Lucas 14CUX Fuel Injection System – Installation and Diagnostic Notes.

Desperately Dull But Necessary Legal Bit

Simple Precautions Before Starting Work

Please take the time to completely read through all of these notes carefully before starting work. If anything is unclear then please do not hesitate to ask. There's no such thing as a silly question, except the one you didn't ask although you needed to!

Never disconnect the ECU whilst the ignition is switched on, and especially not while the engine is running. Never work on the ECU whilst it is plugged in, since this system runs continuously (performing diagnostics) even when the ignition is switched off.

The ECU (Electronic Control Unit) is easily damaged by Static Electricity (ESD or Electro-Static Discharge). Therefore you need to use extreme care should you need to work inside the ECU (e.g. when changing an EPROM). If you do not have the correct facilities then working on an earthed metal workbench can reduce the risk. A stainless steel sink draining board fits this description, or a large sheet of aluminium kitchen foil. Avoid wearing man-made fabrics whilst performing this type of work if possible, since they tend to generate Static Electricity (suggest cotton or wool clothing).

Occasionally within this text, there are references to resetting the ECU. This is done by either by disconnecting the vehicle battery, or disconnecting the ECU from the vehicle for at least ten seconds. The ECU should ***never*** be disconnected whilst the ignition is switched on – switch the ignition off and wait at least ten seconds before disconnecting.

To disconnect the ECU, the main harness plug is removed by pressing down the retaining clip by the connector (at the opposite end of the plug from where the wires enter it) and swinging that end away from the ECU. Resetting should always be done after clearing any fault or making any intrusive test into the system.

Where the colours of a wire are described (e.g. Green/Blue), the first colour named is the primary or main colour, and the second is the tracer colour that appears as a thin stripe or line of dots along the length of the wire.

Temperatures are all given in degrees Centigrade.

All electrical measurements are taken using a digital multimeter. Older analogue types are not appropriate because they impose an excessive electrical load on the circuit being measured, thereby altering the results (and operation of the system being measured).

If you do not have such a meter or cannot borrow one then the following recommendation may help. Gunsons produce a suitable meter called the "Digimeter 320" which is specifically intended for automotive use. This excellent item is widely available for about £45-50 in most motoring accessory shops in the UK.

General Engine Set-up

Firstly the general engine settings must be correct e.g. fuel pressure, ignition timing, spark plugs, etc. Ensure that there are no air leaks into the system, since this will invalidate all the following tests. Then the idle mixture must be set (this is also true for catalyst cars although the procedure is significantly more complex). Follow the guidance of your engine supplier for these details.

It is essential that the coolant thermostat is working correctly, especially on catalyst-equipped cars. The fuel injection system is optimised to provide accurate mixture control within normal temperature ranges. In the case of catalyst-equipped vehicles Oxygen/Lambda control does not start until the engine has reached 70 degrees Centigrade, therefore the absence of a thermostat may cause terminal cat damage.

Competition vehicles should NEVER be run without a thermostat – a 74 degree Centigrade thermostat is available especially for this application.

Fuel Injection Connectors

If the fuel injection wiring has been disturbed (e.g. engine has been changed) then please ensure that all connectors have been replaced correctly, and that all earth connections are good and secure. Common problems here are that the plastic connectors were broken when removing or replacing them.

Check that terminals within the connectors have not been pushed back on connection. Peeling back the rubber boot from the connector whilst connected, and visually inspecting the terminals from behind will confirm this.

Another common problem is that two or more connectors have become mixed up. The most likely candidates are the Coolant Temperature sensor, Fuel Temperature sensor, and one or other of the fuel injectors. All of these have the same connectors, and can easily be swapped since they emerge from the loom in the same place. Sometimes they all have the same connector shell colour, although the Coolant Temperature sensor is supposed to have a Brown shell, and the Fuel Temperature sensor shell should be Grey.

Where the connector shells are all the same colour, the only way to verify that they are in the right place is by checking the wiring colours within the connectors themselves. All injectors have a Yellow wire (with a secondary colour trace – usually Blue or White) and a Brown/Orange wire. The Coolant Temperature sensor wires are Red/Black and Green/Blue, and Fuel Temperature sensor wires are Red/Black and Black/White.

