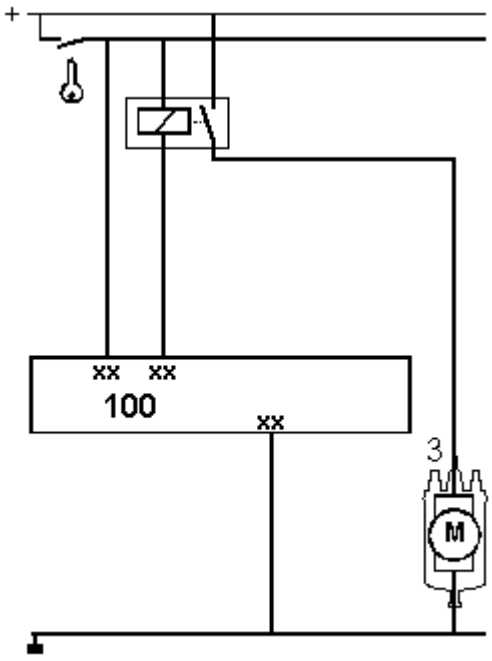
Specifications

pump pressure:	± 0,25 - 6 bars
system pressure:	± 0,6 - 1,1 bar (single-point) ± 2 - 3,5 bar (multi-point)
flow:	± 50 - 100 l/h
supply voltage:	12 Volts
current:	± 5A





Electrical control



The fuel pump is operated by a relay. The conditions the relay is closed are.

- during several seconds after switching on the ignition
- during the time the system receives RPM pulses.

The fuel pump relay is often controlled by the control unit.

The relay coil has two terminals. On one of those terminals is connected with the battery voltage. The other terminal leads directly to the control unit.

The current through the relay coil is switched on during the time the control unit connects this pin to ground. The voltage on this pin is during this time 0 Volts. During the time the relay is not switched on, the voltage on the pin is 12 Volts.

Electrical diagnosis

STATIC

General

- Turn the ignition switch "on"
- Listen to the fuel pump operating sound. The fuel pump should operate for several seconds after the ignition switch is turned "on"

Power supply

- To perform this measurements the relay switching the power to the fuel-pump should be closed. Short circuit the switch in the relay if necessary.

Measurements

- Disconnect the fuel pump connector. Measure the voltage over the fuel pump terminals in the connector. The voltage should be 12 Volts.

result: **12 V**

- replace the fuel pump

0 V

- check ground circuit
- check the wiring between the relay and the pump
- check the relay switching the power to the pump

Mechanical diagnosis

Measurements

- To perform this measurements the relay switching the power to the fuel-pump should be closed. Short circuit the switch in the relay if necessary.
- check the fuel system pressure

result:

- check the fuel level in the tank
- check the fuel pressure regulator
- check the fuel filters
- check the fuel pump
- check the fuel return circuit to the tank

3. fuel pump

Extra Info

Function

The fuel pump consists of an impeller driven by a DC motor. The fuel pump and the fuel pressure regulator maintain constant pressure at the injectors.

Specifications

supply voltage: 12 V
maximum pump pressure: 4.5 - 6.0 bar
system pressure (vacuum connected): 2.1 - 2.6 bar

91. fuel pump relay

Function

A relay is an electrically operated power supply switch, switching supply voltage to the component(s) of the engine management system.

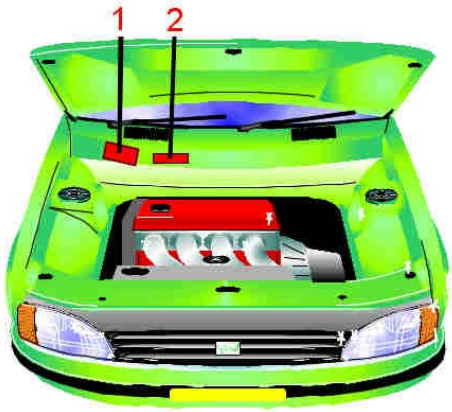
ID Location

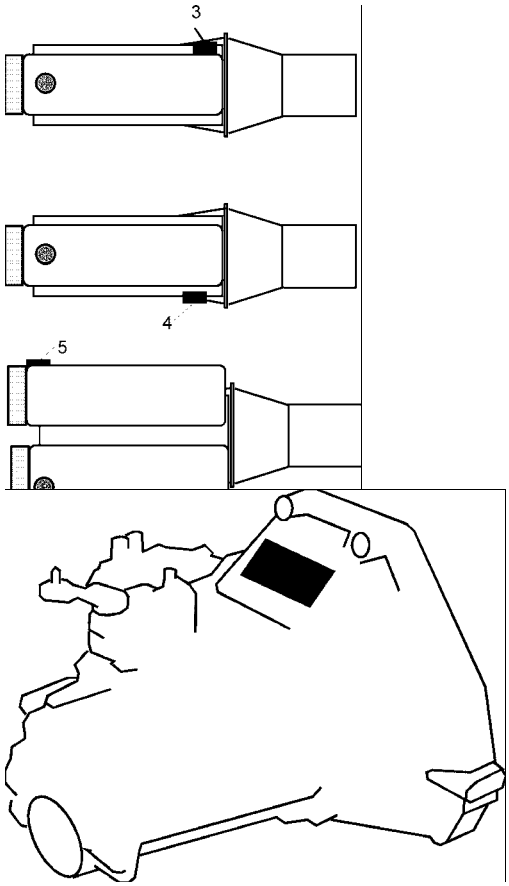
MAZDA - 626 - 1.8i 16V - FP

1 Identification plate
2 VIN

3 Engine code B3 / B5 / B6 / PN
4 Engine code BP / FP / FS
5 Engine code 6-cylinder

6 Manual transmission code





IDLE SPEED CONTROL VALVE

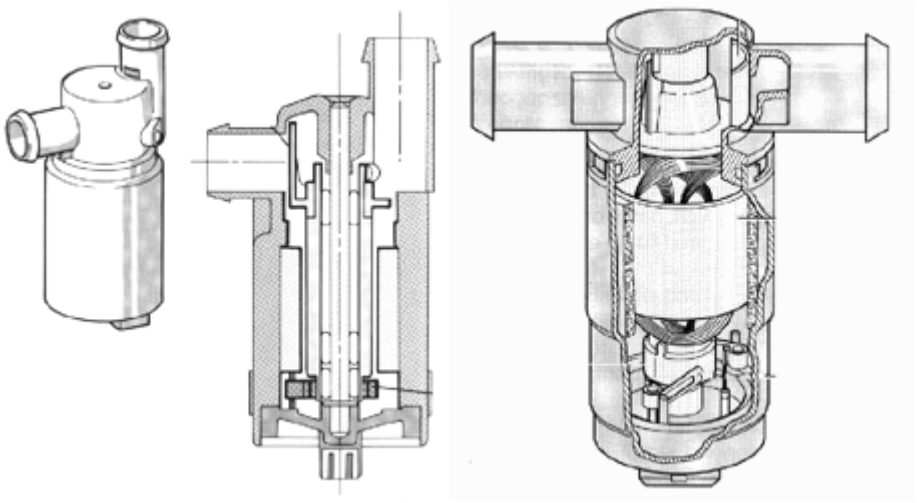
Function

The idle control valve is located in a tube bypassing the throttle. The control unit controls this device to ensure stable idling in all operating conditions.

Specifications

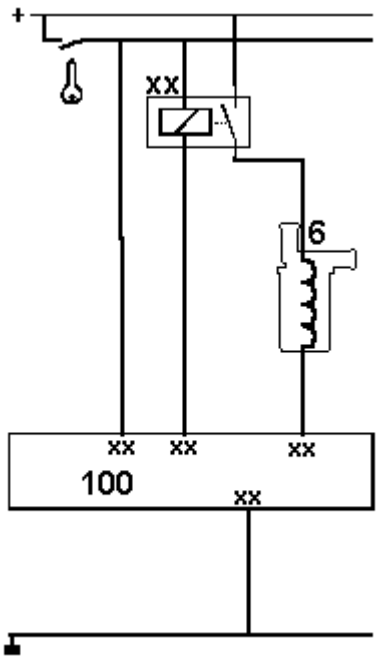
resistance coil(s):	± 20 ohms
supply voltage:	12 Volts

A rotary slide valve attached to the armature is turned to open the air bypass until the desired idle speed is obtained. The position of the armature is controlled by the force of an internal spring opposing the force of a solenoid (types with to terminals) or controlled by two solenoids energised alternately which exerts opposing forces on the armature (types with three terminals).



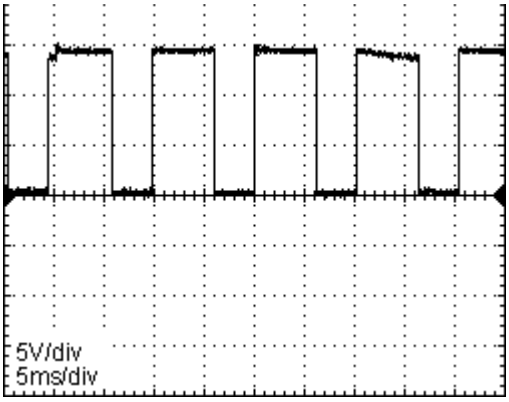
Electrical control

Types with two terminals



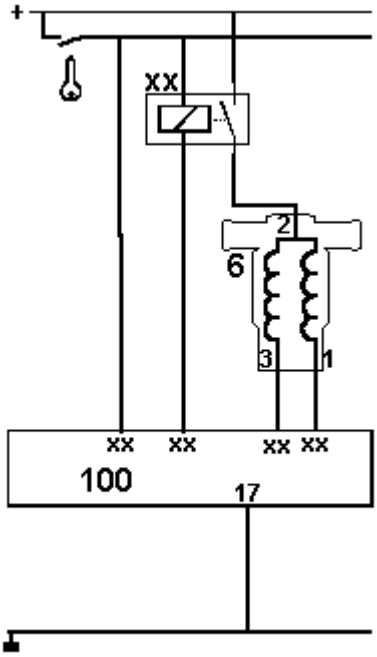
As a current flows through the coil the armature is turned against the spring force. As the current increases the airflow and the idle speed increases. If the current through the coil is switched off due to a mall functioning system, the valve is forced into a position which results in a (too) high idle speed.

The idle control valve has a connector with two terminals. On one of those terminals is connected to the battery voltage. This supply-voltage is often switched with a relay. The other terminal leads directly to the control unit. The current through the coil is switched on during the time the control unit connects this terminal to ground. The voltage on this terminal is during this time 0 Volts. During the time the current through the coil is switched off, the voltage on this terminal is 12 Volts.

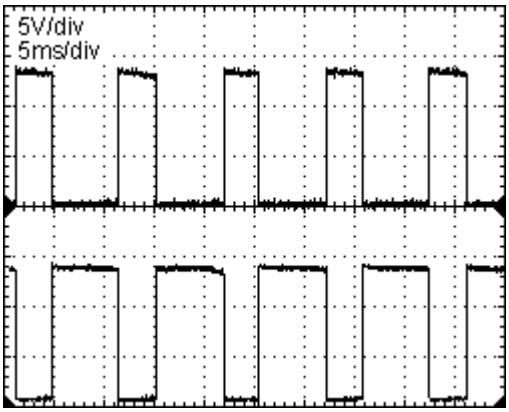


The control unit controls the current through the coil switching the current on and off with a certain duty cycle. The current increases as the duty-cycle increases. The duty cycle varies between approx. 35% (valve closed) and 85% (valve opened). Nominal idle speed is obtained when slightly open.

Three terminal types



The two coils inside this type of idle speed control valve are connected with the supply voltage using one common terminal. The other two terminals lead directly to the control unit. The control unit switches the current through the solenoid on and off alternately with a duty cycle between 35 and 85%.



Electrical diagnosis

STATIC

- To perform this measurements the relay switching the power to the idle control valve should be closed. Short circuit the switch in the relay if necessary.

  Measurements:

  Disconnect the connector and

DYNAMIC TESTS THREE TERMINAL TYPES

- Remove the idle control valve but leave the electrical connections in place. Fully open or close the rotating plunger. Switch on the ignition.

measure the resistance of the coil(s). The nominal value is app. 20 ohms.

- Check the relay switching the power to the idle control valve
- Check the wiring between the relay and the idle control valve
- Check the wiring between the idle control valve and the control unit
- Check the control unit

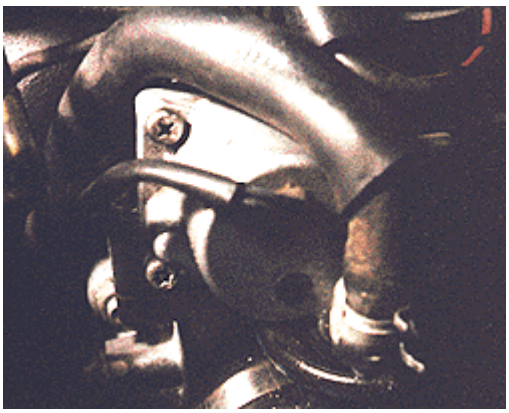
result:

- Switch on the ignition. The rotating plunger must move to a position equivalent to app. 50% opening, and remain there.

Mechanical diagnosis

- Check the air chamber on air leakage.
- Check engine on air leaks into the intake system.
- Remove the idle control valve. The plunger should rotate or move easily. Clean if necessary.

6. idle speed control valve



Extra Info

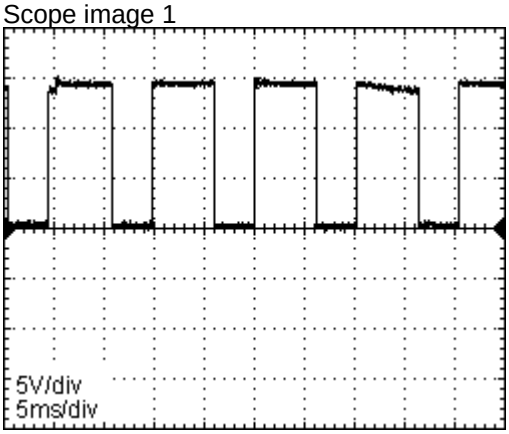
Function

The idle speed control valve regulates the by-pass airflow.

Specifications

supply voltage: 12 V
resistance coil: 4 - 10 ohms
waveform information: engine adjusting idle speed

Scope image 1

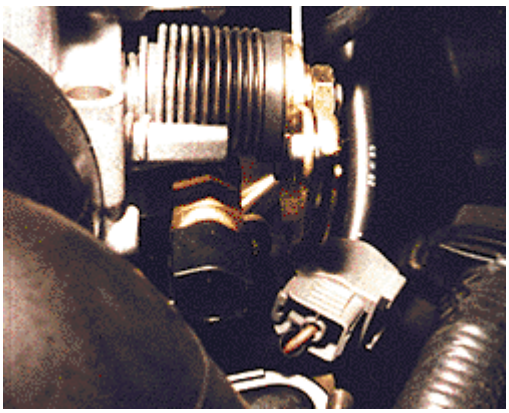


Pins to ground: 2W

Diagnosis

Check connector(s): Inspect the connector(s) and if necessary clean or fix them to make sure the connection is good.
Check resistance:
Turn ignition off. Remove connector from valve.
Measure resistance between the two pins of the valve. Compare with specified resistance.
Check supply voltage:
Turn ignition off. Remove connector from valve.
Crank the engine and measure voltage between one connector terminal and the negative terminal of the battery.
Check the second terminal. One of the two should equal battery voltage. If not check wiring and, if present, fuse(s) and relay.
Check connection to ECU:
Turn ignition off. Remove connector from valve and ECU.
Measure the resistance between one of the two connector terminals and the corresponding terminal in the ECU connector. Check the other terminal. One of the two should be < 1 ohm. If not check wiring.
Check valve activation:
Connect oscilloscope to the signal pin of the ECU and ground. Start the engine and compare to the scope image shown.

53. idle switch



Function

The idle switch returns a signal to the control unit when the throttle is closed.

Specifications

supply voltage: 12 V

IGNITION COIL

Function

The ignition coil transforms the battery voltage into the high voltage needed to create a spark.

The ignition coil consists of an electromagnet (the primary coil) and a high voltage coil (secondary coil).

By switching the current through the primary coil on, a magnetic field is induced. The moment the current is switched of, the magnetic field suddenly disappears.

This change of magnetic field creates an induction voltage in the secondary coil, high enough to ionise the mixture. The ionised mixture is a conductor and a current flows through the spark plug.

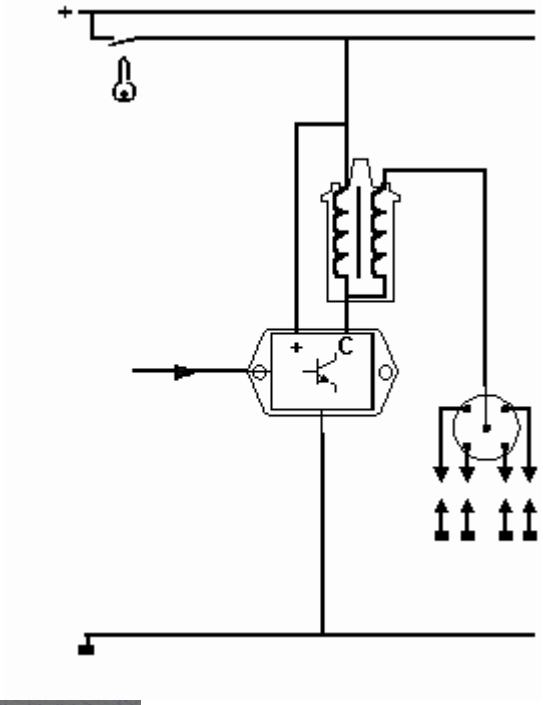
Specifications

RESISTANCE:	
primary:	± 0,3 - 2 ohms
secondary	± 5k - 20k ohms
supply voltage:	12 V
current limited at:	± 7A

Systems with a distributor

Ignition coils used in combination with a distributor consists of one primary and one secondary coil.

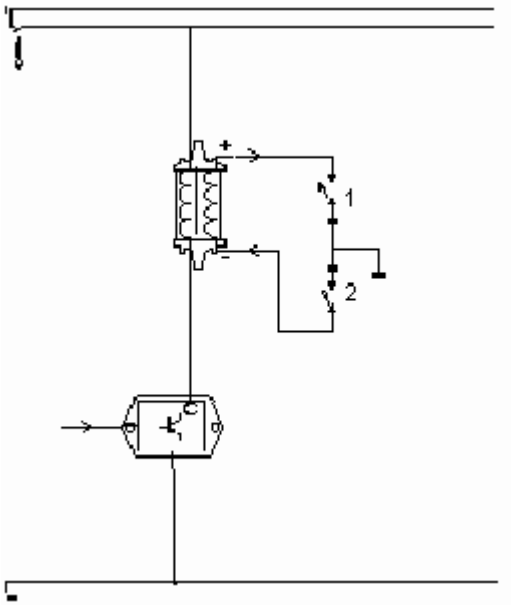
The high voltage, induced in the secondary coil is connected to one of the spark plugs



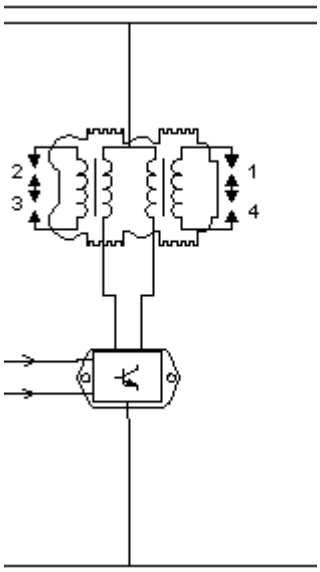
selected by the distributor.

Wasted spark ignition coils

The secondary coil has two ends. In a normal ignition coil one of those ends delivers the high
The other end is connected to either the positive (15) or the negative (1) terminal of the prir
In a wasted spark ignition coil both ends are connected to a spark plug. Therefore both spark
will spark at the same time.

