

# ELECTRONIC DIAGNOSTICS!

Rover MEMS management system, means he is able to predict some of the most likely troubles in store.

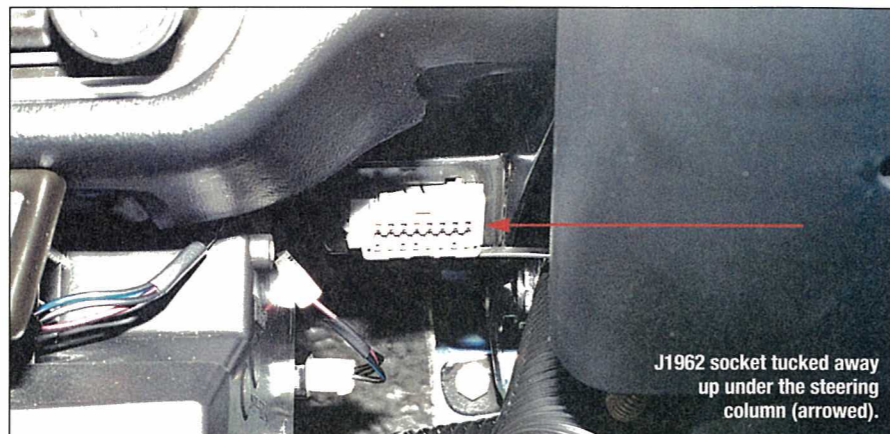
The first potential problem he came up with relates to bad earths. The battery in the Mini is found in the boot, so the earth references have to travel the entire length of the car to reach the negative battery terminal. As with most modern engine management systems, the quality of the earth references is crucial for smooth operation. Frank says that many of the sensors reference the voltage quite close to pure ground, particularly the Lambda sensor. Because of this there is always a potential for earth-related problems.

The symptoms of these can be many and varied, including high throttle potentiometer voltage, poor Lambda switching (where it's not ranging completely down), lean mixture caused by poor injector switching, loss of idle control or a misfiring engine, among others. There is, of course, significant danger of miss-diagnosis. It's easy to jump to the wrong conclusion, blaming either the components or even the ECU, for this problem.

Traditionally there has often been problems with a particular earth return on the offside of the vehicle's bulkhead - the MEMS unit itself returns to this point. The reference has then to travel back through the Mini's body to reach the battery, and down its cable which is bolted to the chassis.

When you check earths they have to be in a 'loaded' condition (ie with a running engine, or one being cranked). Static checks are simply not adequate. A good earth reference would be a maximum of 200mV (0.2V), according to Frank. If this rises to more than 0.5V when the engine's being cranked, then you're starting to get into the problem zone when trouble can strike.

There are no short cuts when dealing with earth problems. The wires



J1962 socket tucked away up under the steering column (arrowed).

must be removed so that the chassis areas can be dressed using an angle grinder. Achieving a bare metal finish is vital, after which a rust inhibitor should be applied - Frank says Vaseline is as good as anything for this. Also, check the earth tabs on the wires and, if necessary, tin-solder them. Often these days they will simply have been crimped at the factory, which can be a source of trouble. If in doubt, re-terminate completely.

In the boot of the car, remove the main earth strap from the chassis and make sure it has a good, bare-metal contact too. Often, Frank says, you find these mounted straight on to paint so the system is relying on thread contact which, quite often, simply isn't good enough. Grind away the paint here as well, if necessary. Also, you might find it advisable in some cases to install additional earth circuits. Frank has done this a number of times by soldering on an additional earth loom and running it from the affected component to a new earth point elsewhere on the chassis.

Frank emphasises the importance of good earth connections, and says that checking them should always be a priority with any engine or management system which is not performing as it should.

Another potential cause of trouble on this application is the crank angle sensor (CAS). This provides the primary input to the ECU and its efficient performance is crucial. Its location, within the bell housing, makes it vulnerable to contamination from metallic dust created as the starter ring gear wears. The

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sensor is magnetic and so attracts this sort of debris. In time the build-up of material on the sensor body will start to have an adverse effect on the quality of the signal it produces, leading to driveability problems, including misfires, then eventually engine failure.

The 'shape' of the sensor's output signal (as viewed on an oscilloscope) is vital, as far as the ECU is concerned. If it becomes distorted by a defect, including metallic contamination, problems are sure to occur. The simplest way to check for this condition is to assess the output signal profile using an oscilloscope.

If it's discovered that any part of the signal trace is miss-shapen, then the chances are that the sensor is at fault. However, don't automatically assume this without checking first. The problem may also be mechanical in nature. Trouble with the phonic wheel, which is bolted on to the flywheel and provides the signal input for the crank angle sensor, can have the same result. The wheel can be damaged during

careless repair work, for example. Bear this in mind if you get a car in with mysterious running problems.

Frank had a typical example in recently, where the car was running, but badly. It appeared to be over-fuelling because the Lambda sensor was not switching and the plugs were visibly sooty. Yet, despite carrying out a thorough assessment of the complete engine management system, no fault could be found. In fact, the only oddity at all was that the ignition timing point was incredibly advanced - by about 60°! The most likely causes of this were a problem with the ECU or a fault with the triggering mechanism. He eliminated the control unit as a cause, only then to find that the trigger signal from the crank angle sensor was good also, so this couldn't be faulted either.

Following a consultation with the dealership which had referred the car, it was discovered that the engine had been running perfectly up until a clutch change (undertaken by a rapid-fit centre!). Knowing this, Frank was immediately suspicious of the phonic wheel and, closer inspection revealed

that it was not bolted correctly to the flywheel. The securing bolt layout means that it is possible to attach this important component in three different positions, although just one is correct. The two wrong positions give ignition which is advanced or retarded by a whopping 60°!