The most common fault here is to swap the Coolant Temperature and Water Temperature sensor connectors. Symptoms of this problem are usually that the car starts fine from cold, but progressively gets richer as the car warms up. This is because the fuel temperature should always be a lot cooler than the coolant temperature. Note that this particular fault does not show up on a fault code reader or cause a fault code to be set in the ECU, because both values are still within a reasonable range.

Ignition Timing

It is important to check that the ignition timing is advancing as the engine speed increases. With the vacuum advance disconnected you should typically see 8 degrees BTDC at idle, rising to 28 degrees BTDC at 4000RPM. These figures work well and safely with most Rover V8 applications, and should be used where no other information is available. Please check the correct values with your vehicle handbook or your engine supplier.

It is not uncommon to find that the centrifugal advance mechanism has seized (locked up). This particular fault will knock off 35-45BHP on a 3.9 Litre car. The car feels good and strong at low revs, but the power drops off and goes flat as the revs rise. After 4500RPM there is a lot of noise but little power.

Note that the timing markers are not always accurately fitted to these engines. Errors of up to ten degrees have been observed. Another cause of error in the markers can be that the crankshaft pulley is not properly secured, or has been loose at some time in the past. This causes fretting in the pulley key-way and allows it to move round on the crankshaft.

If detonation (or pinking) occurs when the correct timing is apparently being used, then the cause must be investigated – it is not always the timing. Failure to do so may result in severe engine damage.

Fuel Pressure

When the ignition is turned on for the first time without starting the engine, the fuel pump will be heard to run for around two seconds and then stop. It will only run again when the engine is started, or if the ignition is switched off and on again.

Correct fuel pressure is vital to operation of the system. To measure it you will need a suitable pressure gauge which can read up to 60 PSI (4 Bar) as a minimum.

Connect the gauge by teeing it into the fuel feed pipe at the fuel rail. If this point is inaccessible then it may be easier to connect it on the engine side of the fuel filter. Make sure that all connections are secure, and that any fuel spillage has been cleared up. Now start the engine and check that there are no leaks.

Pull off the small vacuum line from the Fuel Pressure Regulator and read the pressure gauge. For a standard vehicle with any Lucas Fuel Injection system the pressure should be 36-38 PSI (2.5-2.6 Bar). Now reconnect the vacuum line to the regulator. The pressure should have dropped to 28-30 PSI (1.9-2.0 Bar).

If the pressure is significantly higher then either the regulator is defective, or there is a blockage in the fuel return line to the tank. Check this by inserting the pressure gauge into the return line. The pressure in the return should never exceed 2-3 PSI (0.2 Bar). If the pressure is close to the feed pressure then the return line is blocked, otherwise the regulator is defective.

It is equally important to ensure that the pressure does not fall away under full load, leading to a weak mixture. This can only really be checked on a rolling road, or with the aid of a steep hill. Put the car under full load for at least ten seconds (e.g. full throttle in top gear up a hill) and check that full pressure is achieved and maintained.

If the pressure falls away by more than 1-2 PSI (0.15 Bar) then it is likely that the fuel filter is blocked, or the fuel pump has passed its “Sell By” date. The cause needs to be identified and cured.

Assuming that all these tests have passed, turn off the engine and note the pressure. It should fall immediately by up to 6 PSI (0.4 Bar), and then lose pressure at no more than 1 PSI (0.05 Bar) per minute. If it disappears more quickly then either the regulator is leaking or the one-way valve in the fuel pump is leaking.

Tune Resistor

All 14CUX ECUs contain five sets of engine tune information. The tune to be used is selected by the choice if Tune Resistor. All 14CUX vehicles are fitted with a Tune Resistor, except certain North American Specification (NAS) vehicles. In some cases NAS vehicles may have provision for a Tune Resistor to be fitted (i.e. socket fitted to the loom in the normal place), whilst others have this resistor taped inside the wiring loom to prevent anyone interfering with it.

Always ensure that the correct Tune Resistor is fitted to the vehicle. If an interchangeable Tune Resistor is fitted, then it is located as follows. Follow the wiring loom back from the ECU plug. About twelve inches (30cm) away, a small group of connectors and relays emerge from the loom. Amongst them is a small blue plastic two-pin plug that connects to the Tune Resistor.

The Tune Resistor itself is located in a clear plastic heat-shrink tube, connected to a blue plastic plug by two wires. Tune resistors are identified by the colour of these connecting wires. There is considerable variation according to application so please check for the correct version for your vehicle. If the vehicle is modified then the supplier of the modified ECU software should have specified the correct tune resistor to use.