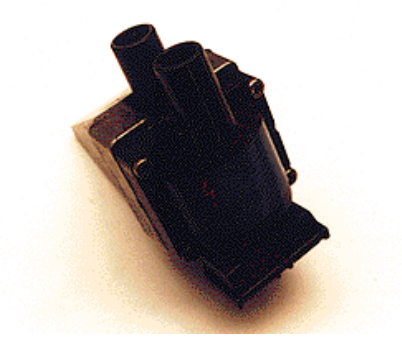


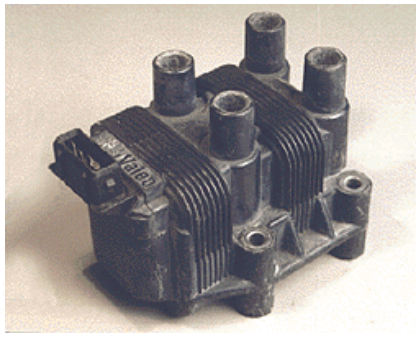
wasted spark ignition coil on 2- cylinder 4-stroke engine



a wasted spark ignition coil on a 4- cylinder 4-str

To supply the four spark plugs of an 4 cylinder engine, two ignition coils are needed. The pic
below (left) shows an ignition coil for two spark plugs. The ignition coil in the right picture
incorporates two of those. This ignition coil supplies four spark plugs.

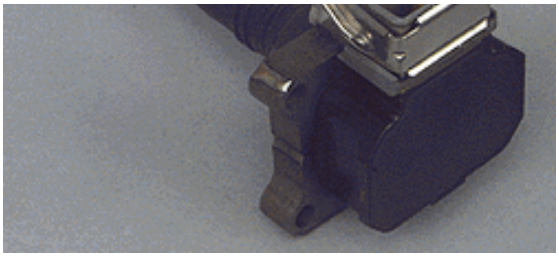


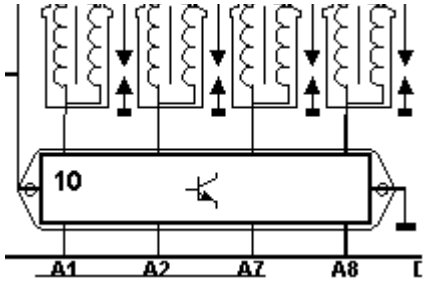


Sequential ignition

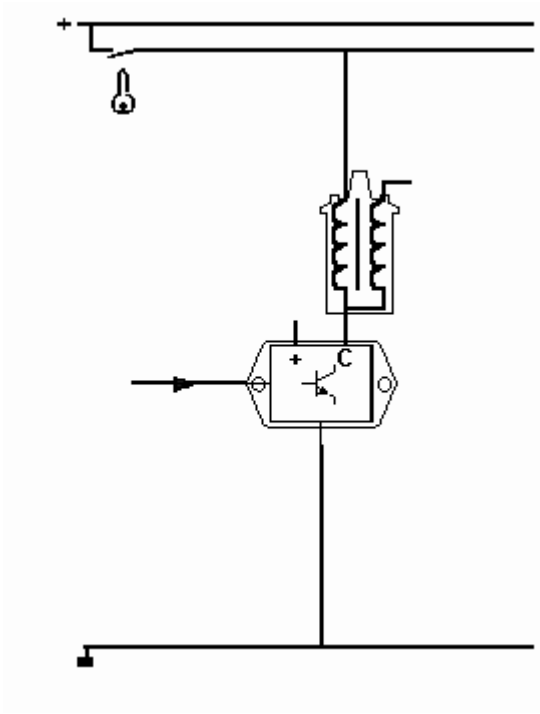
Sequential ignition systems are distributor less ignition systems using one ignition coil per
cylinder.

Each ignition coil is controlled by the control unit individually.





Electrical control



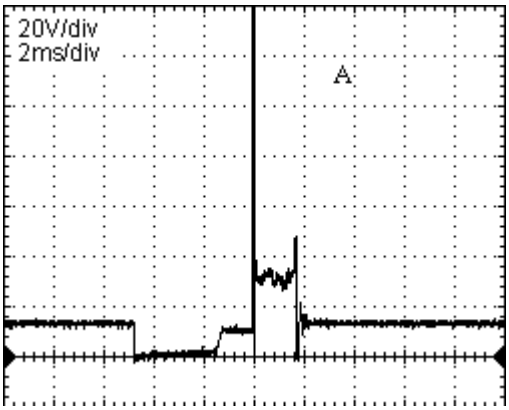
A current through the primary coil induces a magnetic field. The moment the current is switched of, the magnetic field suddenly disappears. This change of magnetic field induces an induction voltage and causes a spark.

The amperage before switching the current off should be high enough to create a high change of magnetic field the moment the current is switched off.

Therefore the current through the primary coil is controlled electronically.

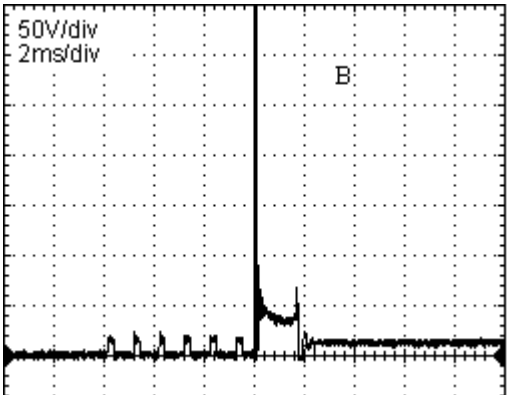
The ignition module is supplied with a current limited circuit. Using this in combination with a low resistance ignition coil the amperage does not depend on the battery voltage.

During the time the current is switched off, the voltage over the ignition module is 12 Volts. The moment the current is switched on, the voltage drops to 0 Volts. From this moment on the current increases until the limiting value is reached.



The oscilloscope images A and B gives you an example of the primary voltage measured on two different current limiting circuits.

By increasing the voltage over the ignition module, the voltage over the primary coil decreases. This causes a limited current in oscilloscope image A.



The ignition module in oscilloscope image B switches the current on and off to limit the current.

Electrical diagnosis

STATIC

To perform this measurements the ignition should be switched on.

Measurements:

- Measure the primary and secondary resistance of the ignition coil.
- Measure the voltage on the positive terminal of the ignition module.

The voltage should be equal to the battery voltage.

result: **Voltage is lower than battery voltage.**

- disconnect positive terminal and repeat measurement

result: **Voltage is equal to battery voltage.**

- check primary resistance of the ignition coil
- check ignition module
- check wiring between ignition module and ignition module.

result **Voltage is still lower than battery voltage.**

- check ignition lock
- check wiring between ignition lock and ignition coil

DYNAMIC

Start the engine and measure the primary voltage using an oscilloscope.

result: **0 V**

- check power supply.

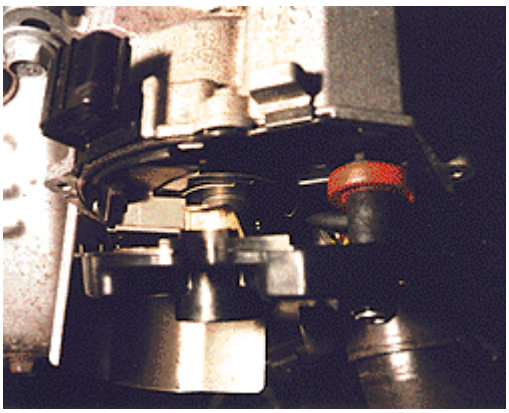
12 V

- check ignition module

Mechanical diagnosis

Not available for this subject !

11. ignition coil



Extra Info

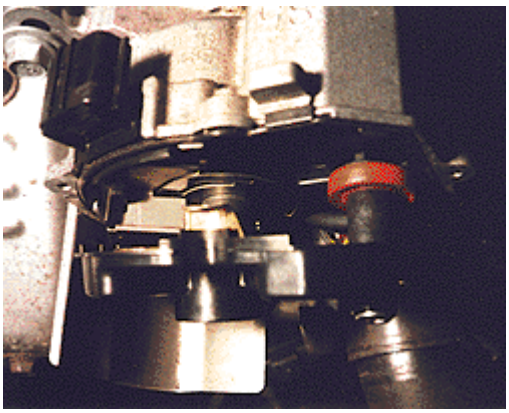
Function

The ignition coil stores energy when current is passed through the coil primary. When the current is switched off a high voltage is induced in the coil secondary.

Specifications

supply voltage: 12 V

10. ignition module



Extra Info

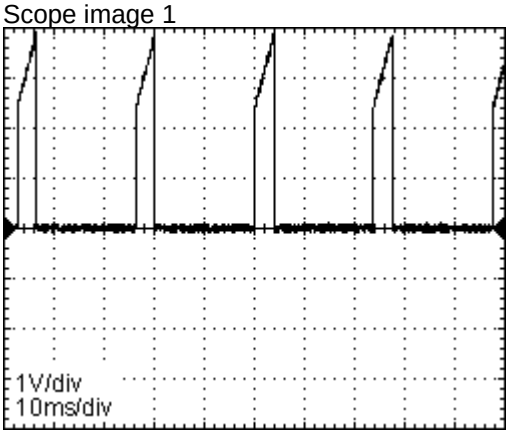
Function

The ignition module receives its input signal(s) from the control unit and switches the current through the coil primary circuit on and off.

Specifications

supply voltage: 12 V
waveform information: engine running at idle

Scope image 1



Pins to ground: 2F

167. increased fuel pressure solenoid

Function

The vacuum solenoid (P.R.C.) regulates the connection between the fuel pressure regulator and the inlet manifold vacuum. The vacuum solenoid is activated by the control unit at air temperatures above 20°C, at engine speeds below 1500 rpm, and with the idle switch closed.

Specifications

supply voltage: 12 V
resistance: 35 - 45 ohms

INJECTOR

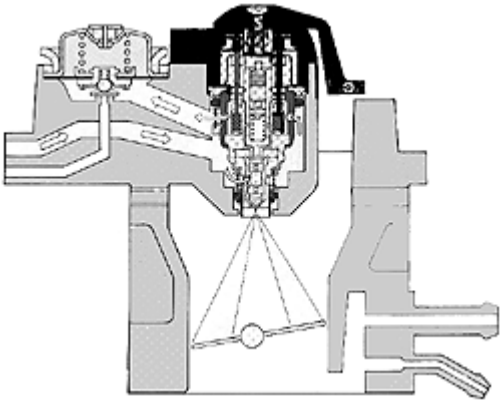
Function

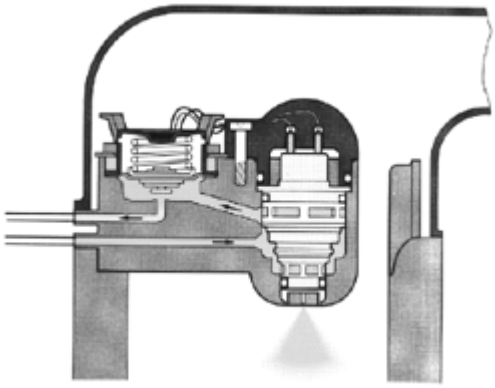
Injectors are electronically operated electromagnetic valves. Using the injectors the control unit is able to inject an exact quantity of fuel. Adding this quantity of fuel to the air, a mixture with the demanded air/fuel ratio is created. Depending on the kind of motormanagement system either one injector per cylinder (multipoint systems) or one injector for all cylinders (singlepoint systems) are used.

Specifications

RESISTANCE:	
high impedance:	± 15 ohms
low impedance:	± 0,5 - 2,5 ohm
flow:	± 50 - 200
gr/minsupply voltage:	1- 12 Volts
current:	± 0,75Amps

Single-point systems





Single-point fuel injection systems use one central placed injector to create the required air/fuel ratio. The injector is mounted in the throttle-body and injects the fuel on top of the throttle. The fuel is delivered by a fuel pump and kept at a constant level by the fuel pressure regulator mounted on the throttle body. The fuel pressure on single-point systems is usually between 0,6 and 1,2 bars.

Multipoint systems

Multipoint fuel injection systems use one injector for each cylinder. The injectors are mounted in the intake manifold. The fuel is injected in the direction of the inlet valves. The fuel is delivered by a fuel pump. The pressure difference between the air pressure in the intake manifold and the fuel pressure is kept at a constant level by the fuel pressure regulator. Therefore the fuel pressure regulator increases the fuel pressure as the intake manifold pressure increases. The fuel pressure on multipoint systems is usually between 2 and 3 bars. The fuel pressure regulator is mounted on the fuel rail.

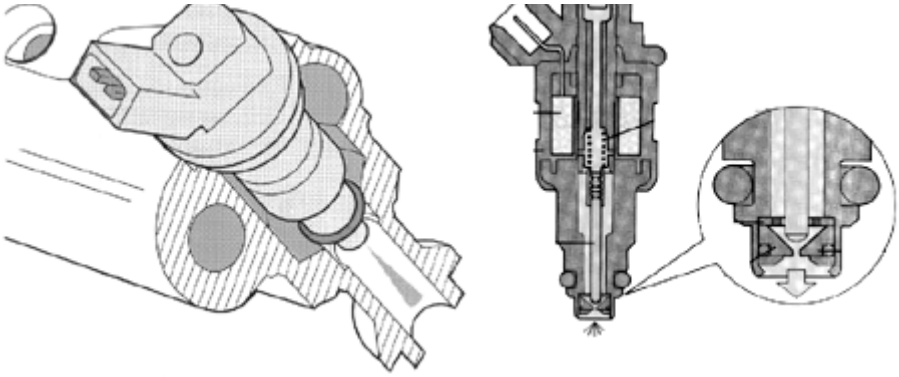
Sequential fuel injection

Sequential fuel injection is a method used by multipoint systems to control the air/fuel ratio and the injection timing per cylinder. Each injector of a sequential injection system is controlled by the control unit individually..

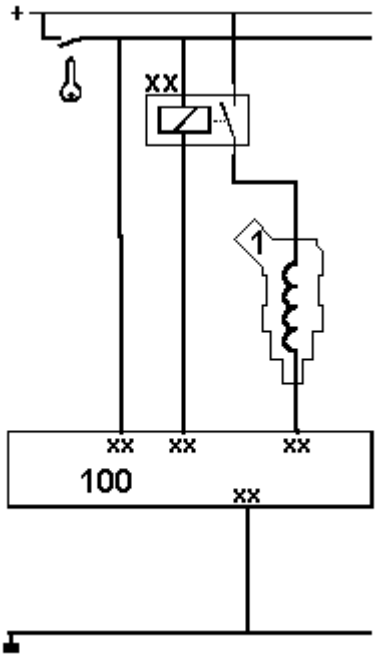
Bottom- and top-feed injectors

The injector fuel inlet can be at the

top or at the bottom. Bottom-feed injectors are often used on singlepoint injection systems while top-feed injectors more often are used as multipoint injectors.



Electrical control

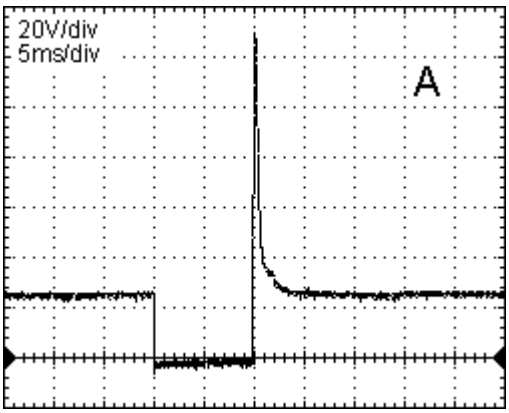


The electrical behaviour of an injector is determined by the coil inside. As a current flows through the coil the injector needle is pulled up against the spring force which courses the fuel to be injected. Two types of injector coils are used. The resistance of a normal coil is approximate 15 ohms. Other injection systems use low resistance coils (approximate 1-2,5 ohms).

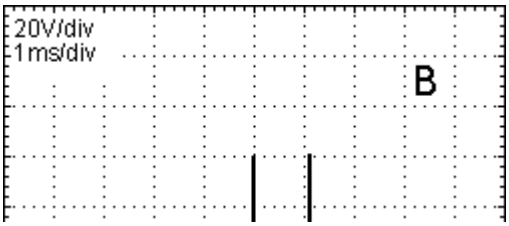
Low impedance injector can be switched on in two different ways:

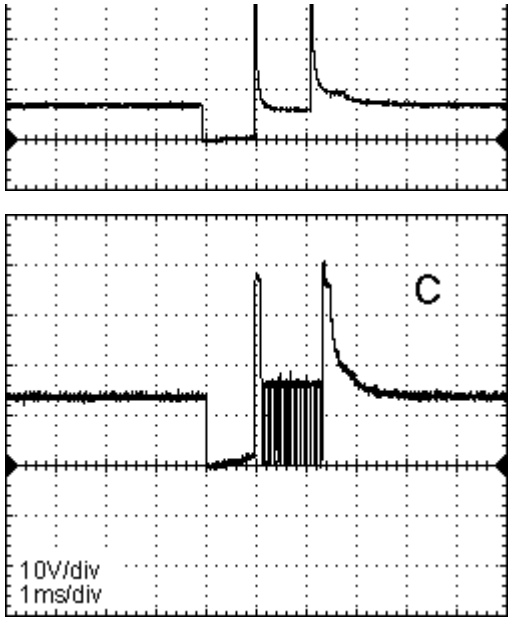
- using an extra external resistance to limit the current
- using a current limiting circuit inside the control unit.

An injector has an electrical connector with two pins. On one of those pins is connected with the battery voltage. This supply-voltage is often switched to the injector using a relay. The other pin leads directly to the control unit. The current through the injector is switched on during the period the control unit connects this pin to ground. The voltage on this pin is during this time 0 Volts. During the period the injector is not switched on, the voltage on the pin is 12 Volts



Oscilloscope image A shows the voltage signal measured on an high impedance injector or low impedance injector with external resistance.





Oscilloscope images B and C show two different current limiting circuits used on low impedance injectors.

Electrical diagnosis

STATIC

- To perform this measurements the relay switching the power to the injector(s) should be closed. Short circuit the switch in the relay if necessary. Perform the tests on one injector at the time. Disconnect parallel switched injectors.

  Measurements

  Measure the voltage on the control unit. Use the pin which switches the injector current.

result: **12 V**

- injector and wiring are electrically OK

0 V

- check the relay switching the power to the injector(s)
- check the wiring between the relay and the injector
- check the injector resistance
- check the wiring between the injector and the control unit
- check the control unit

DYNAMIC

- Connect all injectors. Start the engine and measure using an oscilloscope the voltage on the control unit's pin switching the injector current.

result: **0 V**

- perform static tests.

12 V

- control unit does not switch the injector(s).

Mechanical diagnosis

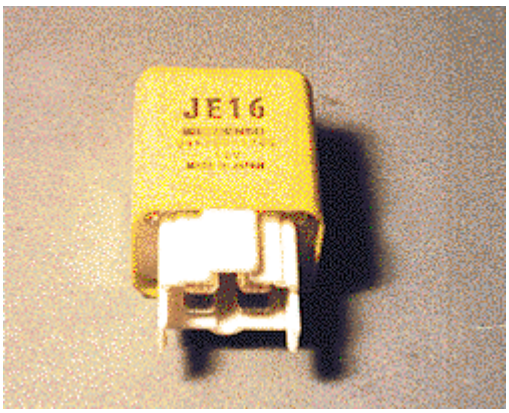
- check fuel system pressure
- check injectors on leakage and pollution
- bottom-feed injectors: check the seal between the injector and the throttle body
- multipoint systems: disconnect the hose between the fuel pressure regulator and the intake manifold. No fuel should leak out of the fuel pressure regulator.

Lubricants and Fluids

MAZDA - 626 - 1.8i 16V - FP

Engine		
Motor oil API SG	Below 0 °C	SAE 5W-30
Motor oil API SG	Above -25 °C	SAE 10W-30
Cooling system		
Coolant	All temperatures	
Manual transmission		
Gear oil API GL-4	All temperatures	SAE 75W-90
Gear oil API GL-5	All temperatures	SAE 75W-90
Gear oil API GL-4	Above 5 °C	SAE 80W-90
Gear oil API GL-5	Above 5 °C	SAE 80W-90
Automatic transmission		
ATF Dexron II	All temperatures	
ATF M-III	All temperatures	
Transfer box		
Gear oil API GL-5	Above -20 °C	SAE 90
Gear oil API GL-5	Below -20 °C	SAE 80W
Differential, rear (4x4)		
Gear oil API GL-5	Above -20 °C	SAE 90
Gear oil API GL-5	Below -20 °C	SAE 80W
Power steering		
ATF Dexron II	All temperatures	
ATF M-III	All temperatures	
Brakes system		
Brake fluid DOT 3	All temperatures	

90. main relay



Function

Switches power to sensors, actuators and / or control unit.