The catch is, that apart from the poor performance, everything else appeared fine. Even the trace on the oscilloscope looked perfect! This particular car arrived with Frank from a Rover main dealer, who ran into a diagnostic brick wall because they were looking at the problem electronically and had not considered the mechanical possibilities.

Finally, Frank thinks there's a possibility of fuel injector problems with this vehicle as mileage builds. Because there are only two injectors supplying the fuel for four cylinders, he believes that each employs a split nozzle arrangement. For this reason the likelihood of trouble is increased. A partial blockage in one or other of the nozzles causes a corresponding increase in flow through the remaining one. This then sets up a fuelling imbalance be-

tween those two cylinders.

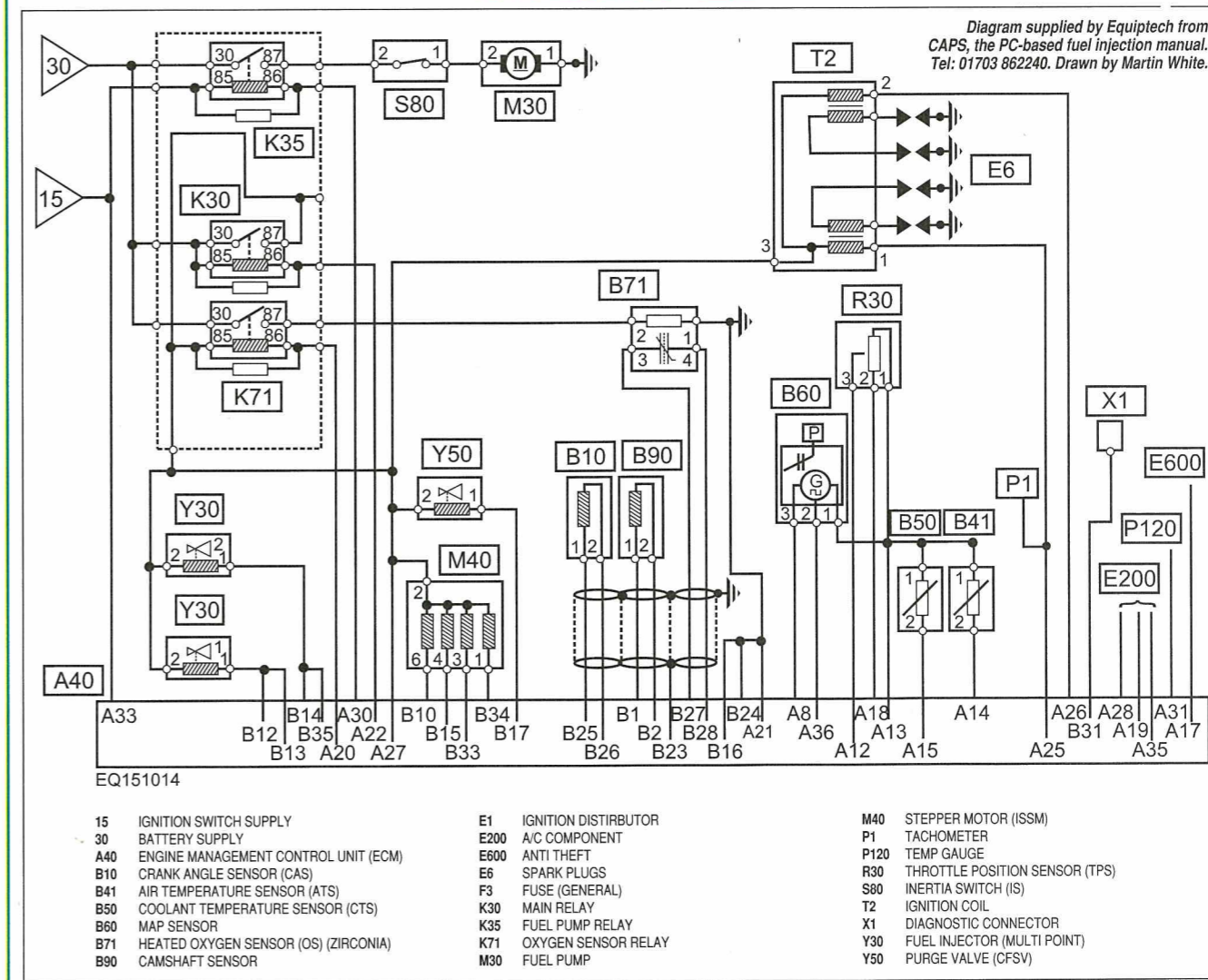
The evidence of this can be seen clearly at the spark plugs. Any which looks out of place will point towards an injector-related problem with that cylinder. Another potential problem can arise if manifold bolts are not tight. This can result in a loss of pressure and driveability problems. Any air leaks on the inlet side will allow in additional oxygen that will be detected by the Lambda sensor, which, in turn, will lean off the mixture accordingly.

An air leak on the exhaust side is potentially even more critical, because this will allow oxygen in after combustion has taken place which will certainly lead to over-fuelling. This will be irrespective of the original mixture quality.

Faulty injectors should be removed and tested professionally using a flow bench so that spray patterns and delivery rates can be assessed accurately. If they do not respond to cleaning then replacement is the only solution.

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## MEMS 2J



## CRANK ANGLE SENSOR PROBLEMS?