Wire Colour	Resistance (Ohms)	Catalyst Operation	Common Application
Red	180	No	Australian 3.9
Green	470	No	Europe & UK 3.9 (or 3.5 Disco)
Yellow	910	No	Gulf States 3.9, or Europe & UK 4.2
Blue	1800	Yes	Gulf States 3.9, or Europe & UK 4.2
White	3900	Yes	Europe & UK 3.9 (or 3.5 Disco)

If there is any doubt about the presence or value of a Tune Resistor then the simplest method of checking it is as follows. Disconnect the ECU plug, and measure resistance between pins 5 and 27. The table above gives a list of the possible values:

Note that certain NAS vehicles do not use Tune Resistors, even though there may be a facility to fit one. In these cases the ECU will always operate as if a White Tune Resistor were present, and Oxygen Sensors are mandatory. If a Tune Resistor is later fitted, then it will be ignored. This is a function of the software version used inside the ECU, so of course it may be modified by a software upgrade.

For those of you who wonder if there is some advantage to be gained by experimenting with the resistor value - the answer is no! It must assume one of five particular values – if it does not then the system will detect a fault condition.

It is of particular importance to ensure that the choice of a cat or non-cat tune is correct.

- If a non-cat tune is selected where cats are fitted, then the cats may be destroyed. This happens because a non-cat tune will exercise no control over the cruise fuel setting. If the mixture is excessively lean or too rich, this can cause very high hydrocarbon levels (unburnt fuel) in the exhaust. This in turn can be burnt in the cats, leading to severe overheating. Certain fault conditions that cause over-fuelling will be undetected, which can also lead to severe catalyst overheating (and even a fire). Any input from Oxygen/Lambda sensors will be ignored.

- Where a cat tune is selected, but no oxygen sensors are fitted, the car will run terribly rich. Eventually this will cause a fault flag to be set within the ECU, thus forcing it to drop into limp-home mode.

Note that the default (or limp home) tune is a cat tune, and will therefore always cause rich running on a car not equipped with Oxygen/Lambda sensors. If no Tune Resistor is fitted then the default tune will be selected (other than NAS vehicles described above).

Should the Tune Resistor be changed or disturbed for any reason, the ECU should be reset afterwards by disconnecting it for ten seconds. Failure to do this may cause the ECU to select the default tune.

Road Speed Sensor

If the Road Speed Sensor is defective then the vehicle will tend to stall when you pull up to a halt with it. Secondly a fault code will be set in the ECU, which effectively disrupts operation of the Oxygen feedback system on catalyst equipped cars. Under certain circumstances this can dramatically shorten the life of the cats.

The reason for stalling with a defective (or absent) Road Speed Sensor is quite simple. Under normal operation when slowing down for a halt, the throttle may be closed but the engine is being driven by the inertia of the vehicle whilst the car is in gear (overrun). Because of the Road Speed Sensor the ECU will not try to adjust the idle in these circumstances, so the idle control valve is held open until the vehicle halts. The effect of this is that when the vehicle does halt, the idle valve is open and the ECU drops the engine onto idle smoothly.

However if the road speed signal is not present then the ECU attempts to adjust the idle whilst the engine ***is*** being overrun. Obviously this is a task it cannot accomplish - a fact that is recognised by setting a fault flag. In this case the idle valve is closed when the vehicle comes to a halt because the ECU has been trying to shut down the idle speed. Therefore it is a question of whether the ECU can lift the idle before the engine stalls.

Diagnosis of these simple devices is very straightforward. The road speed signal appears on the yellow wire (usually yellow/pink on later “Serpentine” vehicles) at the main connector where the fuel injection loom plugs into the vehicle body loom. Obviously the location of this plug varies between models of vehicle. In general for Land Rover vehicles it is at the top of the right-hand foot well (viewed from the driver’s seat) next to the transmission tunnel.

This signal is tested by monitoring the Yellow wire with the positive probe of the Voltmeter, with the negative probe connected to a good chassis ground. Switch on the ignition, and roll (or drive) the vehicle slowly in whichever direction is most convenient. The signal should go up and down between 0-2.0 Volts and 10.5-13.0 Volts, changing every 4-5 metres. This signal is 8000 pulses per mile.