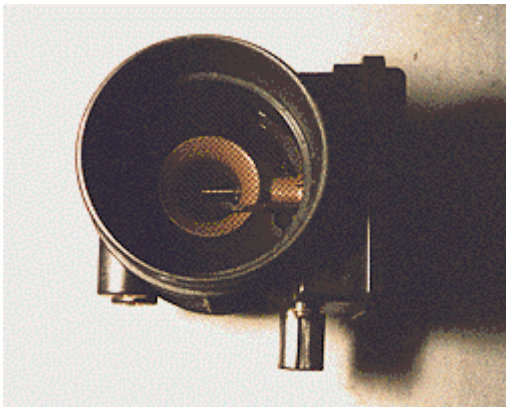
Specifications

single normally opened relay.
colour relay: yellow

Diagnosis

Check connector(s): Inspect the connector(s) and if necessary clean or fix them to make sure the connection is good.
Check relay:
Turn ignition off. Remove relay from relay box.
Connect the input of the coil to battery voltage and the output of the coil to ground. The relay should click. If not replace relay.
Check the switch of the relay. Measure the resistance between the input of the switch and the output(s). When coil connected the resistance should be < 1 ohm. When coil disconnected resistance should be infinite. If not replace relay.
Check supply voltage:
Turn ignition off. Remove relay from relay box.
Turn ignition on. Connect a circuit tester between the input terminal of the coil or between the input terminal of the switch in the relay box and the negative terminal of the battery. The tester should light up. If not check wiring and, if present, fuse(s) and second relay.
Check connection to ECU:
Turn ignition off. Remove relay from relay box and remove connector from ECU.
Measure the resistance between the output terminal(s) of the switch in the relay box and the corresponding terminal(s) in the ECU connector. It should be < 1 ohm. If not check wiring.
Check connection to ground:
Turn ignition off. Remove relay from relay box. Measure the resistance between the output terminal of the coil and the negative battery terminal. It should be < 1 ohm. If not check wiring.

31. mass airflow meter



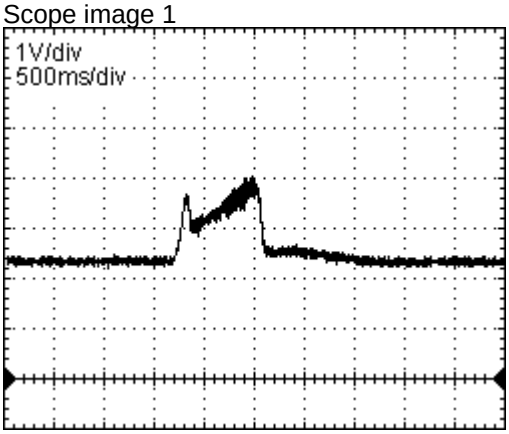
Function

The mass airflow meter uses a wire filament kept at constant temperature to measure the air mass entering the engine inlet system.

Specifications

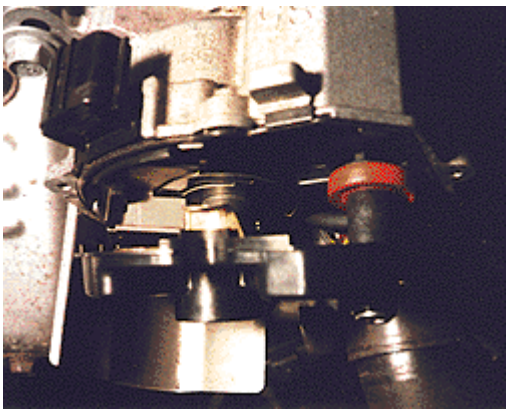
supply voltage: 12 V
output voltage: 0 - 5 V
waveform information: during acceleration

Scope image 1



Pins to ground: 2O

178. opto-coupler



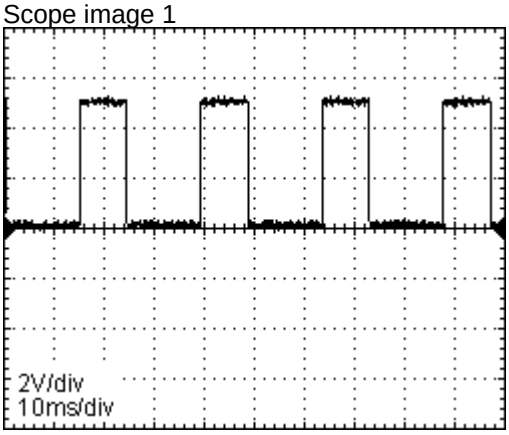
Function

The disc mounted on the rotor passes through the opto-coupler, which sends a signal to the control unit to determine TDC.

Specifications

supply voltage: 12 V
waveform information: engine running at idle

Scope image 1



Pins to ground: 2E

Overhaul data - Cylinder block

MAZDA - FP

General cylinder block data			
Cylinder block height			
New	261.5	mm	
Cylinder bore			
Bore			
Standard	83.000 - 83.019	mm	
1st Oversize	83.250 - 83.269	mm	
2nd Oversize	83.500 - 83.519	mm	
Cylinder bore ovality			
Standard	< 0.010	mm	
Limit	0.010	mm	
Taper			
Standard	< 0.010	mm	
Limit	0.010	mm	
Pistons			
Piston diameter			
Standard	82.954 - 82.974	mm	
1st Oversize	83.204 - 83.224	mm	
2nd Oversize	83.454 - 83.474	mm	
Measuring point		mm	**radial to piston pin hole** **16.5 mm from bottom**
Piston pin bore diameter	18.988 - 19.000	mm	
Piston rings			
1st Compression ring gap	0.15 - 0.30	mm	
2nd Compression ring gap	0.15 - 0.30	mm	
Oil-scraper ring gap	0.20 - 0.70	mm	
Side clearance 1st compression ring	0.035 - 0.065	mm	
Side clearance 2nd compression ring	0.030 - 0.065	mm	
Connecting rod			
Center distance of big and small end bore	129.15 - 129.25	mm	
Big end bore	51.000 - 51.015	mm	
Big end bearing radial clearance	0.024 - 0.061	mm	
Limit	0.067	mm	
Big end, end play	0.110 - 0.262	mm	
Limit	0.30	mm	
Small end bore	18.943 - 19.961	mm	

✸ Data from secondary source; No manufacturer's information

Overhaul data - Cylinder block

MAZDA - FP

Radial play piston pin	0.008 - 0.026	mm	
Radial play in small end	0.013 - 0.037	mm	**press fit**
Crankshaft			
Max. crankshaft swing	< 0.03	mm	
Limit	0.03	mm	
Grinding allowed			**yes**
Number of bearings	5		
Main journal diameter, standard	55.937 - 55.955	mm	
Main journal diameter, 1st Undersize	55.687 - 55.705	mm	
Max. main journal ovality	< 0.003	mm	
Limit	0.003	mm	
Main bearing clearance			
1st Main bearing	0.024 - 0.050	mm	
2nd Main bearing	0.024 - 0.050	mm	
3rd Main bearing	0.030	mm	
4th Main bearing	0.024 - 0.050	mm	
5th Main bearing	0.024 - 0.050	mm	
Limit	0.67	mm	
Crankshaft end play	0.080 - 0.282	mm	
Limit	0.30	mm	
Crank-pin diameter			
Standard	47.940 - 47.955	mm	
Limit	47.935	mm	
1st Undersize	47.690 - 47.705	mm	
Limit	47.685	mm	
2nd Undersize	47.440 - 47.455	mm	
Limit	47.435	mm	
Max. pin journal ovality	< 0.003	mm	
Limit	0.003	mm	
Max. pin journal taper	< 0.006	mm	
Limit	0.006	mm	
Big-end bearing radial clearance	0.024 - 0.061	mm	
Limit	0.067	mm	
Bearing shells			
Main bearing shells			
Fitting position			**oil grooves facing crankshaft**

✸ Data from secondary source; No manufacturer's information

Overhaul data - Cylinder block

MAZDA - FP

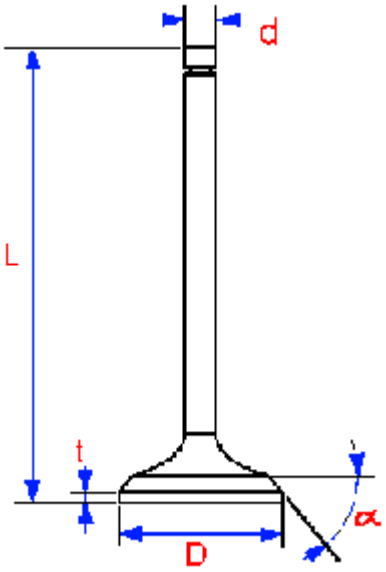
Fitting position			**bearing shell with oil groove in cylinder block**
Thickness crankshaft thrust halfring			
Fitting position			**oil groove facing crankshaft**
Standard	2.500 - 2.550	mm	
1st Oversize	2.625 - 2.675	mm	
2nd Oversize	2.750 - 2.800	mm	
3rd Oversize	2.875 - 2.925	mm	
Oil pump			
Type			**eccentric gearwheel**
Clearance inside rotor - outside rotor	0.02 - 0.18	mm	
Limit	0.200	mm	
Clearance outside rotor - pump housing	0.113 - 0.186	mm	
Limit	0.210	mm	

✸ Data from secondary source; No manufacturer's information

Overhaul data - Cylinder head

MAZDA - FP

General cylinder head data		
Number of cylinder heads	1	
Cylinder head height		
New	124.45 - 124.55	mm
Warpage cylinder head fitting face		
Standard	< 0.10	mm
Limit	0.10	mm
Max. grinding allowance	< 0.15	mm
Valves		



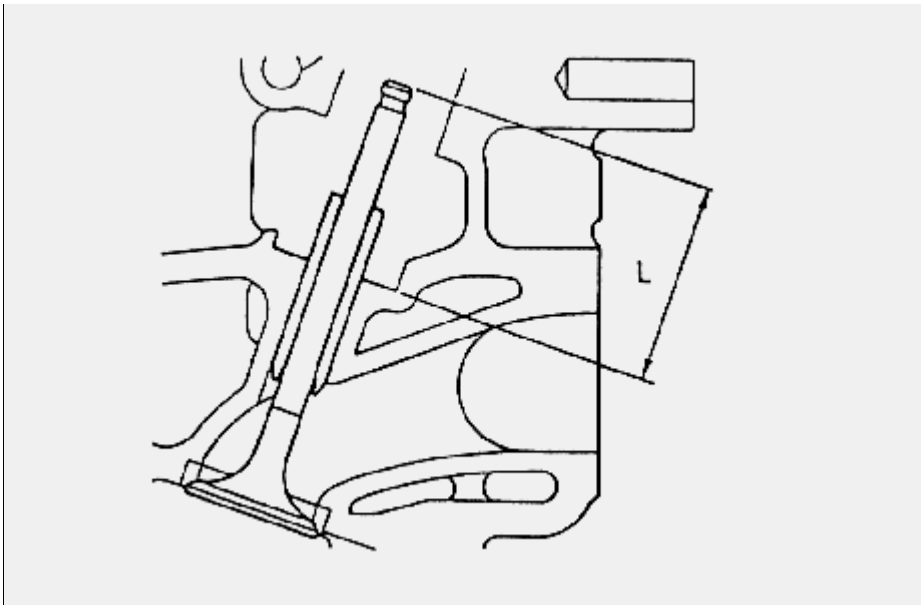
Valve dish diameter (D)		
Intake	31.4 - 31.6	mm
Outlet	27.5 - 27.7	mm
Valve length (L)		
Intake new	89.68	mm
Limit	89.28	mm
Outlet new	89.78	mm
Limit	89.38	mm
Valve stem diameter (d) intake		
Standard	5.970 - 5.985	mm
Limit	5.940	mm
Valve stem diameter (d) outlet		
Standard	5.965 - 5.980	mm
Limit	5.935	mm
Valve seat angle		

✸ Data from secondary source; No manufacturer's information

Overhaul data - Cylinder head

MAZDA - FP

Intake	45	°
Outlet	45	°
Valve dish thickness (t)		
Intake	> 1.10	mm
Outlet	> 1.20	mm
Valve build-in height		



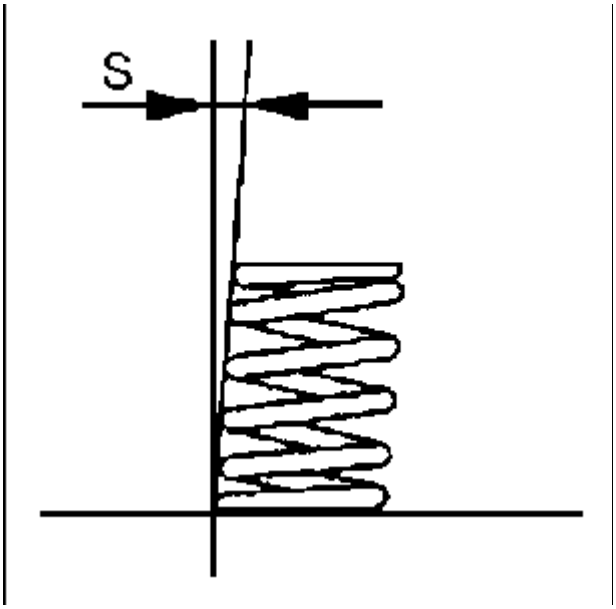
Intake	L = 39.0	mm
Limit	L < 40.6	mm
Outlet	L = 39.0	mm
Limit	L < 40.6	mm
Valve springs		
Fitting position		**fine windings down**
Length unladen		
Intake	44.0	mm
Outlet	44.0	mm
Intake	177.1-200.3 N: 36.5	mm
Outlet	177.1-200.3 N: 36.5	mm

✸ Data from secondary source; No manufacturer's information

Overhaul data - Cylinder head

MAZDA - FP

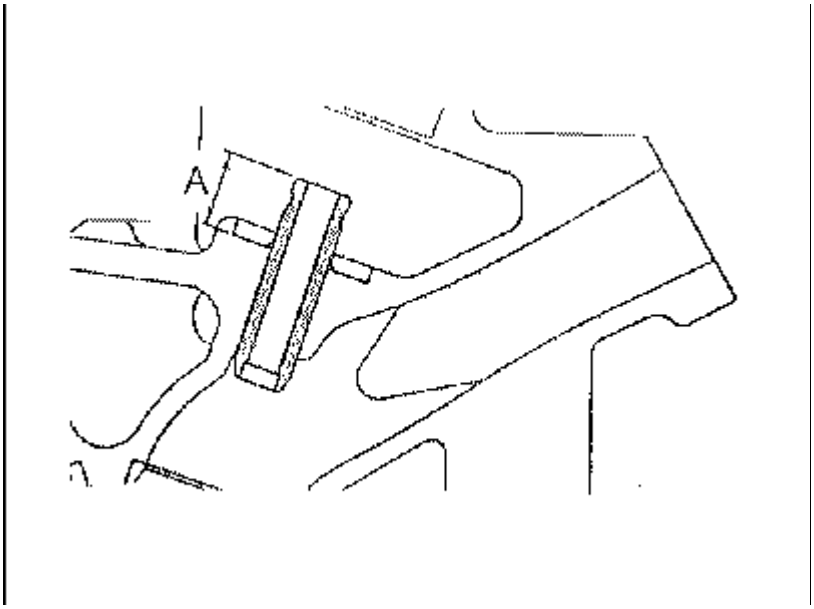
Inclination(s)



Intake	< 1.54	mm
Outlet	< 1.54	mm

Valve guides

Fitting height



Intake	A = 13.5 - 14.1	mm
Outlet	A = 13.5 - 14.1	mm

Inner diameter, standard

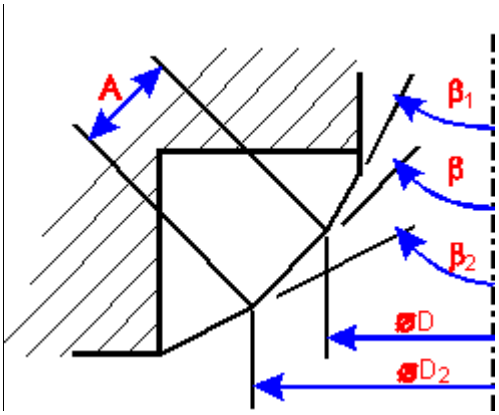
Intake	6.01 - 6.03	mm
Outlet	6.01 - 6.03	mm

Clearance between valve stem and guide

✸ Data from secondary source; No manufacturer's information

Intake	0.025 - 0.060	mm
Limit	0.20	mm
Outlet	0.030 - 0.065	mm
Limit	0.20	mm

Valve seats



Seating angle (Я)		
Intake	45	°
Outlet	45	°
Correction angle (Я1)		
Intake	65	°
Outlet	75	°
Correction angle (Я2)		
Intake	35	°
Outlet	35	°
Seating size (A)		
Intake	0.9 - 1.3	mm
Outlet	0.9 - 1.3	mm
Valve lifter		
Type		**hydraulic**
Valve lifter diameter		
Standard	29.959 - 29.975	mm
Valve lifter bore diameter		
Standard	30.000 - 30.025	mm
Valve lifter radial play	0.025 - 0.066	mm
Limit	0.180	mm
Camshaft		
Camshaft journal diameter, standard	25.940 - 25.965	mm
Camshaft bearing radial clearance	0.035 - 0.081	mm

✸ Data from secondary source; No manufacturer's information

Overhaul data - Cylinder head

MAZDA - FP

Limit	0.15	mm
Camshaft end play	0.08 - 0.20	mm
Limit	0.21	mm
Max. camshaft swing	< 0.03	mm
Limit	0.03	mm
Total camheight		
Intake new	42.323	mm
Intake min.	42.173	mm
Outlet new	43.338	mm
Outlet min.	43.188	mm

✸ Data from secondary source; No manufacturer's information

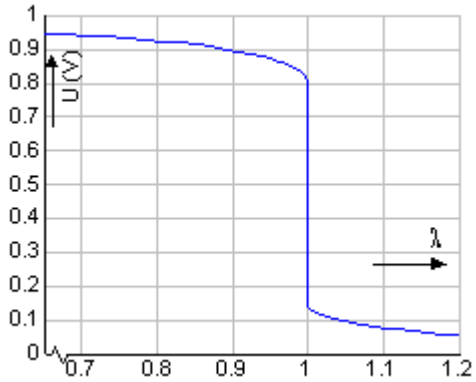
37. oxygen sensor

Function

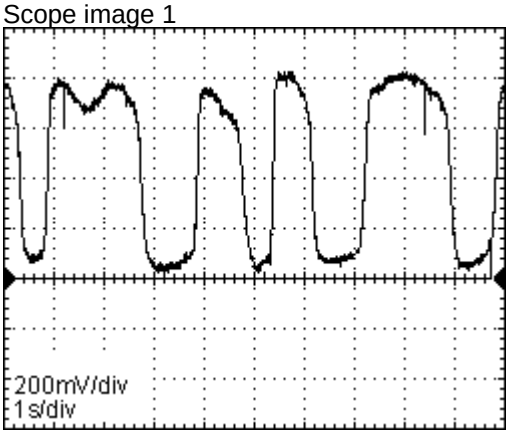
The oxygen sensor is exposed to exhaust gas flow and returns an output signal proportional to the oxygen content of the exhaust gases. A heating element maintains the sensor at constant operating temperature.

Specifications

supply voltage heating element: 12 V
resistance heating element: 4 - 40 ohms (20°C)
output voltage: 200 - 850 mV
waveform information: hot engine running at idle

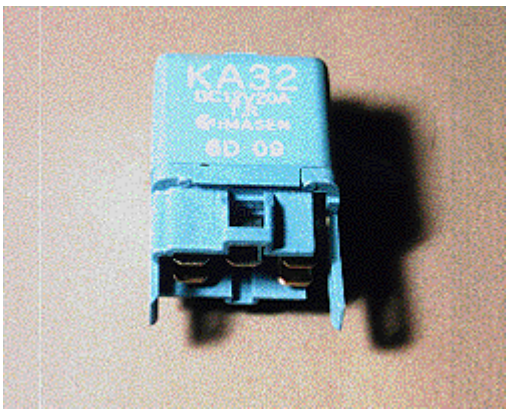


Scope image 1



Pins to ground: 2N

92. relay



Function

A relay is an electrically operated power supply switch, switching supply voltage to the component(s) of the engine management system.

Specifications

single normally opened relay.