Road speed sensors ***are*** serviceable to a certain extent. They are very simple devices internally, consisting of a toothed magnetic rotor that runs past a reed switch. The reed switch is mounted on a simple circuit board in series with a 120 Ohm resistor. Often the device gets water in it, which destroys the circuit board. Inspection of the device reveals that four bifurcated rivets hold on the end plate. If you drill out the rivets then it will just come apart (no spring-loaded stuff inside!). Reassembly is easy using a small self-tapping screw into each rivet hole.

Note that all Lucas 14CUX (and GEMS systems) have a road speed limiter programmed in their software. According to the model this may be at 105 or 112 MPH. At first sight it appears that you could disconnect the road speed sensor itself to remove the limit, but the only correct way to get around this is to reprogram the ECU. Simply disconnecting it will cause the nasty stalling problems listed above.

Inhibitor Switch Sense – Manual and Automatic Transmission

The ECU uses this inhibitor switch signal to know whether it is managing a vehicle with a manual or an automatic transmission. For an automatic transmission, the ECU needs to know whether the car is in gear or not.

For cars with a manual transmission, this signal is connected to chassis ground via a 510 Ohm resistor. With automatic transmission it is connected to the inhibitor switch. In this case the signal is grounded when the transmission shifter is in the Park or Neutral positions. In gear the signal is allowed to float up, which means 5 Volts normally.

The inhibitor switch signal appears on the orange/black wire at the main connector where the fuel injection loom plugs into the vehicle body loom. Obviously the location of this plug varies between models of vehicle. In general for Land Rover vehicles it is at the top of the right-hand foot well (viewed from the driver's seat) next to the transmission tunnel.

This signal is tested by monitoring the Orange/Black wire with the positive probe of a Voltmeter, with the negative probe connected to a good chassis ground. Switch on the ignition and observe the reading. For a manual transmission, this should be approximately 2.5 Volts. With automatic transmission, the reading should be 0 Volts with the shifter in Park or Neutral, and 5 Volts in gear.

Base Idle Speed

Finally it will be necessary to set the "Base Idle Speed" which is the speed the engine idles at when it is not controlled by the ECU. This operation is performed when the engine is at operating temperature, and all other adjustments are correct. The idle bypass hose between the Idle Speed Control Valve (on the back of the Plenum Chamber) and the throttle body is blocked off using corks or bungs. The engine is then started and the idle speed adjusted using the bypass screw located on the side of the throttle body.

Base Idle speed is usually 525 RPM ± 25 RPM for standard engines. This value should also be used for modified engines unless specified otherwise by your engine or ECU software supplier. The value is always clearly indicated on the ECU label that is supplied with Tornado or Optimax EPROMs.

The vehicle's own Tachometer is rarely accurate enough to be used for this adjustment. A proper professional quality Tachometer must be used to get worthwhile results.

Once the adjustment has been completed, the ECU must be reset to clear the fault code that it will now have registered.

Ignition timing and idle mixture heavily affect Base Idle speed. If any of these things change then it is highly likely that the adjustment will have to be repeated. This can be considered to be a regular service adjustment.

It is important to understand that the Lucas 14CUX system is adaptive, and its idle (and mixture control for catalyst cars) behaviour will change over the first couple of hundred miles. This will always happen after the system has been disconnected or otherwise powered down.

Where the idle speed shoots up to 1800 RPM and takes at least 10 seconds to come down, this usually means that the Base Idle has not been set correctly. For catalyst-equipped cars it may mean that either there is a defective oxygen sensor, or that the basic mixture adjustment is incorrect. Contact your supplier for specialist advice in this case.

Throttle Potentiometer

The potentiometer (or Throttle Position Sensor – TPS) can only be adjusted after the throttle body has been set correctly as specified by Land Rover. Using a digital Voltmeter put the negative probe into the Red/Black wire (engine side of throttle potentiometer plug), and the positive into the Red wire. The throttle potentiometer wires have only two colour codes according to age. The change occurred with the "Serpentine" engine around 1994, as follows:

	EFi Loom	**Early TPS**	**Serpentine TPS**
5 Volt Supply	Yellow	Yellow	Brown
Signal	Red	Red	Green
Ground	Red/Black	Green	Blue

Leave the potentiometer connected. Start the engine and check that the voltage reading is 0.32 – 0.34 Volts.

Incorrect Voltages produce the following symptoms. If it is less than 0.28 Volts, the system will not adjust the idle speed. The idle speed will probably be very low, and the vehicle may tend to stall (note that this is not the only cause of stalling). If the Voltage exceeds 0.38 then the system will not recognise that the throttle is in the idle position, and the idle speed stays at 1100 to 1200 RPM despite setting the Base Idle speed correctly.