Diagnosis

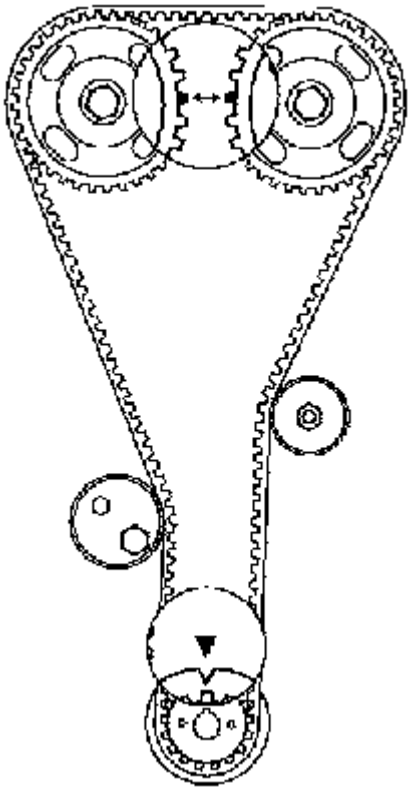
Check connector(s): Inspect the connector(s) and if necessary clean or fix them to make sure the connection is good.
Check relay:
Turn ignition off. Remove relay from relay box.
Connect the input of the coil to battery voltage and the output of the coil to ground. The relay should click. If not replace relay.
Check the switch of the relay. Measure the resistance between the input of the switch and the output. When switch is closed the resistance should be < 1 ohm. When switch is open, the resistance should be infinite. If not replace relay.
Check supply voltage:
Turn ignition off. Remove relay from relay box.
Turn ignition on. Connect a circuit tester between the input terminal of the coil or the input terminal of the switch in the relay box and the negative terminal of the battery. Both times the tester should light up. If not check wiring and if present fuse(s), second relay and inertia switch.
Check connection to ECU:
Turn ignition off. Remove relay from relay box and remove connector from ECU.
Measure the resistance between the output terminal of the coil in the relay box and the corresponding terminal in the ECU connector. It should be < 1 ohm. If not check wiring.
Check signal from ECU:
Measure voltage between the output terminal of the coil and the positive terminal of the battery. Crank the engine. It should equal battery voltage. If not check ECU.

Timing

MAZDA - 626 - 1.8i 16V - FP

General

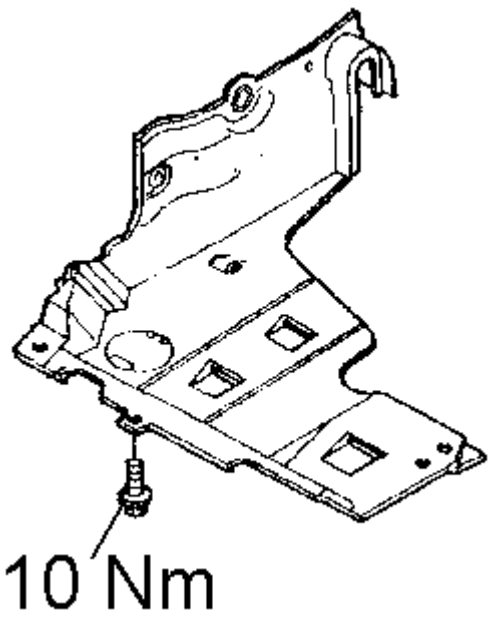
Item	Note
Always check the timing marks before timing belt removal	



Before disconnecting the battery cable, check the audio system security code

Removal

Item	Note
Disconnect the battery	
Remove the right front wheel	
Remove the engine lower cover	



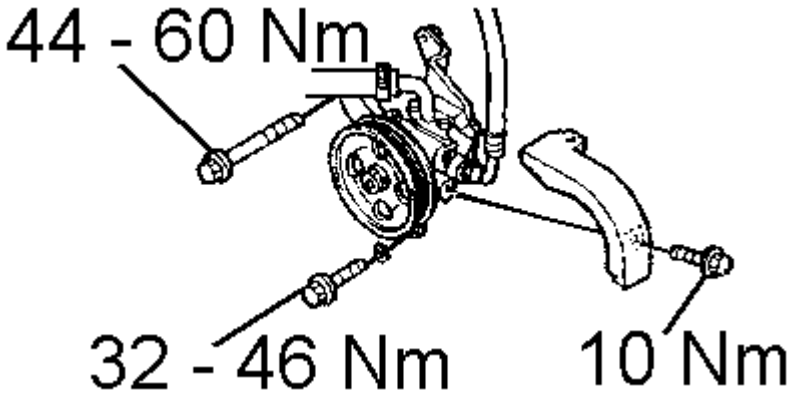
Remove the camshaft position sensor(s)

Remove the crankshaft position sensor

Remove the spark plugs

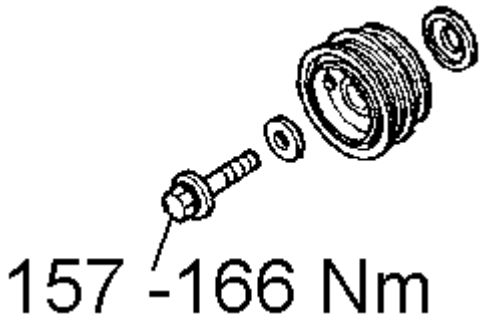
Remove the ancillary drive belt

Remove the power steering pump

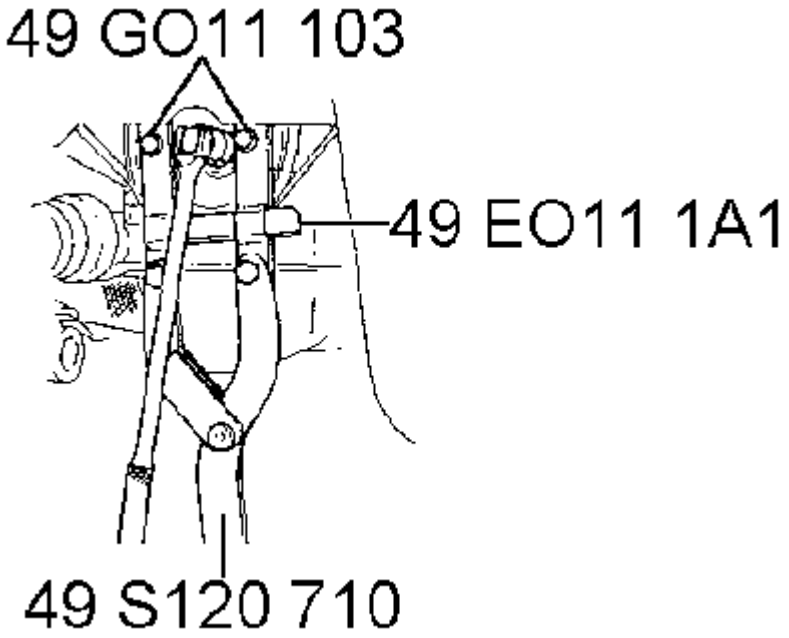


Remove the water pump pulley

Remove the crankshaft pulley

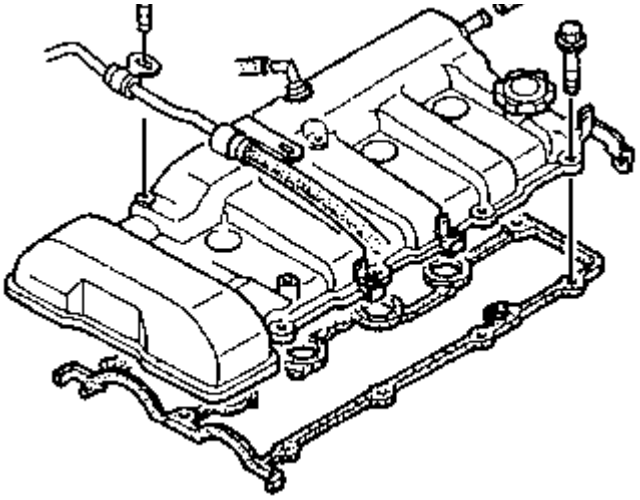


Use the special tools 49 GO11 103 / 49 EO11 1A1 / 49 S120 710

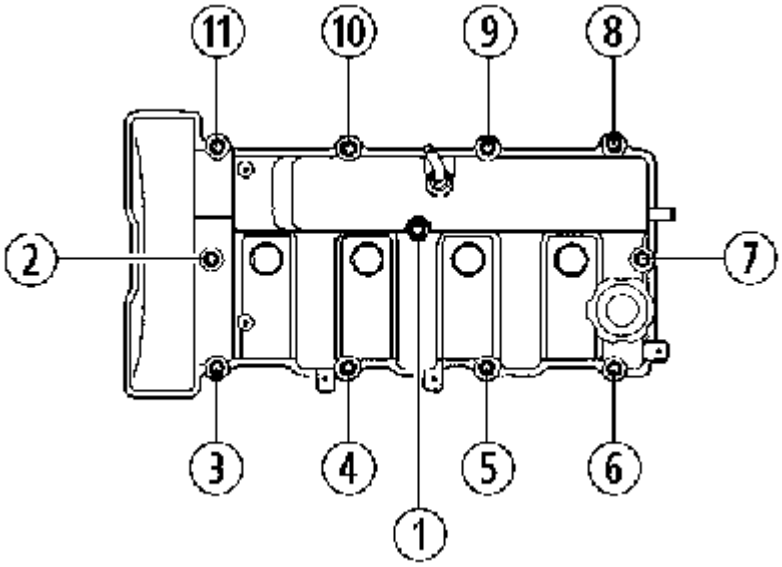


Remove the guide plates

Remove the camshaft cover

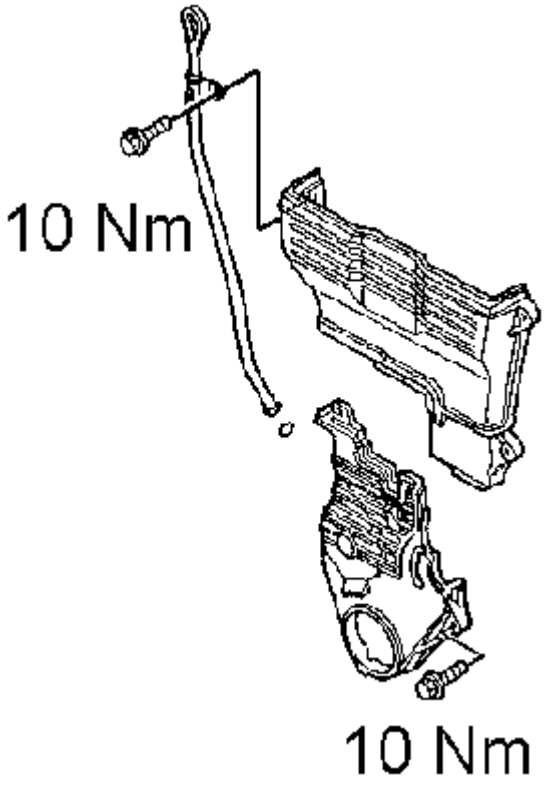


In the order shown

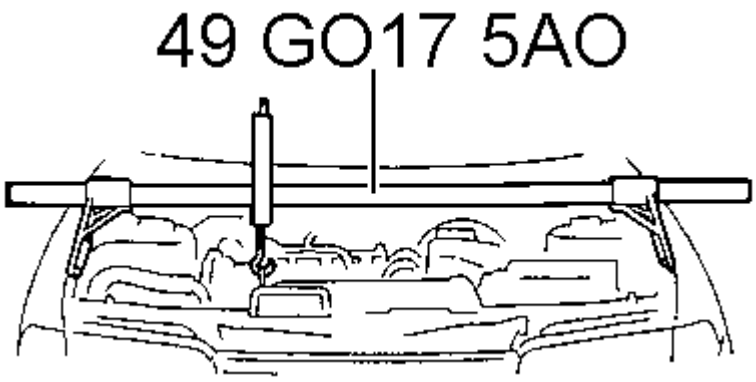


Remove the dipstick tube

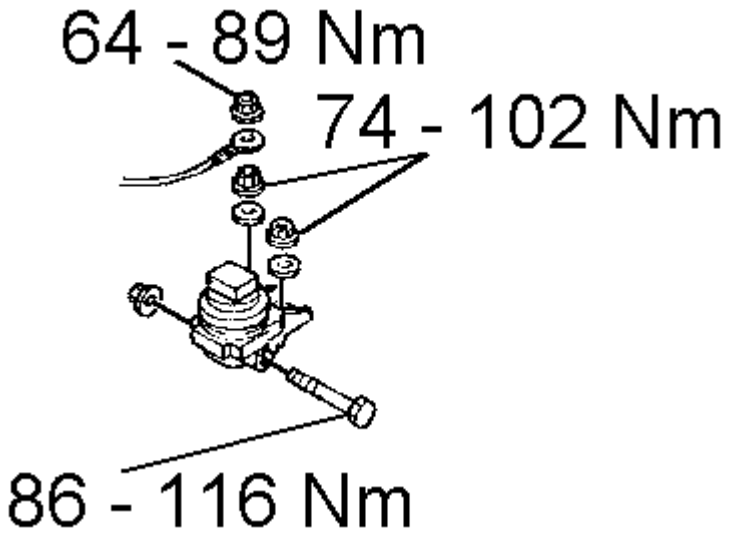
Remove both timing-belt covers



Use a hoist to support the engine 49 GO17 5AO



Remove the engine mount



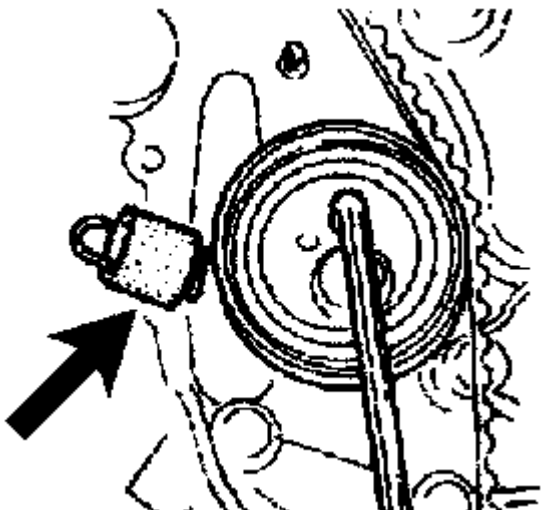
Remove the tensioner

Remove the timing belt

Check the tensioner and idler pulleys, renew if necessary

Installation

Item	**Note**
Check the timing marks	
Refit the tensioner	
Turn the tensioner clockwise	



Tighten the tensioner

Fit the timing belt

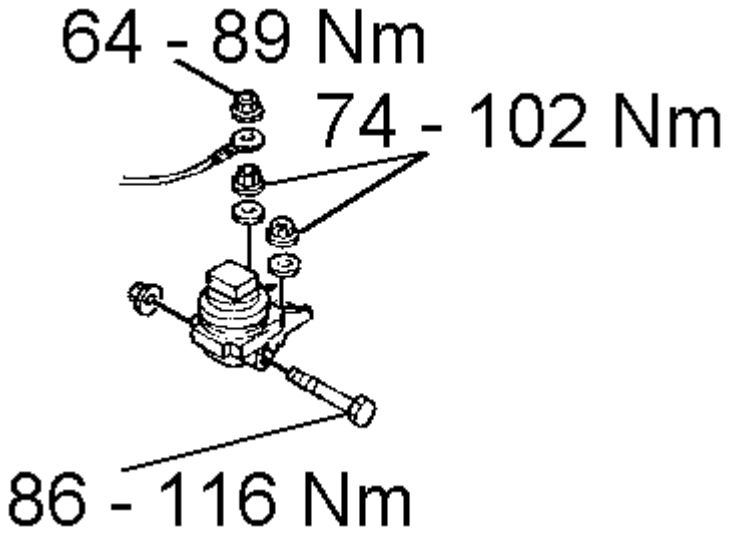
Loosen the tensioner

Tighten the tensioner

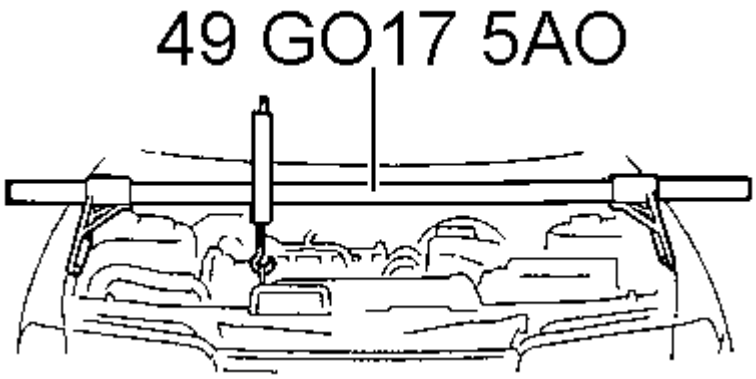
Turn the engine 2 rotations by hand

Check the timing marks again

Refit the engine mount

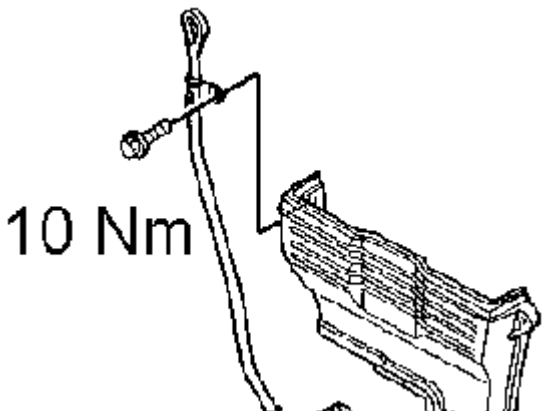


Remove the hoist

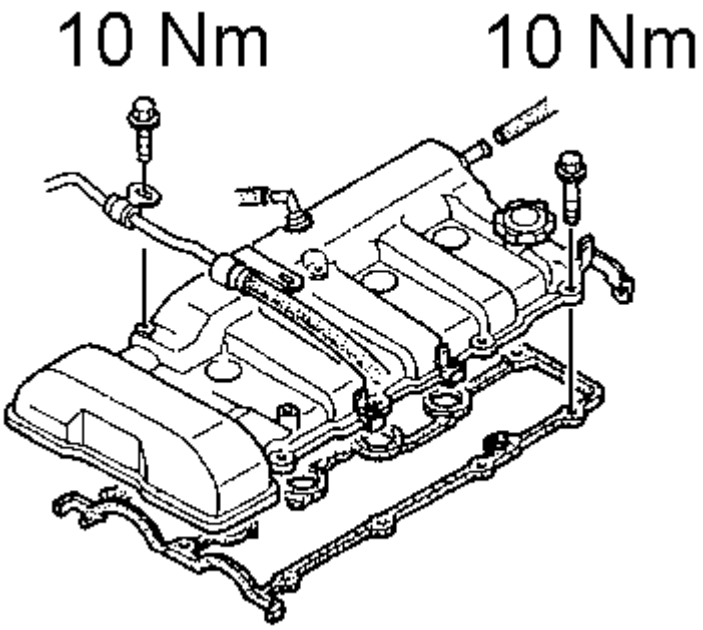


Refit the timing belt covers

Refit the dipstick tube

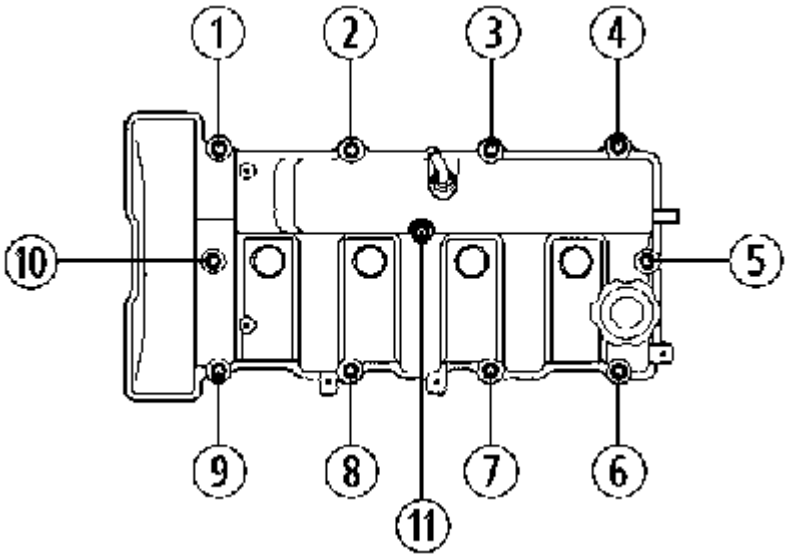


Refit the camshaft cover 10 Nm



Always use new gaskets

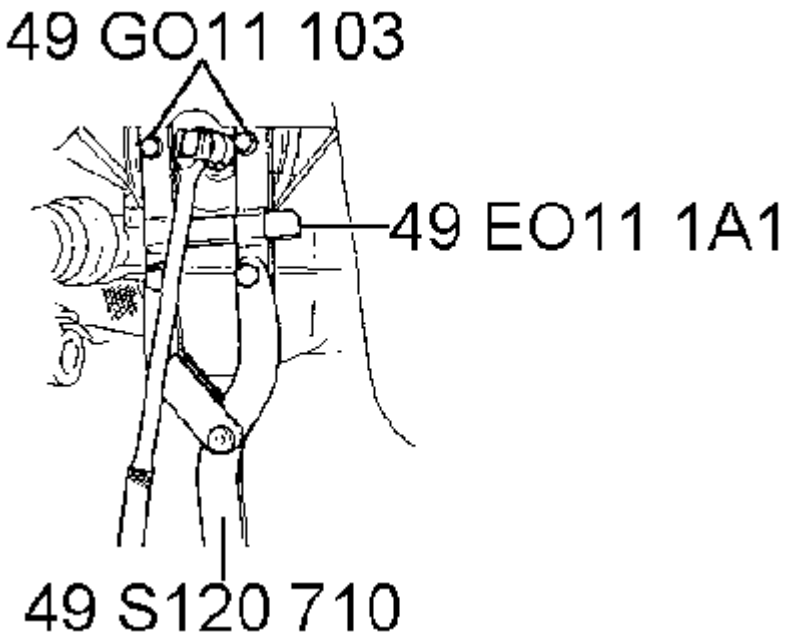
In the order shown



Refit the timing belt guide plates

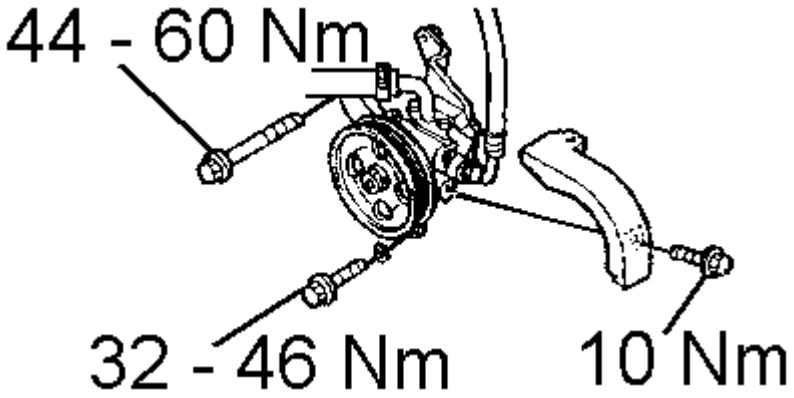
Refit the crankshaft pulley 157 - 166 Nm