If the reading is incorrect then slacken the mounting screws, rotate the potentiometer to achieve the correct reading, and then retighten. Note that some potentiometers do not have slots for the mounting screws, and in this case the mounting holes may need to be elongated to allow adjustment.

Check that the voltage rises smoothly as the throttle is opened. It may be easier to stop the engine before performing this test, but do remember to leave the ignition on when reading the meter. If there is any wear in the potentiometer then it will show up around the low throttle (just off idle) position, since this area gets the most use.

Incidentally, the 5.0 Volt feed on the Yellow wire is derived directly from the ECU internal 5.0 Volt rail, and should be very stable and accurate. If there is a significant deviation then this is a clue to an internal ECU fault, or a major wiring fault.

Airflow Meter

This is one of the key fuel-metering elements of the system. Note that you can drive without an airflow meter in case of emergency (i.e. airflow meter disconnected), because the system will drop into a default (limp-home) mode based on throttle opening.

Most airflow meter faults will cause the engine to run excessively rich. However if the airflow meter remains connected whilst defective then the vehicle will probably not run. In most cases the output from a defective airflow meter will be in the range 2.0-2.5 Volts, which is a viable value. This represents a moderate load and will cause heavy over-fuelling without setting a fault code.

Testing is performed in the following manner. Peel back the rubber boot on the airflow meter connector and leave it plugged in to the airflow meter. Set up the digital multimeter to read voltage. Insert the negative probe into the Red/Black wire (sensor ground), and the positive into the Blue/Green wire (Airflow signal).

Turn on the ignition, but do not start the engine. The meter should immediately indicate a reading of approximately 0.3-0.34 Volts. Most defective airflow meters will overshoot to 0.5 Volts or higher, and take at least 2 seconds to come down to the correct voltage.

Now start the engine, and the reading should rise to 1.6 Volts (3.5 Litre engine) to 1.75 Volts (5.0 Litre engine).

The next test is full load, and as with the fuel pressure test it will require use of a rolling road or a steep hill in the same manner. Under full load the voltage should rise to 4.45 Volts (3.5 Litre engine) to 4.95 Volts (5.0 Litre engine).

On this injection system, the idle CO mixture adjuster is provided on the airflow meter. It is located in a boss on the top of the airflow meter, pointing towards the engine. Leaving the multimeter negative probe in the Red/Black wire, move the positive probe to the Blue/Red wire.

Now turn on the ignition but do not start the engine. Observe the voltage. The normal adjustment range is between 0.0 and 3.6 Volts, with the higher Voltages producing higher idle CO values. There are approximately 20 turns of the adjuster screw to cover the entire range.

Annoyingly, the adjustment may be clockwise or anticlockwise to increase the value, and this varies from meter to meter! For this reason it is always preferable to have the multimeter connected in this manner when adjusting idle CO, so that you see can something is actually happening.

Typical Voltages that would be found at this point are between 0.9 to 1.4 Volts for non-catalyst cars. This Voltage is always factory pre-set to 1.8 Volts for catalyst vehicles. A value near to 3.5 Volts will generally produce an idle CO value of 9-10%. These Voltages may be used as safe initial values particularly if no CO measuring equipment is available.

Coolant and Fuel Temperature Sensors

Both these items are very similar in operation, and can be tested in the same way. Firstly a simple recap on the function of each one. Both of these devices almost always fail open-circuit, and are usually intermittent in the early stages of decline. Whilst they are intermittent they usually play up when hot rather than when cold.

The Coolant Temperature sensor is used to enrich the fuel mixture when the engine is cold. These devices almost always fail open-circuit, which makes the injection system believe that the engine is at somewhere around –40 degrees Centigrade. The system will always detect this as a fault condition, and use a substitute value of 30 degrees Centigrade whilst setting a fault code in the ECU. In practice this means that the car will be difficult to start when cold (too lean), and will be too rich when warmed up. However it will usually get home!

The Fuel Temperature sensor is used to enrich the fuel mixture when the engine is very hot, in order to compensate for decreasing density of the fuel as it approaches boiling point. Failure of this sensor does not produce major symptoms other than slight difficulty with hot starting. The system will always detect this as a fault condition, and use a substitute value of 30 degrees Centigrade whilst setting a fault code in the ECU. Historically, these Fuel Temperature sensors have proved to be very reliable.

A very simple resistance test will give a good indication of the health of the sensor. Disconnect the sensor, and probe it with the multimeter set to measure resistance. The resistance should be approximately 2400-2600 Ohms at 20 degrees Centigrade, and 300-400 Ohms at 80 degrees Centigrade.

Lambda (Oxygen) Sensors

Clearly this item is only applicable to cat equipped vehicles. Note that the vehicle does not use Lambda/Oxygen feedback until the engine has reached 70 degrees Centigrade, the engine speed is below 3100 RPM, and it is below approximately ½ throttle. Faults in this system will produce very rich mixture, and/or high idle speed problems. Symptoms may clear when the engine speed gets over 3100RPM.

When handling the sensors themselves, note that they are quite delicate and a knock on the casing may destroy them. For this reason it is essential that the correct tool should be used to remove and fit them. A special tool is essential for TVR cars, since the sensor is mounted in a recess in the exhaust. If you can't reach it properly with the correct tool then don't touch it.

Over time the oxygen sensors will be damaged or poisoned by any of the following: excess fuel in an excessively rich mixture (especially modified cars with inappropriate chips), leaded fuel, major head gasket failure allowing anti-freeze into the exhaust, physical abuse, or just old age. The typical lifespan of an Oxygen sensor in a healthy engine is 80,000-90,000 Miles.

If you remove the sensors the correct colour for the tips (in the exhaust gas flow) is an even mid to light grey coating after a run. You may see little lumps of carbon beginning to form in the gills of the sensor, or the sensor itself may be fairly black. If there is any significant difference between the appearance of the two sensors then one is almost certainly faulty – usually the blacker one.

A simple electrical test is now necessary by probing the sensor at the connector whilst it is still connected. Wiring colours in this section refer to the sensor side (N.B. the loom colours are different). Colours for this circuit are given in the following table:

	EFi Loom	**Sensor**
Heater	Orange/White	Red
Signal	Blue	Black
Ground	Black	White

With the ignition switched off, test for continuity between the White ground wire and the engine block. There should be no resistance (i.e. a short circuit). Now set the multimeter to read Voltage, and insert the negative probe into the White ground wire, and the positive probe into the Red heater wire.

Now start the engine and check the voltage. There should be 12-14 Volts present when the engine is running, which is the supply for the sensor heater. This comes from the same relay that feeds the fuel pump, and shares the same fuse. If this supply is absent then the sensors will never give the correct reading.

Next the sensor signal itself should be probed. Leave the negative ground probe in the White ground wire, and put the positive probe into the Black signal wire. The voltage here should oscillate up and down between 0.2 and 1.2 Volts approximately 2 to 3 times per second. If the signal is stuck at 0 Volts or over 3.5 Volts then the sensor MAY be defective.

Don't automatically replace it until you are sure it is causing a mixture problem, not just reporting it. If there is a major difference between the behaviour between them then there is a problem. With these sensors a low voltage indicates a lean mixture, and a high voltage indicates a rich mixture is being seen.

Here is an example. If the car is clearly running rich and the Oxygen sensor output voltage is low, then the Oxygen sensor is clearly causing the problem. In response to the information that the mixture is weak, the ECU will keep enriching the fuelling.

Now disconnect the Oxygen sensor, and test the resistance of the heater element. Check the resistance between the sensor White and Red wires, which should between 4 and 6 Ohms. If the heater is not working the sensor will still give a reading, but it will be erroneous most of the time. The sensor needs to operate at a minimum of 350 degrees Centigrade to give reliable signal, which is unlikely to be achieved at idle or light throttle without the heater.

If you do need to replace the sensor and are forced to use a pattern part, make sure it is of the correct type. Some suppliers are offering cheap pattern replacements but beware, because there are two major sensor families. The first and cheapest type is a Zirconia type, which produces a voltage in proportion to the Oxygen level in the exhaust gas. The second type (used here) is the Titania type. This changes resistance in proportion to the Oxygen level, and operates over a wider range of levels than its cheaper cousin. If possible, use an original.

USA Model Fault Codes

North American Specification Land Rover vehicles were equipped with a fault code display module (Lucas 17EM). This was located near to the ECU, and so was usually under the right-hand seat, or under the right-hand side of the dashboard. It is a small box with a two-digit red LED display. Most TVR Griffith and Chimaera models are fitted with the socket for this unit.