Use the special tools 49 GO11 103 / 49 EO11 1A1 / 49 S120 710



Refit the water pump pulley 10 Nm

Refit the power steering pump



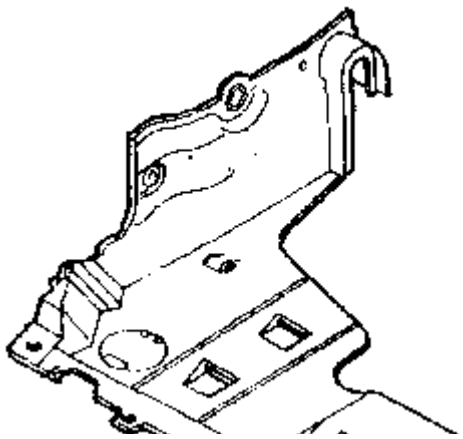
Fit the ancillary drive belt

Refit the spark plugs

Fit the crankshaft sensor

Fit the camshaft sensor

Refit the engine lower covers



Refit the right front wheel

Reconnect the battery earth cable

Check ignition timing

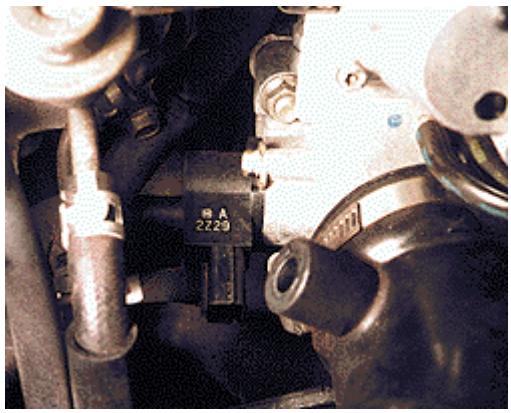
Torque settings

Item	Note
Crankshaft pulley:	157 - 166 Nm
Camshaft cover:	10 Nm
Tensioner:	38 - 51 Nm
Idler pulley:	38 - 51 Nm
Water pump pulley:	10 Nm

Special tools

Item	Note
Engine hoist:	49 GO17 5AO
Crankshaft pulley:	49 GO11 103 / 49 EO11 1A1 / 49 S120 710

33. throttle position sensor

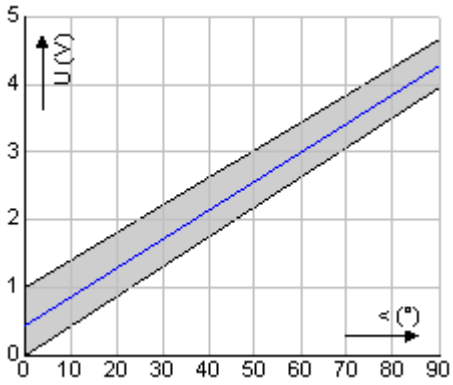


Function

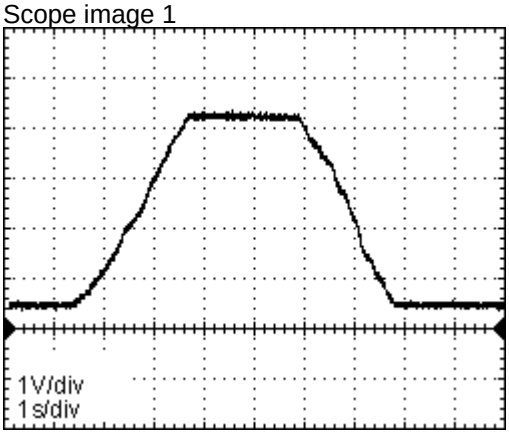
The throttle position sensor measures the angle of the throttle shaft using a potentiometer. The sensor returns a signal proportional to the throttle shaft angle.

Specifications

supply voltage: 5 V
output voltage: 0 - 5 V
waveform information: output signal while opening throttle.



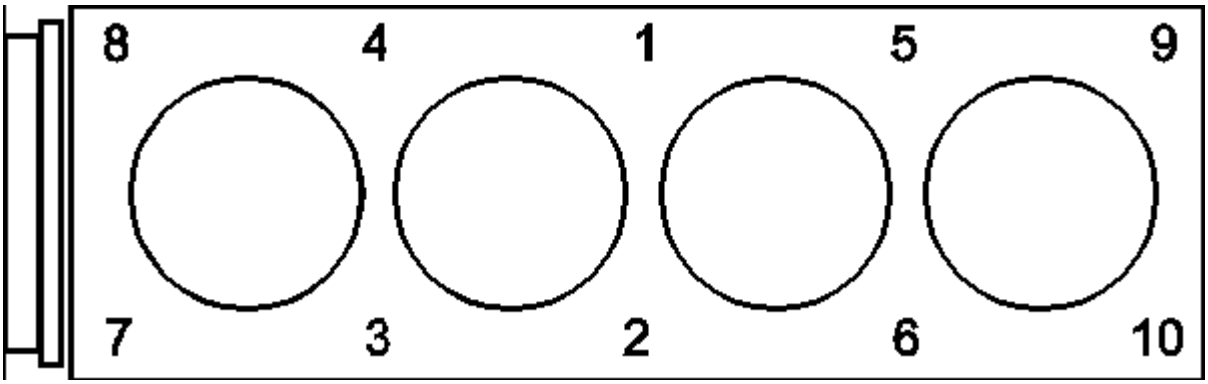
Scope image 1



Pins to ground: 2M

Torque settings

MAZDA - FP

Cylinder-head bolts		
		
Stage 1	17.2 - 22	Nm
Stage 2	90 ± 5	°
Stage 3	90 ± 5	°
Max. bolt length	105.5	mm
Main bearing cap		
Stage 1	17.2 - 22	Nm
Stage 2	90 ± 5	°
Max. bolt length	46.7 - 47.3; < 48.0	mm
Connecting-rod bearing cap		
Stage 1	22.1 - 26.9	Nm
Stage 2	90 ± 5	°
Max. bolt length	67.7 - 68.3; < 69.0	mm
Camshaft-bearing cap	11.3 - 14.2	Nm
Camshaft sprocket	50 - 60	Nm
Crankshaft sprocket	157 - 166	Nm
Flywheel	97 - 102	Nm
Drive plate	97 - 102	Nm
Oil pump	19 - 25	Nm
Oil-sump	19 - 25	Nm
Spark plug	15 - 22 *	Nm

* Data from secondary source; No manufacturer's information

Adjustment Data

MAZDA - 626 - 2.0 Comprex D - RF-CX

Engine (general)

Item	Values	Units
Engine code	RF	
Capacity	1998	(cc)
Idle speed	725 ± 25	(rpm)
Valve clearance		
Valve clearance		
Cold		
Inlet	0.25	(mm)
Exhaust	0.35	(mm)
Compression pressure		
Normal	29	(bar)
Minimum	27	(bar)
Oil pressure	1.5/1000	(bar / rpm)
Injection pump (make & type)	ZEXEL / Kiki VE	
Injector firing order	1-3-4-2	
Injection-pump timing (static)	1.00	(mm)
Injector pressure	135	(bar)
Minimum	113	(bar)
Exhaust-gas analysis (opacity)	66	(%)
Oil temperature during test	60	(°C)
Idle speed, minimum	700	(rpm)
Idle speed, maximum	750	(rpm)
Min. empty running governed speed	5000	(rpm)
Max. empty running governed speed	5200	(rpm)
Exhaust-gas analysis	< 2.5	m-1

Cooling system

Item	Values	Units
Cap pressure	0.95 - 1.25	(bar)
Thermostat opens at	83 - 86	(°C)

Electrical

Item	Values	Units
Battery	70	(Ah)
Alternator	75	(A)

Brakes

Item	Values	Units
Disc thickness, front, min.	22.0	(mm)
Disc thickness, rear, min.	8.0	(mm)

Steering and wheel alignment

Item	Values	Units
Toe-in, front	17' ± 17'	(°)
Camber, front	-36' ± 45'	(°)
Castor, front	2° 37' ± 45'	(°)
K.P.I., front	15° 04'	(°)
Toe-in, rear	17' ± 17'	(°)
Camber, rear	-07' ± 45'	(°)

Wheels and tyres

Item	Values	Units
Tyre size	195/65R14	
Front tyre pressure	2.2	(bar)
Rear tyre pressure	1.8	(bar)

Capacities

Item	Values	Units
Engine sump, incl. filter	5.5	(l)
Manual transmission		
Gearbox refill	2.7	(l)
Automatic transmission		
Gearbox refill	6.5	(l)
Cooling system	9.5	(l)
Air-conditioner refrigerant	700	(g)
Air-conditioner compressor oil	175	(ml)

Torque settings

Item	Values	Units
Cylinder head		
Stage 1	30	(Nm)
Stage 2	90°	(°)
Stage 3	90°	(°)
Front hub	235 - 319	(Nm)
Rear hub	98 - 177	(Nm)
Wheel nuts	88 - 118	(Nm)
Injector nozzle	59 - 68	(Nm)
Glow plugs	15 - 19	(Nm)

Environmental Data

MAZDA - 626 - 2.0 Comprex D - RF-CX

Item	Values	Units
Engine code	RF	
Idle speed	725 ± 25	(rpm)
Injection pump (make & type)	ZEXEL / Kiki VE	
Injector firing order	1-3-4-2	
Injection-pump timing (static)	1.00	(mm)
Injector pressure	135	(bar)
Minimum	113	(bar)
Exhaust-gas analysis (opacity)	66	(%)
Oil temperature during test	60	(°C)
Idle speed, minimum	700	(rpm)
Idle speed, maximum	750	(rpm)
Min. empty running governed speed	5000	(rpm)
Max. empty running governed speed	5200	(rpm)
Exhaust-gas analysis	< 2.5	m-1

Engine code RF-CX

MAZDA - RF-CX

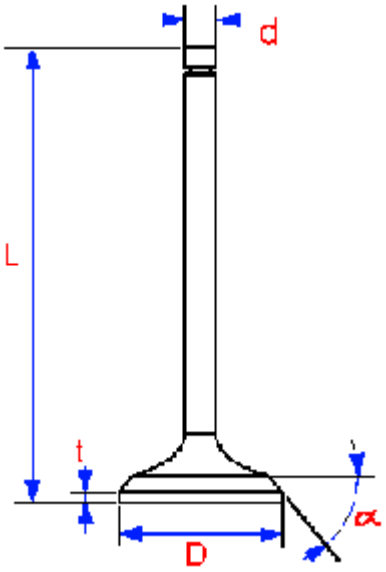
Charger			
Type			**Comprex**
Compression			
Compression ratio	21.1	: 1	
Compression pressure	30	bar	
Limit	27	bar	
Idle speed	700 - 750	/ min	
Oil pressure			
At idle speed	1.5 (1000)	bar (/ min)	
At rated power	3.4 (3000)	bar (/ min)	
Thermostat opening temperature	83.5 - 86.5	°C	**main**
	78.5 - 81.5	°C	**auxiliary**
Valve timing			
Intake opens	13	°	**before TDC**
Intake closes	15	°	**after BDC**
Outlet opens	60	°	**before TDC**
Outlet closes	8	°	**after BDC**
Valve clearance			
Condition			**hot / cold**
Intake	0.30 / 0.25	mm	
Outlet	0.40 / 0.35	mm	
Injection order	1-3-4-2		
Injection timing	1	°	**after TDC**
Injector nozzle pressure			
New	135	bar	
Min.	113	bar	

✸ Data from secondary source; No manufacturer's information

Overhaul data - Cylinder head

MAZDA - RF-CX

General cylinder head data			
Number of cylinder heads	1		
Warpage cylinder head fitting face			
Standard	< 0.10	mm	
Limit	0.10	mm	
Max. grinding allowance		mm	**grinding not allowed**
Pre-combustion chamber			
Pre-combustion chamber protrusion	-0.020 ... +0.005	mm	
Valves			



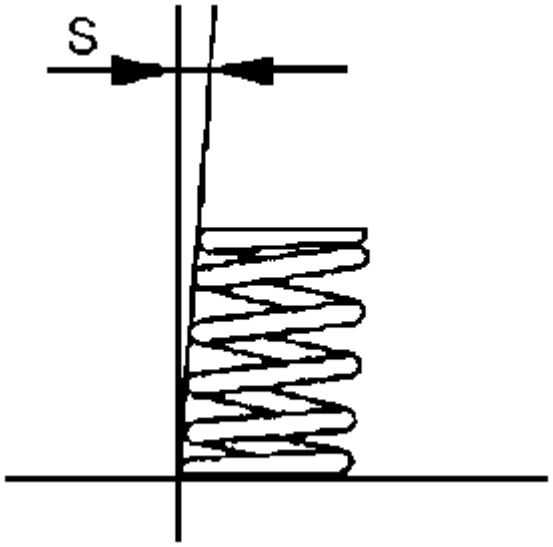
Valve protrusion (+/-)	-0.75 - 1.05	mm	
Limit	-1.55	mm	
Valve length (L)			
Intake new	106.9	mm	
Limit	106.4	mm	
Outlet new	106.8	mm	
Limit	106.3	mm	
Valve stem diameter (d) intake			
Standard	7.970 - 7.985	mm	
Limit	7.920	mm	
Valve stem diameter (d) outlet			
Standard	7.965 - 7.980	mm	
Limit	7.915	mm	
Valve seat angle			
Intake	30	°	

✸ Data from secondary source; No manufacturer's information

Overhaul data - Cylinder head

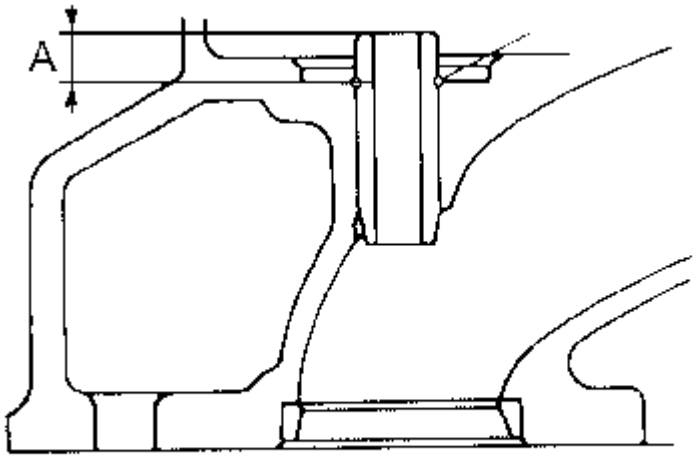
MAZDA - RF-CX

Outlet	45	°
Valve dish thickness (t)		
Intake	> 1.80	mm
Outlet	> 1.65	mm
Valve springs		
Length unladen	45.11	mm
Limit	44.80	mm
Inclination(s)	< 1.6	mm



Valve guides

Fitting height



Intake	A = 8.3 - 8.8	mm

✸ Data from secondary source; No manufacturer's information

Overhaul data - Cylinder head

MAZDA - RF-CX

Outlet	A = 8.3 - 8.8	mm
Length		
Intake	40.5	mm
Outlet	37.6	mm
Inner diameter, standard		
Intake	8.030 - 8.050	mm
Outlet	8.030 - 8.050	mm
Valve seats		
Seating angle (Я)		
Intake	30	°
Outlet	45	°
Seating size (A)		
Intake	1.4 - 1.8	mm
Outlet	1.64 - 2.04	mm
Valve lifter		
Valve lifter diameter		
Standard	34.949 - 35.010	mm
Valve lifter radial play	0.025 - 0.061	mm
Limit	0.10	mm
Camshaft		
Camshaft journal diameter, standard	31.959 - 31.975	mm
Camshaft bearing radial clearance	0.025 - 0.066	mm
Limit	0.10	mm
Camshaft end play	0.02 - 0.15	mm
Limit	0.20	mm
Max. camshaft swing	< 0.10	mm
Total camheight		
Intake new	42.521	mm
Intake min.	42.110	mm
Outlet new	45.300	mm
Outlet min.	44.900	mm

✸ Data from secondary source; No manufacturer's information

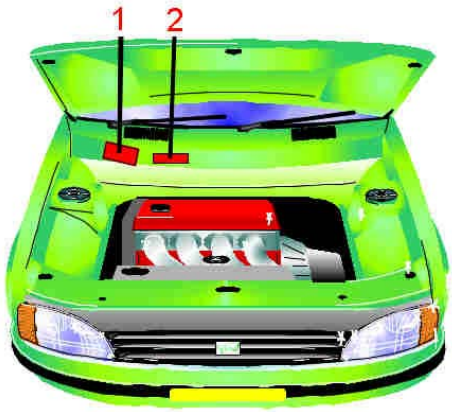
ID Location

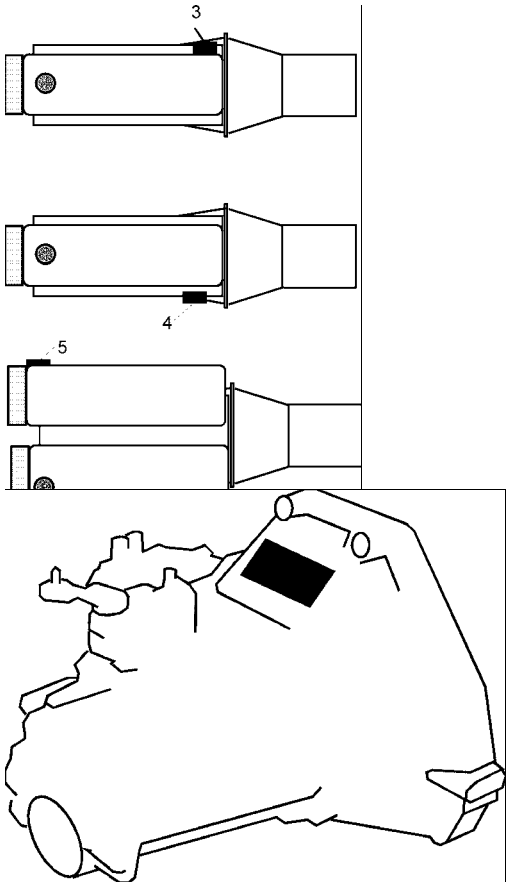
MAZDA - 626 - 2.0 Comprex D - RF-CX

1 Identification plate
2 VIN

3 Engine code B3 / B5 / B6 / PN
4 Engine code BP / FP / FS
5 Engine code 6-cylinder

6 Manual transmission code





Lubricants and Fluids

MAZDA - 626 - 2.0 Comprex D - RF-CX

Engine		
Motor oil API CD	Below -20 °C	SAE 5W-30
Motor oil API CD	From -25 °C to 30 °C	SAE 10W-30
Motor oil API CD	From -15 °C to 35 °C	SAE 15W-40
Motor oil API CD	From 0 °C to 40 °C	SAE 30
Motor oil API CD	Above 40 °C	SAE 40
Cooling system		
Coolant	All temperatures	
Manual transmission		
Gear oil API GL-4	All temperatures	SAE 75W-90
Gear oil API GL-5	All temperatures	SAE 75W-90
Power steering		
ATF Dexron II	All temperatures	
ATF M-III	All temperatures	
Brakes system		
Brake fluid DOT 3	All temperatures	
Air conditioning		
Refrigerant R134a		
Compressor oil PAG, ISO 46		