A summary of the fault codes is shown in the following table.

Fault Code	Description
03	Fault information has been corrupted
12	Airflow Meter
14	Coolant temperature thermistor
15	Fuel temperature thermistor
17	Throttle position sensor
18	Throttle high when airflow low
19	Throttle low when airflow high
21	Tune select resistor
23	Fuel supply
25	System Misfire
28	Air leak (global)
29	ECU self-check (memory error)
34	Injectors - Bank A
36	Injectors - Bank B
40	System Misfire - Bank A
44	Lambda Sensor - Bank A
45	Lambda Sensor - Bank B
48	Stepper motor or incorrect base idle
50	System Misfire - Bank B
59	Group fault (code 23 & 28)
68	Road speed sensor
69	Neutral/drive switch or Manual resistor
88	Purge valve

Sensor fault codes may indicate problem with associated wiring. Bank A is the left-hand bank when sitting in the driver's seat (cylinders 1,3,5,7), and Bank B is the right-hand bank when sitting in the driver's seat (cylinders 2,4,6,8).

Two other fault codes may be displayed. Code **02** may be displayed for the duration of one journey (between power-up and power-down) and is quite normal. On power-up the code **8.8** may be flashed as a bulb check. Detailed descriptions follow:

Fault Code	Description
02	Live feed to ECU has been interrupted. Normal if ECU has been disconnected to clear old fault codes. Code 02 will clear if ignition turned off for 15 seconds then on again.
03	Stored data corrupted since last trip. No useful information available. Test drive and try again.
12	Airflow meter signal voltage out of range. Possible air leak or wiring fault. In practice this means zero Volts output.
14	Coolant thermistor signal out of range. Faulty sensor or wiring.
15	Fuel thermistor signal out of range. Faulty sensor or wiring.
17	Throttle sensor signal out of range. Sensor needs adjustment or is faulty or has wiring fault. This can cause low speed misfires.
18	Throttle sensor output too high when air flow is low. Large air leak between throttle butterfly and A/F meter or faulty throttle sensor or A/F meter.
19	Throttle sensor output too low when airflow high. Faulty A/F meter or throttle sensor.
21	Tune resistor out of range. Check the tune resistor resistance.
23	Fuel supply - low fuel pressure. Blocked fuel filter or faulty pump or pressure regulator. Valid for cat cars only.
25	Misfire at full load. Faulty plugs, leads, electronic ignition unit, distributor or coil, low fuel pressure or valve or head gasket leak. See 40 and 50. Valid for cat cars only.
28	Air leak (global) in A/F meter hoses, injector seals, inlet manifold gasket, plenum gasket, servo or crankcase vent hoses or Lambda sensors. Valid for cat cars only.
29	ECU self-check (memory error). The ECU is fried, or has a dodgy EPROM.
34	Fuelling fault in injector bank A. Injector or Lambda sensor wiring fault, faulty injectors, air leak at injector seals or inlet manifold, blocked injectors. Valid for cat cars only.
36	Fuelling fault in injector bank B. As above. Valid for cat cars only.
40	System misfire on cylinder bank A. See code 25. Valid for cat cars only.
44	Lambda Sensor - Bank A sensor out of range. Faulty or lead-poisoned sensor or sensor wiring fault. Valid for cat cars only.
45	Lambda Sensor - Bank B sensor out of range. As above. Valid for cat cars only.
48	Stepper motor or incorrect base idle. Stepper motor fully open below 500 rpm or fully closed above 750 rpm. Sticking stepper valve, incorrect base idle speed adjustment, air leak on non-cat cars, incorrect stepper motor adjustment, incorrect throttle butterfly adjustment, rough running because of fuel or ignition or mechanical faults.
50	System Misfire - Bank B. See code. Valid for cat cars only.
59	Group fault (code 23 & 28). ECU is unable to distinguish between faults 23 and 28. Fault occurred for insufficient time for ECU to diagnose.
68	No road speed sensor output at medium rpm and high airflow. Possible sensor or wiring fault (may also cause wrong speedometer readings on electrical speedometer cars).
69	Neutral/drive inhibitor switch or Manual resistor. Sometimes occurs if automatic vehicle put into Drive/Reverse immediately after starting.
88	Purge valve

In case you are wondering, the fault code display unit can be fitted to all 14CUX systems. Where no socket is provided, it is quite straightforward to fit one. A kit is available which contains full details.