Capacities

MAZDA - 626 - 2.0 Comprex D - RF-CX

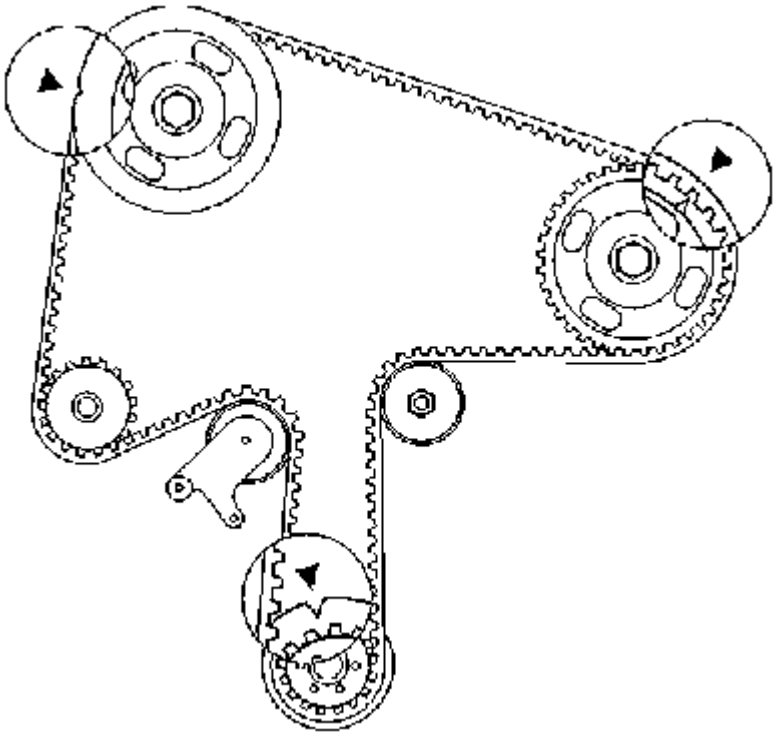
Item	Values	Units
Engine sump, incl. filter	5.5	(l)
Manual transmission		
Gearbox refill	2.7	(l)
Automatic transmission		
Gearbox refill	6.5	(l)
Cooling system	9.5	(l)
Air-conditioner refrigerant	700	(g)
Air-conditioner compressor oil	175	(ml)

Timing

MAZDA - 626 - 2.0 Comprex D - RF-CX

General

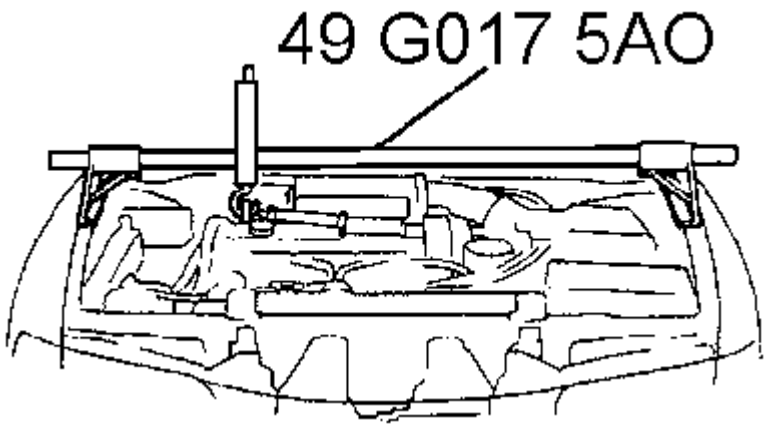
Item	Note
Always check the timing marks before timing belt removal	



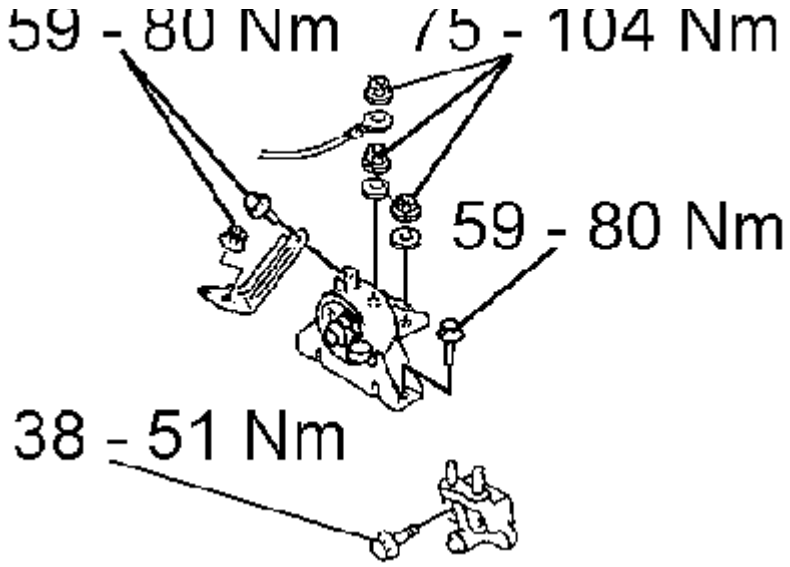
Item	Note
Before disconnecting the battery cable, check the audio system security code	

Removal

Item	Note
Disconnect the battery	
Drain the coolant	
Remove the cylinder-head cover	
Remove the upper timing cover	
Remove the ancillary drive belt	
Fit the special tool to support the engine	49 G017 5A0



Item	Note
Remove the engine mount	

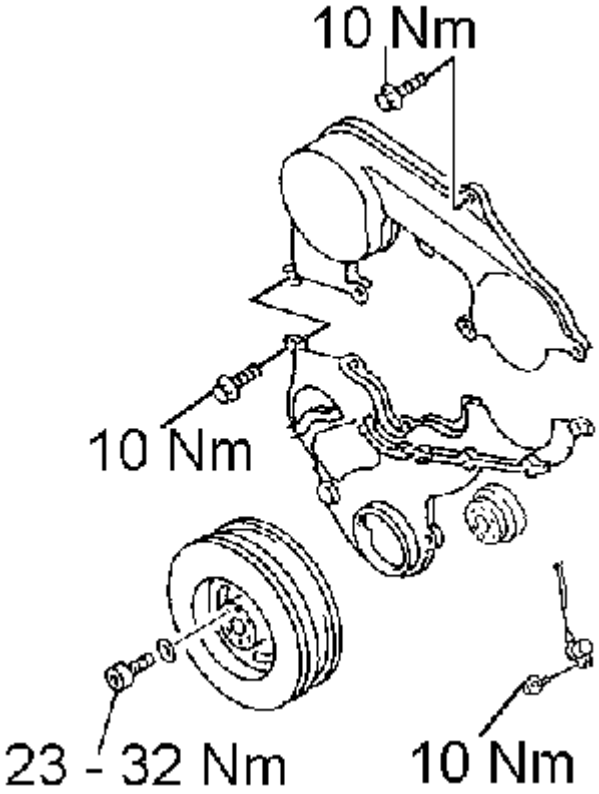


Remove the crankshaft pulley

Remove the lower timing cover

Remove the timing belt guide plates

Remove the crankshaft position sensor



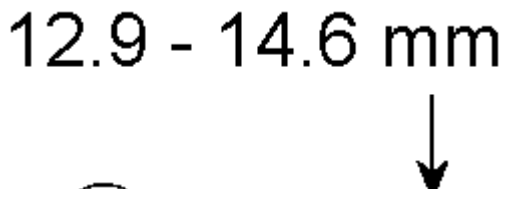
Turn the crankshaft clockwise to align the timing marks

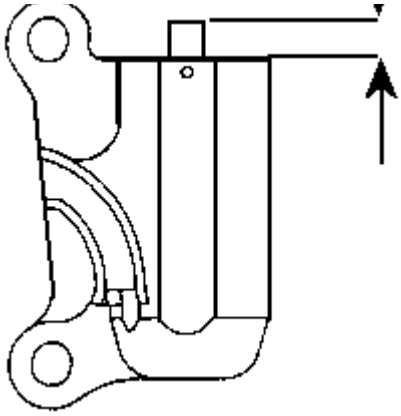
Remove the timing belt tensioner

Remove the timing belt

Check the tensioner and idler pulleys, renew if necessary

Measure the protrusion of the tensioner push rod from the housing end 12.9 - 14.6 mm





If out of specification, replace with a new one

Compress the tensioner

The force needed should be approximately (N) 235

If out of specification, replace with a new one

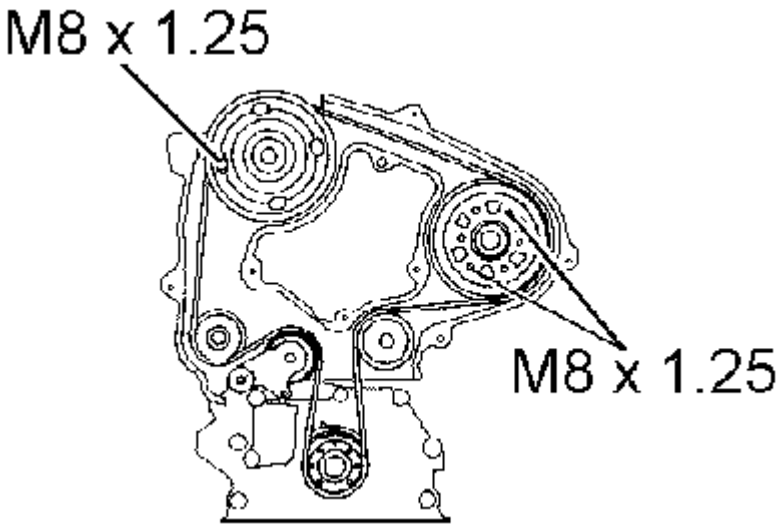
Lock the tensioner, use a locking pin

Installation

Item	**Note**

Check the timing marks

Lock the camshaft and injection pump with M8 bolts.

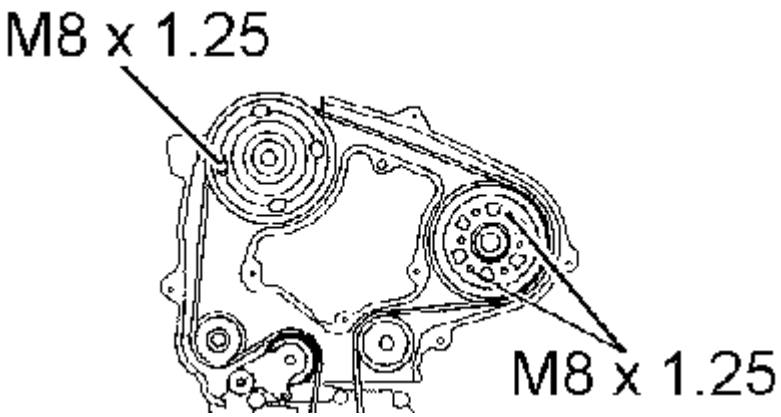


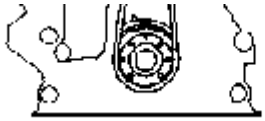
Note: Do not tighten the bolts

Fit the timing belt anti-clockwise, starting at the crankshaft gearwheel

Fit the locked tensioner

Remove the bolts





Remove the locking pin

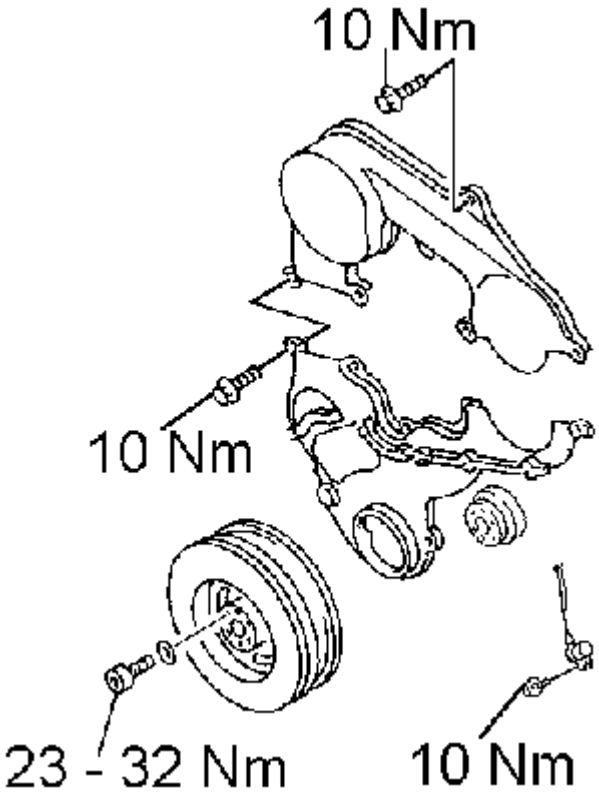
Turn the crankshaft two rotations by hand

Check the timing marks again

Fit the crankshaft sensor

Refit the timing belt guide plates

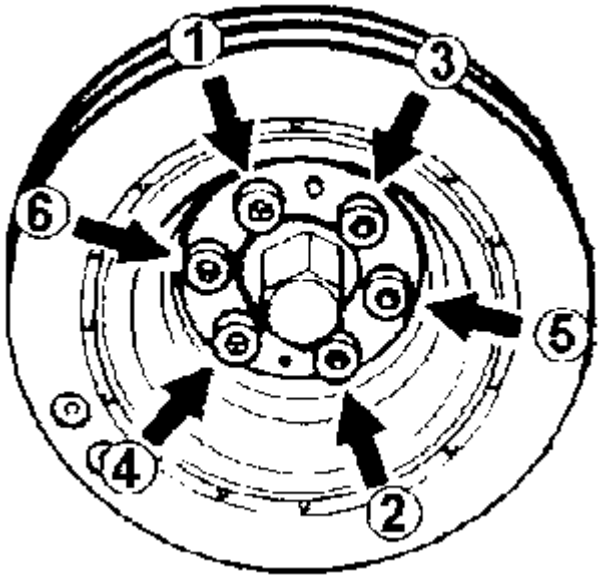
Fit the lower timing cover



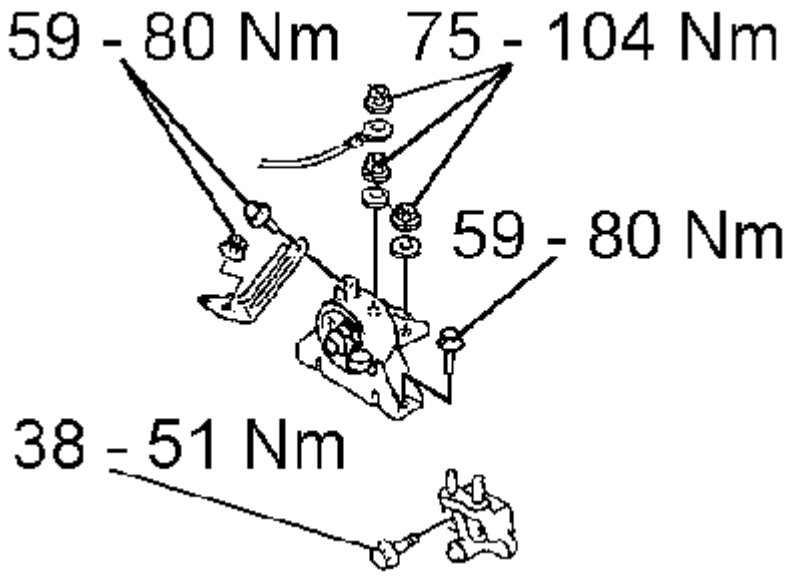
Refit the crankshaft pulley

Tighten the bolts 23 - 32 Nm

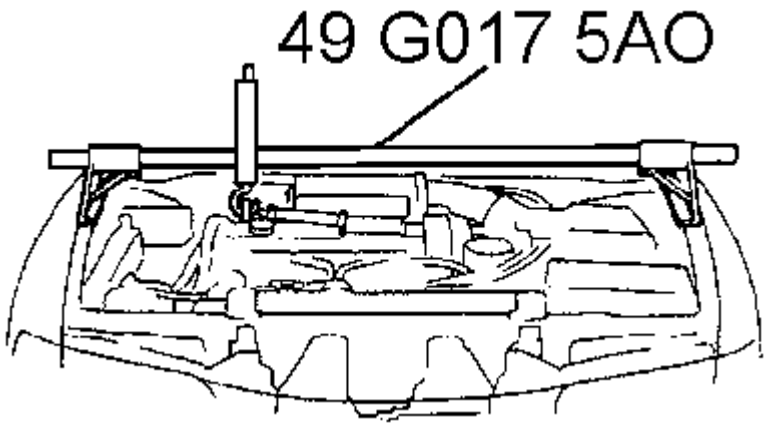
In the order shown



Refit the engine mount



Remove the special tool 49 G017 5A0



Fit the ancillary drive belt

Fit the upper timing cover

Replace fluids

Refit the cylinder-head cover

Reconnect the battery earth cable

Torque settings

Item	Note
Crankshaft pulley:	23 - 32 Nm
Tensioner:	19 - 25 Nm
Crankshaft sensor:	10 Nm
Timing cover	10 Nm

Special tools

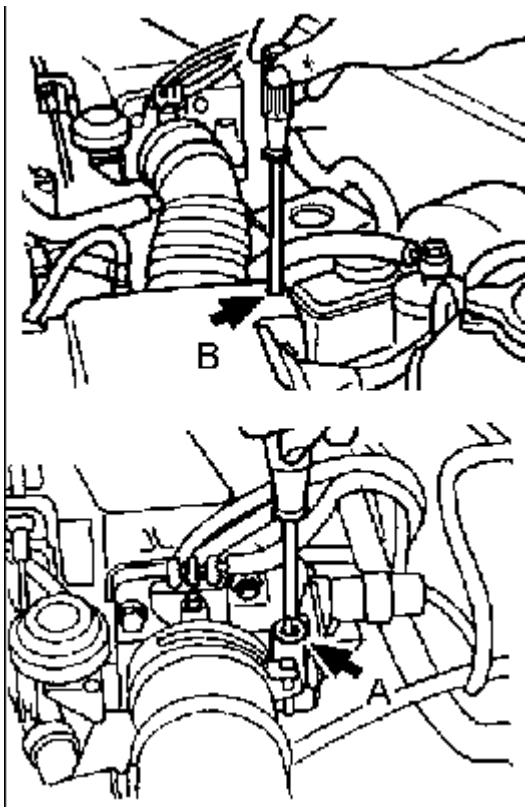
Item	Note
Engine support:	49 GO17 5AO

Adjustment Data

MAZDA - 626 - 2.2i - F2

Engine (general)

Item	Values	Units
Engine code	F2	
Capacity	2184	(cc)
Idle speed	750 ± 25	(rpm)
Valve clearance		
Hydraulic		
Compression pressure		
Normal	11.4	(bar)
Minimum	8.0	(bar)
Oil pressure	2.95 - 3.95	(bar / rpm)
Fuel system (make & type)	Denso EGI	
Adjustment screws (A = idle speed B = CO)	A	



Firing order	1-3-4-2	
Timing stroboscopic (before TDC)	6 ± 1/750	(° / rpm)
Start	0 ± 2/110	(° / mmHg)
End	18 - 22/275	(° / mmHg)
Centrifugal advance		
Start	0 ± 2/1200	(° / rpm)
End	16 - 20/4500	(° / rpm)
Ignition-coil resistance, primary	0.72 - 0.88	(ohms)
Ignition-coil resistance, secondary	10200 - 15200	(ohms)
Spark plugs (make & type)	NGK/ZFR6F-11	

Spark-plug gap	1.0 - 1.1	(mm)
Fuel-pump pressure	4.5 - 6.0	(bar)
Injection pressure / system pressure	2.4 - 2.8	(bar)
CO exhaust gas	< 0.5	(%)
CO2	13 - 16	(%)
HC	300	(ppm)
O2	0.5 - 2.0	(%)
Lambda	0.97 - 1.03	
Lambda change (Delta Lambda)	0.03	
Oil temperature during test	60	(°C)
Fast-idle speed	2500-2800	(rpm)
CO at fast-idle speed	< 0.3	(%)
Closed-loop test at: (rpm)	700 - 800	(rpm)

Cooling system

Item	Values	Units
Cap pressure	0.75 - 1.05	(bar)
Thermostat opens at	86 - 90	(°C)
Fan on at	97	(°C)

Electrical

Item	Values	Units
Battery	60	(Ah)
Alternator	70	(A)

Brakes

Item	Values	Units
Disc thickness, front, min.	22.0	(mm)
Drum diameter, rear, max.	201.5	(mm)

Steering and wheel alignment

Item	Values	Units
Toe-in, front	0' ± 18'	(°)
Camber, front	17' ± 45'	(°)
Castor, front	1° 13' ± 45'	(°)
K.P.I., front	12° 47'	(°)
Toe-in, rear	0 ± 18'	(°)
Camber, rear	-30' ± 45'	(°)

Wheels and tyres

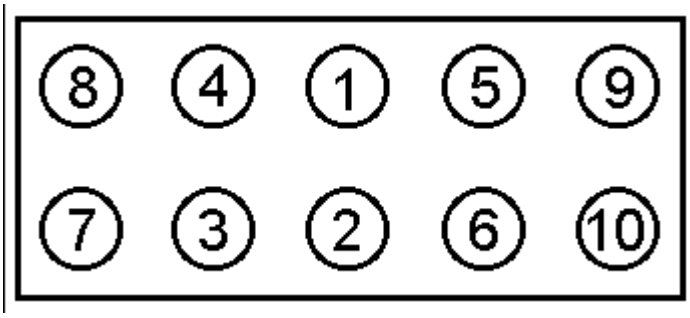
Item	Values	Units
Tyre size	195/60R15	
Front tyre pressure	2.2	(bar)
Rear tyre pressure	1.8	(bar)

Capacities

Item	Values	Units
Engine sump, incl. filter	4.6	(l)
Manual transmission		
Gearbox refill	3.35	(l)
Cooling system	7.5	(l)

Torque settings

Item	Values	Units
Cylinder head		



Stage 1	20 - 26	(Nm)
Stage 2	50 - 56	(Nm)
Stage 3	80 - 86	(Nm)
Front hub	235 - 319	(Nm)
Rear hub	98 - 117	(Nm)
Wheel nuts	88 - 118	(Nm)
Spark plugs	15 - 23	(Nm)

Capacities

MAZDA - 626 - 2.2i - F2

Item	Values	Units
Engine sump, incl. filter	4.6	(l)
Manual transmission		
Gearbox refill	3.35	(l)
Cooling system	7.5	(l)

Accessing trouble codes

- Ensure ignition switched OFF.
- Bridge data link connector (DLC) (green) terminal and earth **Fig. 1** [1].
- Connect LED test lamp between terminals 1 and 2 **Fig. 1** [2].

NOTE: Connect LED test lamp positive connection to DLC terminal 2.

- Switch ignition ON.
- Check that LED illuminates for 3 seconds.
- Count LED flashes. Note trouble codes. Compare with trouble code table.
- Long flashes indicate the LH digit.
- Short flashes indicate the RH digit.

NOTE: If no faults are recorded: LED test lamp will illuminate for 3 seconds and then extinguish.

- The ECM fault memory can also be checked using suitable diagnostic equipment connected to the data link connector (DLC) **Fig. 1** .

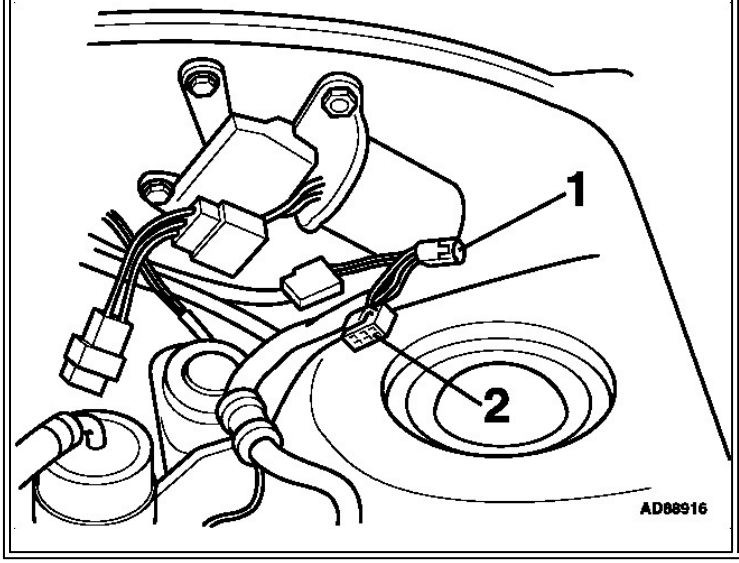
Erasing trouble codes

- Ensure ignition switched OFF.
- Disconnect battery earth lead.
- Depress brake pedal for 3 seconds.
- Reconnect battery earth lead.
- Repeat checking procedure to ensure no data remains in ECM fault memory.

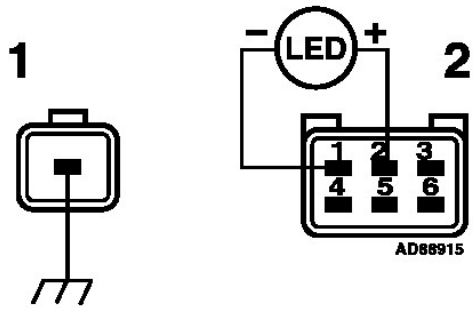
WARNING: Disconnecting the battery may erase memory from electronic units (e.g. radio, clock).

Trouble code identification

Trouble code	Fault location
01	Ignition pulse
08	Volume air flow (VAF) sensor
09	Engine coolant temperature (ECT) sensor
10	Intake air temperature (IAT) sensor
12	Throttle position (TP) sensor
14	Barometric pressure (BARO) sensor
15	Oxygen sensor (O2S)
16	Exhaust gas recirculation (EGR) valve position sensor
17	Oxygen sensor (O2S)
25	Fuel pressure regulator control solenoid
26	Evaporative emission (EVAP) canister purge valve
28	Exhaust gas recirculation (EGR) solenoid - vacuum
34	Idle air control (IAC) valve - C
35	Idle air control (IAC) valve - B



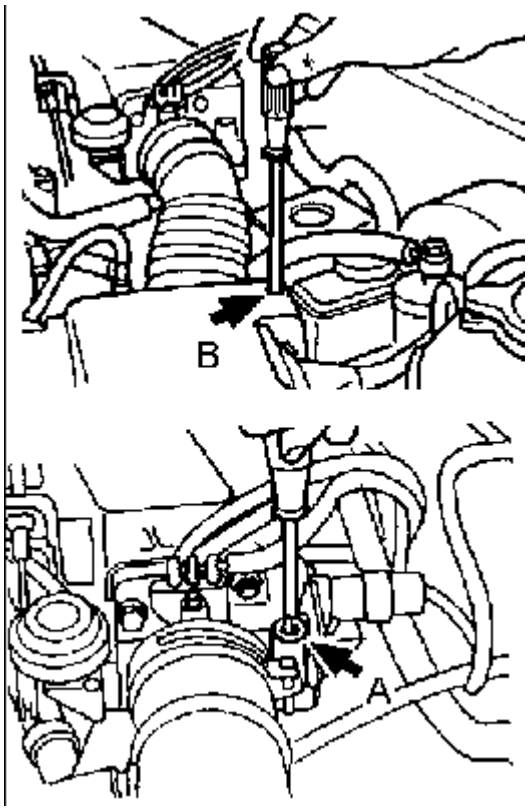
1



Environmental Data

MAZDA - 626 - 2.2i - F2

Item	Values	Units
Engine code	F2	
Idle speed	750 ± 25	(rpm)
Fuel system (make & type)	Denso EGI	
Adjustment screws (A = idle speed B = CO)	A	



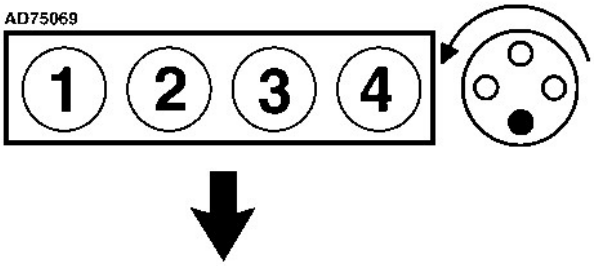
Timing stroboscopic (before TDC)	6 ± 1/750	(° / rpm)
Start	0 ± 2/110	(° / mmHg)
End	18 - 22/275	(° / mmHg)
Centrifugal advance		
Start	0 ± 2/1200	(° / rpm)
End	16 - 20/4500	(° / rpm)
Fuel-pump pressure	4.5 - 6.0	(bar)
Injection pressure / system pressure	2.4 - 2.8	(bar)
CO exhaust gas	< 0.5	(%)
CO2	13 - 16	(%)
HC	300	(ppm)
O2	0.5 - 2.0	(%)
Lambda	0.97 - 1.03	
Lambda change (Delta Lambda)	0.03	
Oil temperature during test	60	(°C)
Fast-idle speed	2500-2800	(rpm)
CO at fast-idle speed	< 0.3	(%)
Closed-loop test at: (rpm)	700 - 800	(rpm)

Notes			Specified value	Measured value
Vehicle identification				
	No. of cylinders	Type	**4/OHC**	
	Capacity (Fiscal)	cc	**2184 (2169)**	
	Compression ratio	:1	**8,6**	
	Suitable for unleaded petrol		**Yes**	
	Minimum octane rating	RON	**91**	
	Ignition system	Type	**HEI**	
	Ignition system	Description	**Trans-i**	
	Trigger location		**Distributor**	
	Fuel system	Make	**Mazda**	
	Fuel System	Type	**EGI**	
	Fuel System	Description	**MFI-i**	
	Air metering	Type	**Flow**	
	Combined ignition and fuel ECM		**No**	
	Diagnostic socket		**Yes**	
Ignition system				
	Ignition coil	Make	**Hanshin**	
	Ignition coil supply voltage	+ with ballast V	**11,0**	
	Primary resistance	Ohm	**0,72-0,88**	
	Secondary resistance	Ohm	**10200-15200**	
	Firing order		**1-3-4-2**	
	Distributor (ECM)	Make	**Mitsubishi**	
Tuning and emissions				
5	Tuning conditions			
	Ignition timing	o = without + = with vacuum	**o**	
	Ignition timing - basic BTDC	°Engine/rpm	**6±1/750**	
	Ignition advance		**Without vacuum and basic timing**	
	Ignition advance checks	°Engine/rpm	**0-2/1200**	
	Ignition advance checks	°Engine/rpm	**10-16/2400**	
	Ignition advance checks	°Engine/rpm	**16-20/4500**	
	Vacuum check	+ = advance o = retard	**+/o**	
	Vacuum range	°Engine	**18-22/3-8**	
	Vacuum starts	mbar	**147/147**	
	Vacuum ends	mbar	**366/266**	
	Idle speed	rpm	**750±25**	
	Oil temperature for CO test	°C	**60**	
	CO level at idle speed - tailpipe (Cat)	Vol. % CO	**0,5 Max Not adjustable**	
	HC level at idle speed	ppm	**100**	
	CO2 level at idle speed	Vol. % CO2	**14,5-16**	
	O2 level at idle speed	Vol. % O2	**0,1-0,5**	
	Increased idle speed for CO test	rpm	**2500-2800**	
	CO content at increased idle speed	Vol. %	**0,3**	
	Lambda at increased idle	λ	**0,97-1,03**	
Spark plugs				
	Spark plugs	Original equipment	**NGK**	
	Spark plug	Type	**ZFR6F-11**	
	Electrode gap	mm	**1,1**	
	Spark plugs	Make	**Autolite**	
	Spark plug	Type	**APP64**	
	Electrode gap	mm	**0,8**	
	Spark plugs	Make	**Bosch**	
	Spark plug	Type	**FR7LCX**	
	Electrode gap	mm	**1,1**	
	Spark plugs	Make	**Champion**	
	Spark plug	Type	**RC9YC4**	

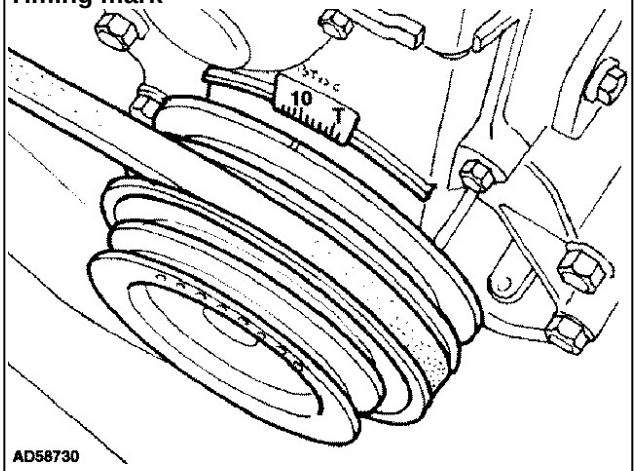
	Electrode gap	mm	**1,1**	
	Spark plugs	Make	**NGK**	
	Spark plug	Type	**ZFR6F-11**	
	Electrode gap	mm	**1,1**	
Fuel system				
	System pressure without vacuum	bar	**2,35-2,75**	
	Engine coolant temperature (ECT) sensor	Ohm/°C	**280-350/80**	
	Injector	Ohm	**12-16**	
	Idle speed control valve	Ohm	**6,3-9,9**	
Service checks and adjustments				
	Valve clearance -INLET	mm	**Hydraulic**	
	Valve clearance -EXHAUST	mm	**Hydraulic**	
	Compression pressure	bar	**7,8-11,2**	
	Oil pressure	bar/rpm	**2,9-3,9/3000**	
	Radiator cap	bar	**0,74-1,03**	
	Thermostat opens	°C	**87-90**	
	Drive belt tension - alternator/PAS/AC	mm	**7-9**	
Lubricants and capacities				
	Engine oil grade - cold climate	SAE	**5W/30**	
	Engine oil grade - moderate climate	SAE	**10W/30**	
	Engine oil grade - hot climate	SAE	**20W/40**	
	Engine oil classification	API/ACEA	**SJ/A2-96**	
	Engine oil grade - alternative - moderate climate	SAE	**10W/40**	
	Engine oil classification - alternative - moderate climate	API/ACEA	**SJ/A2-96**	
	Engine with filter	litres	**4,1**	
	Gearbox oil grade	SAE	**75W/90**	
	Gearbox 4/5 speed	litres	**3,35**	
	Automatic transmission fluid	Type	**Dexron II**	
	Cooling system	litres	**7,5**	
	Brake fluid	Type	**DOT 3/4**	
	Power steering fluid	Type	**Dexron II**	
	Power steering fluid	litres	**1,0**	
Tightening torques				
	Cylinder head instructions			
Cylinder head				
		Renew bolts	**No**	
	Stage 1	Tighten	**20-26 Nm**	
	Stage 2	Tighten	**50-56 Nm**	
	Stage 3	Tighten	**80-86 Nm**	
Other tightening torques				
	Main bearings	Renew bolts/nuts	**No**	
	Main bearings	Stage 1	**41 Nm**	
	Main bearings	Stage 2	**82-88 Nm**	
	Big end bearings	Renew bolts/nuts	**No**	
	Big end bearings	Stage 1	**33 Nm**	
	Big end bearings	Stage 2	**65-69 Nm**	
62	Oil pump to cylinder block			
	Sump bolts		**10 Nm**	
	Sump drain bolt		**30-40 Nm**	
	Flywheel/driveplate		**100 Nm/100 Nm**	
	Clutch to flywheel		**18-26 Nm**	
	Crankshaft pulley/damper		**157-167 Nm**	
	Camshaft sprocket/gear		**47-65 Nm**	
	Camshaft carrier/cap		**18-26 Nm**	
	Camshaft/rocker cover		**6-8 Nm**	
	Inlet manifold to cylinder head		**20-30 Nm**	
	Exhaust manifold to cylinder head		**20-30 Nm**	

	Spark plugs		**15-23 Nm**	
	Front hub		**235-319 Nm**	
	Rear hub		**98-117 Nm**	
	Steering track rod end		**29-44 Nm**	
	Brake caliper to carrier	Front	**36 Nm**	
	Brake caliper carrier to hub	Front	**88 Nm**	
	Brake caliper to carrier	Rear	**20 Nm**	
	Brake caliper carrier to hub	Rear	**57 Nm**	
	ABS sensor	Front	**20 Nm**	
	ABS sensor	Rear	**20 Nm**	
	Road wheels		**88-118 Nm**	
Starting and charging				
	Battery	V/RC(Ah)	**12/90 (60)**	
	Starter motor	Make	**Mitsubishi**	
	Starter motor	Type	**1,4 kW**	
	Maximum cranking amps	A	**162-198**	
	Alternator/Regulator	Make	**Mitsubishi**	
	Alternator output at engine speed	A/V/rpm	**70/14,5/3000**	
	Regulated voltage	V	**14,1-14,7**	
Brake disc and drum dimensions				
44	Minimum disc thickness - ventilated	Front	**18 mm**	
	Minimum disc thickness	Rear	**8 mm**	
	Disc runout	Front	**0,10 mm**	
	Disc runout	Rear	**0,10 mm**	
	Maximum drum diameter	Rear	**230,1 mm**	
	Minimum pad thickness	Front	**2 mm**	
	Minimum pad thickness	Rear	**1 mm**	
	Minimum shoe thickness	Rear	**1 mm**	
	Handbrake travel	No. of notches	**5-7**	
Air conditioning				
	Air conditioning refrigerant	Type	**R12**	
	Air conditioning refrigerant quantity	grams	**800**	
	Air conditioning oil	Type	**FREOL DS-83P**	
	Air conditioning oil quantity	cmi	**150**	

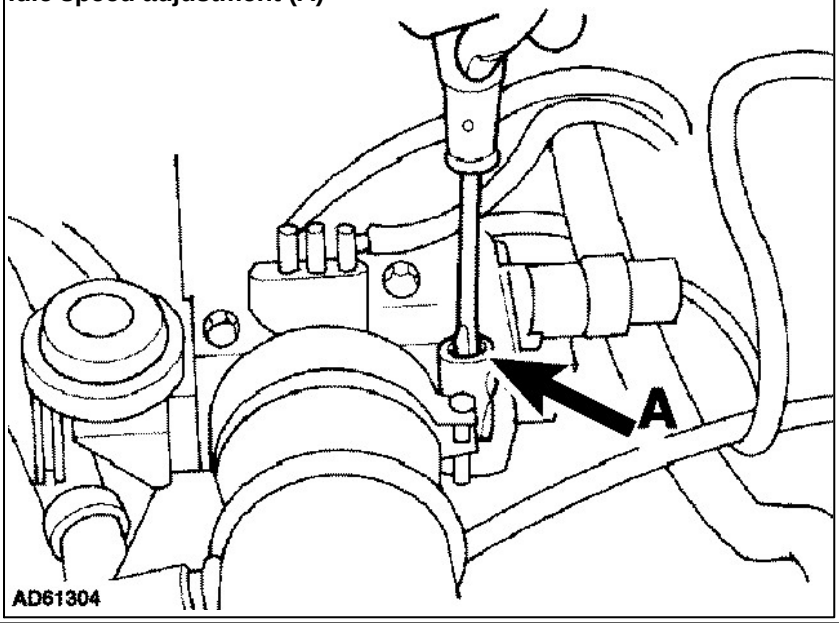
Cylinder layout



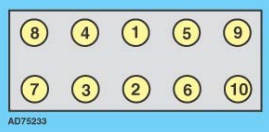
Timing mark



Idle speed adjustment (A)



Tightening sequence



Lubricants and Fluids

MAZDA - 626 - 2.2i - F2

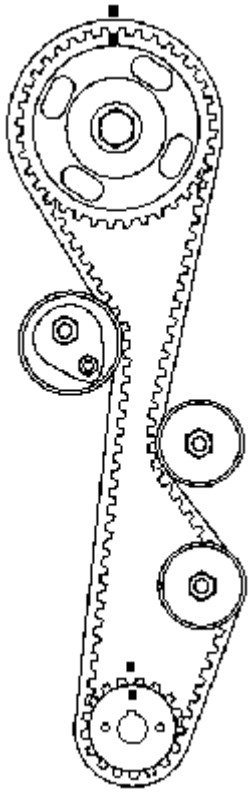
Engine		
Motor oil API SG	Below 0 °C	SAE 5W-30
Motor oil API SG	Above -25 °C	SAE 10W-30
Cooling system		
Coolant	All temperatures	
Manual transmission		
Gear oil API GL-4	All temperatures	SAE 75W-90
Gear oil API GL-5	All temperatures	SAE 75W-90
Gear oil API GL-4	Above 5 °C	SAE 80W-90
Gear oil API GL-5	Above 5 °C	SAE 80W-90
Automatic transmission		
ATF Dexron II	All temperatures	
ATF M-III	All temperatures	
Transfer box		
Gear oil API GL-5	Above -20 °C	SAE 90
Gear oil API GL-5	Below -20 °C	SAE 80W
Differential, rear (4x4)		
Gear oil API GL-5	Above -20 °C	SAE 90
Gear oil API GL-5	Below -20 °C	SAE 80W
Power steering		
ATF Dexron II	All temperatures	
ATF M-III	All temperatures	
Brakes system		
Brake fluid DOT 3	All temperatures	

Timing

MAZDA - 626 - 2.2i - F2

General

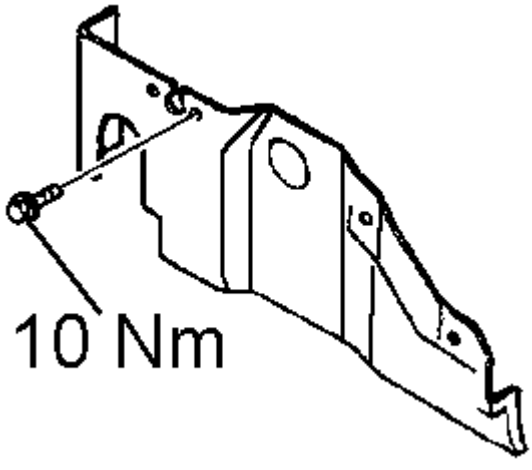
Item	Note
Always check the timing marks before timing belt removal	



Before disconnecting the battery cable, check the audio system security code

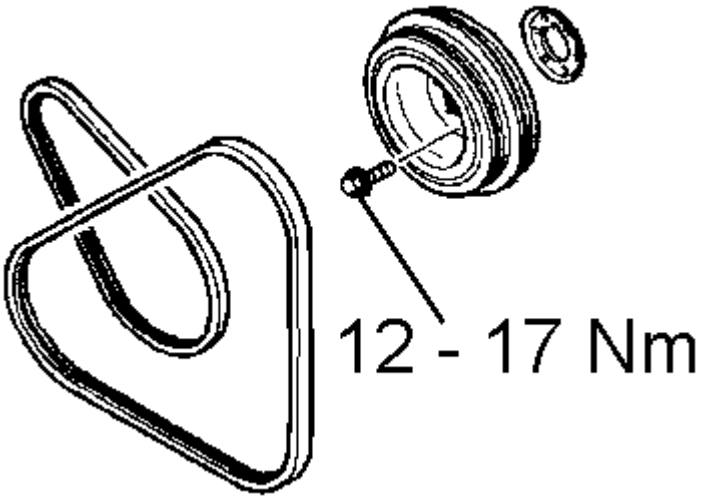
Removal

Item	Note
Disconnect the battery	
Disconnect the spark-plug leads	
Remove the spark plugs	
Remove the lower cover	

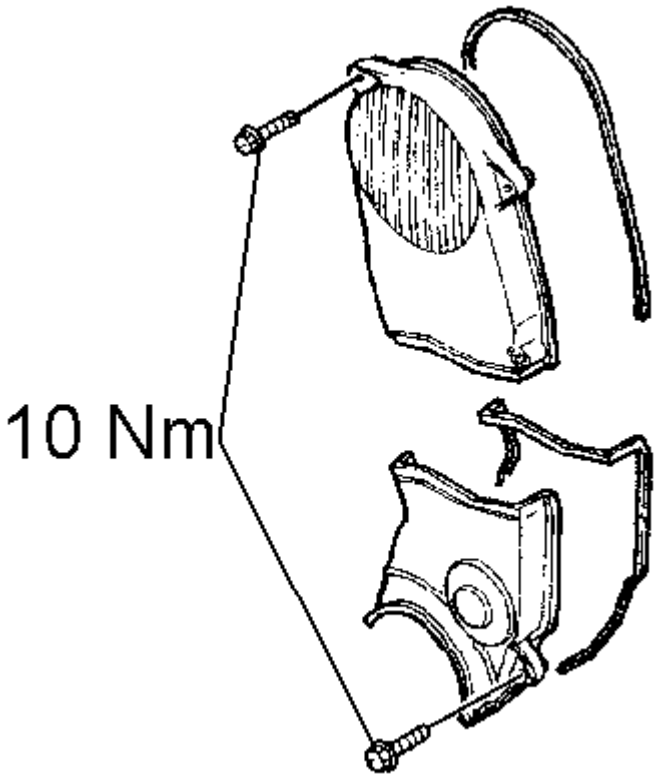


Remove the ancillary drive belt

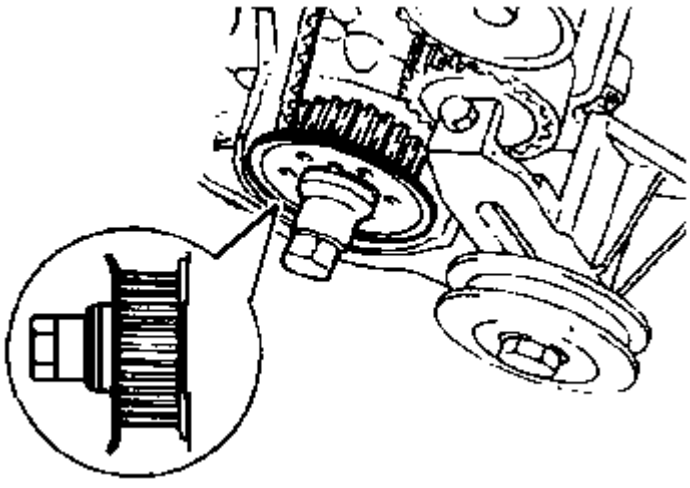
Remove the crankshaft pulley



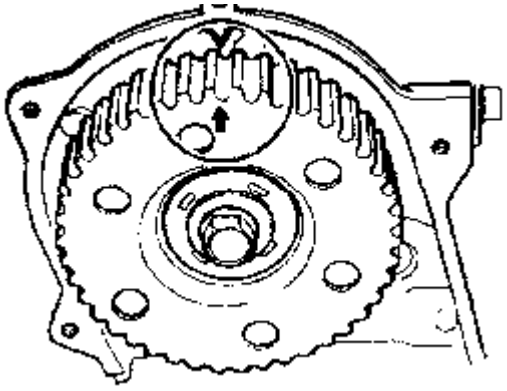
Remove the timing-belt covers

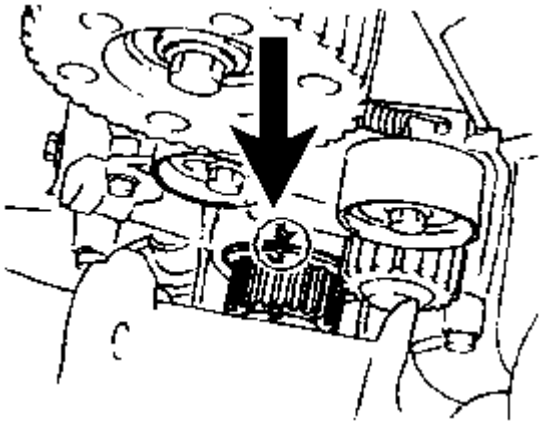


Remove the guide plates

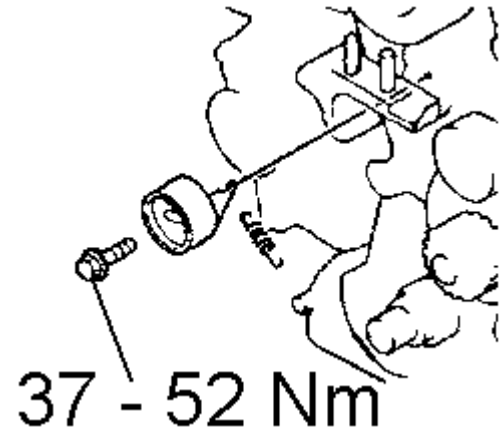


Align the timing marks





Loosen the tensioner



Push the tensioner pulley away from the timing belt

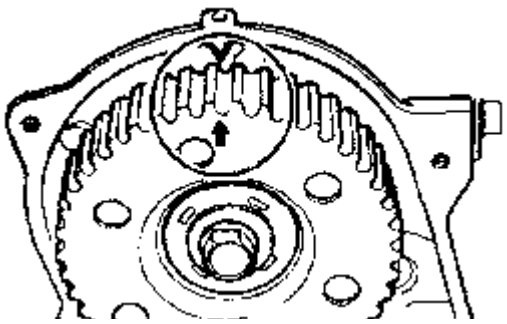
Tighten the tensioner

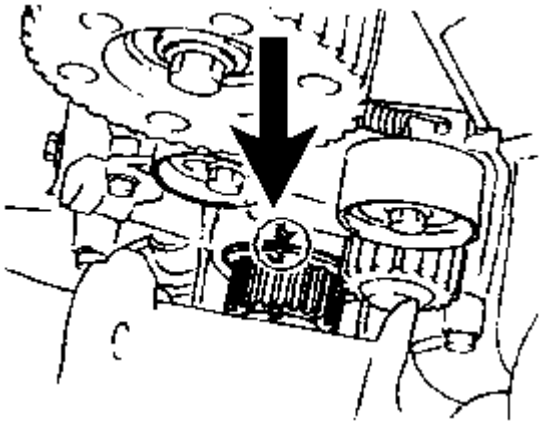
Remove the timing belt

Installation

Item	**Note**

Check the timing marks





Fit the timing belt

Turn the engine 2 rotations by hand

Check the timing marks

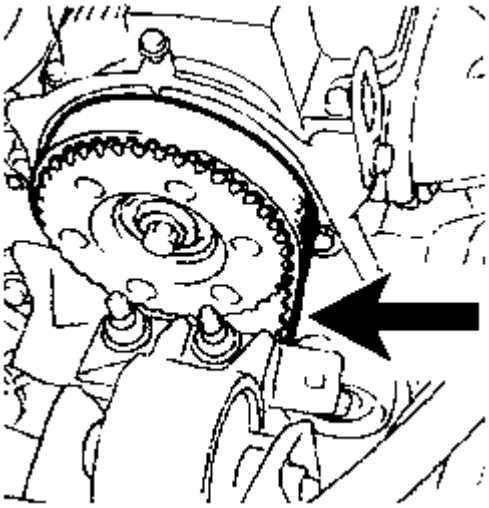
Loosen the tensioner

Tighten the tensioner	37 - 52 Nm

Turn the engine 2 rotations by hand

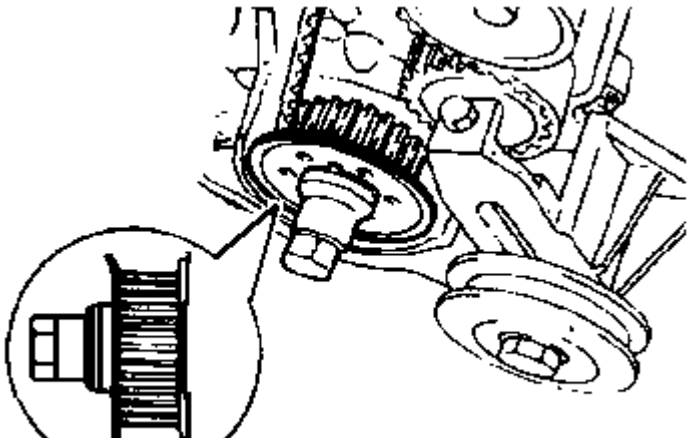
Check the timing marks again

Measure the timing belt deflection	98 N

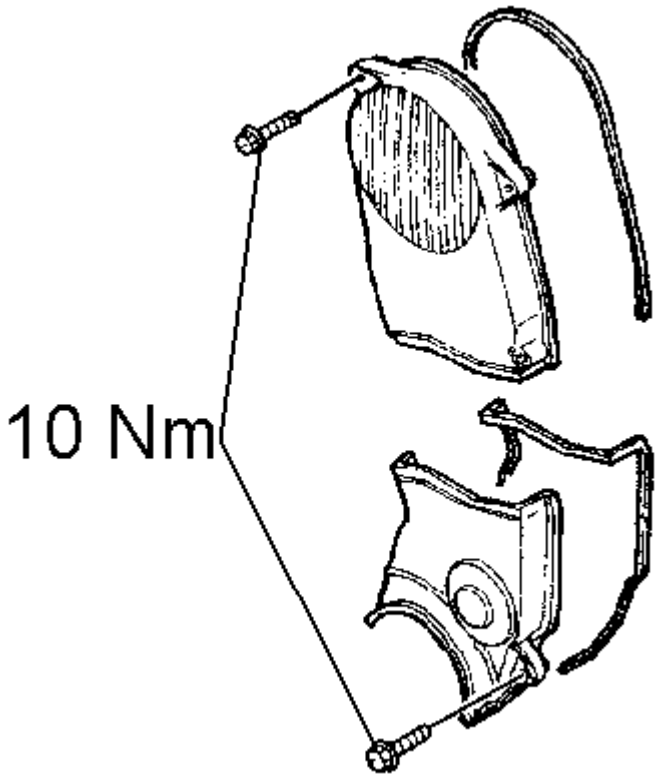


The tension is set at a deflection of:	8 - 9 mm

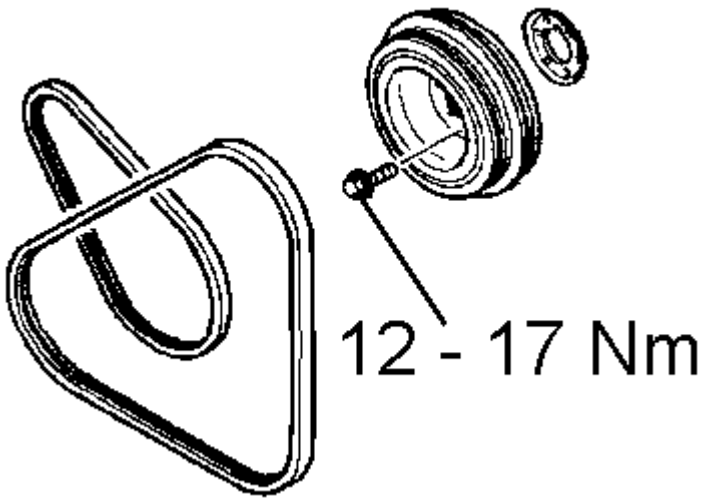
Refit the timing belt guide plates



Refit the timing belt covers

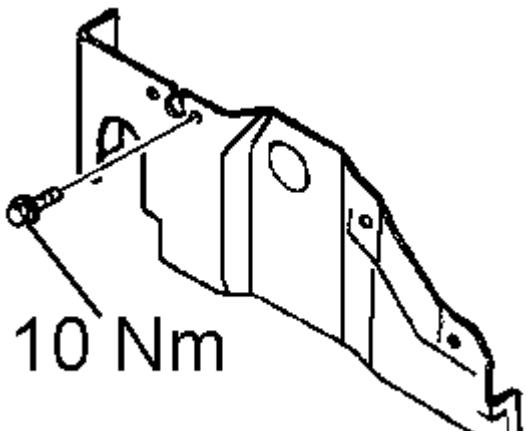


Refit the crankshaft pulley



Fit the ancillary drive belt

Refit the engine lower covers



Refit the spark plugs

Refit the spark plug leads

Reconnect the battery earth cable

Torque settings

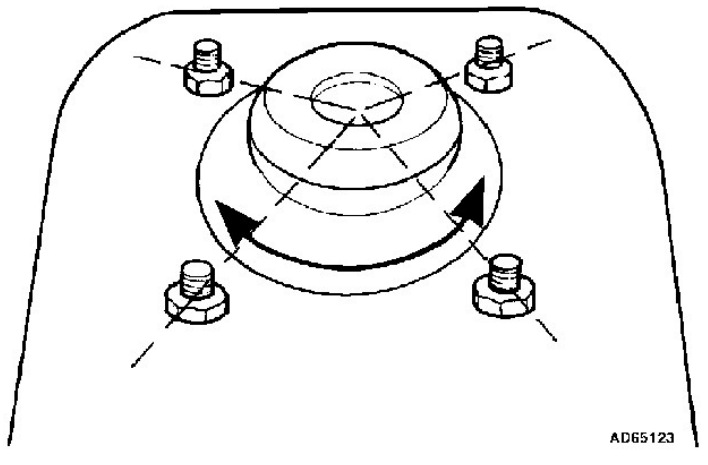
Item	Note
Tensioner	37 - 52 Nm
Crankshaft pulley:	12 - 17 Nm
Spark plugs:	15 - 23 Nm

Special tools

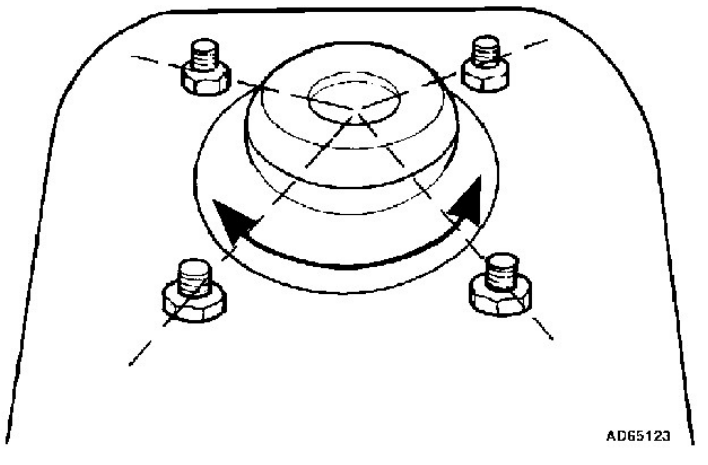
Item	Note
Special tools are not required	

Setting data - Four wheels				
Notes			**Specified value**	**Measured value**
	Load positioning		**unladen**	
	Fuel tank - percentage full	%	**100**	
	Toe-in (N = negative, toe-out)	mm	**0±2**	
	Toe-in	deg	**0°±18'**	
	Toe-in	deg-1/100	**0±0,30**	
	Camber	deg	**0°17'±45'**	
	Camber	deg-1/100	**0,28±0,75**	
	Tolerance left/right	deg	**0°30'**	
	Tolerance left/right	deg-1/100	**0,50**	
	Camber adjustment		**$ADJ**	
	Castor	deg	**1°13'±45'**	
	Castor	deg-1/100	**1,22±0,75**	
	Tolerance left/right	deg	**0°40'**	
	Tolerance left/right	deg-1/100	**0,67**	
	Castor adjustment		**$ADJ**	
	KPI (SAI)	deg	**12°47'**	
	KPI (SAI)	deg-1/100	**12,78**	
	Included angle	deg	**13°4'**	
	Included angle	deg-1/100	**13,07**	
	Lock angles - max. inner	deg	**36°26'**	
	Lock angles - max. inner	deg-1/100	**36,43**	
	Lock angles - max. outer	deg	**30°59'**	
	Lock angles - max. outer	deg-1/100	**30,98**	
	Rear toe-in	mm	**0±2**	
	Rear toe-in	deg	**0°±18'**	
	Rear toe-in	deg-1/100	**0±0,30**	
	Rear toe-in adjustment		**$ADJ**	
	Rear camber	deg	**0°30'N±45'**	
	Rear camber	deg-1/100	**0,50N±0,75**	
	Rear camber adjustment		**Not adjustable**	

Camber adjustment



Castor adjustment



Rear toe-in adjustment