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Technical Newsletter

Automotive Electronic Control Systems

AECS
Training, Equipment and Data for Automotive Diagnostic Specialists

Scan tools, Scopes, or Emission testers?

What equipment do you have to have, to diagnose common electronic faults in modern cars?

This question is often asked by technicians and workshop owners. I would only buy the most effective tool myself and leave the rest. Just to get maximum return on investment, while still being able to do most of the work that comes into the workshop.

I am sure that you would do the same.

Categories

Automotive diagnostic equipment can be categorised into 3 main groups,

Scan tools,
Oscilloscopes, and
Emission testers.

There are many different brands of equipment available in each group. All have merits but some are simply not suitable for NZ market conditions.

There are equally many suppliers of equipment out there, some with back up, and some with just sales staff.

What is best suited for your shop?

That is an individual question; it totally depends on the type of work you get and the technical ability of you or your staff. Let's paint a picture of an average NZ workshop.

Let us say that: The workload is predominant Japanese vehicles, a large percentage of Australian vehicles and a small number of European vehicles.

The average age of the vehicles in the workshop is about 8 years.

There are about 4 technicians on the floor, of which one technician has far higher than average skills.

There will be about 10 vehicles per week coming in, which require diagnosing, as they have faults of which the customer in some cases is not even aware of.

In most workshops, the vehicle is leaving the workshop again with the same faults, the work done was just the work requested by the customer.

How much work?

Let us generalise again. I know as a fact that many worn oxygen sensor go undetected. Do not get me wrong, this is only a portion of the faults you will diagnose when you go fully into this field. I just want to use the slow oxy sensor as an example.

To measure an oxygen sensor pattern with an oscilloscope in recording mode takes about 5 minutes.

To replace an average oxy sensor takes about 0.75 hrs. Labour. Include ordering and stock take of the parts, make it say 1hrs labour.
The aftermarket sensor costs about $100. The sell price to the customer is around $200.

Play with the figures!

Costs

Therefore, to diagnose will set you back 5 minutes times 10 cases per week. This equals 50 minutes of a trained technician's time per week. See this as marketing costs.
Let us assume that 50% of the diagnosed jobs turn into work.

If you are cautious you know on which vehicles you should not even bother measuring (the car is either too new or too old), so the percentage turning into work goes up.
A well-paid diagnostician would cost a workshop $30 per hour inclusive of unproductive time.
Diagnostic time equals 1hrs per week. Fitting the parts equals 5 x 1hrs per week.
Total is 6 hours labour times $30 equals $180 per week.
The costs of parts is $500 (5 x $100) per week.
The diagnostician needs training and equipment, but those investments will be covered later.

Income

Each job in the sample should be charged out at 1hrs labour (+/-$100) and $200 parts.
At 5 jobs per week will this generate 5 x $300, equals $1500 extra turn over per week.
Take away 5 times the costs of parts and labour ($500 + $180)
The net income of this very conservative calculation is:
$1500 - $500 - $180 = $820 per week.
This income arrives every week in your shop and in most shops just leaves again untouched.

Marketing

Think about how much marketing you need to do in the form of advertising etc. to get this as extra income from new customers?
You have already done the marketing; the work has already entered your workshop! You just need to point out to the customer that certain work needs to be done, with compelling evidence in the form of print outs from your scope, scan tool or emission tester.

$820 per week equals $41,000 per year based on 50 weeks.
Just a high quality oscilloscope, which sets you back around $7,000, can generate you a great portion of this money.

Add to that say 2 training seminars at $450 each to keep the skill level of the diagnostician up to scratch, that still leaves you after one year with a net extra income of $33,100.

After one year, the skills of the diagnostician have only increased (experience), so the investment in the training has not diminished.

In addition, there are many of the ATS scopes that are already more than 10 years old, so that investment does not need to be remade again either in the next few years.

Scan tool

A scan tool of around $5,000 can also generate a portion of this income but never as much as a scope can. You can look at some of the fault codes and live data, but you can never go into as much depth as you can with a simple scope measurement.

The worn oxygen sensor case I used as an example can 'sort of' be diagnosed by the scan tool as the short fuel trim will move too far from one extreme to the other, but the reason for it to be slow oscillating is impossible to diagnose with just the scan tool.

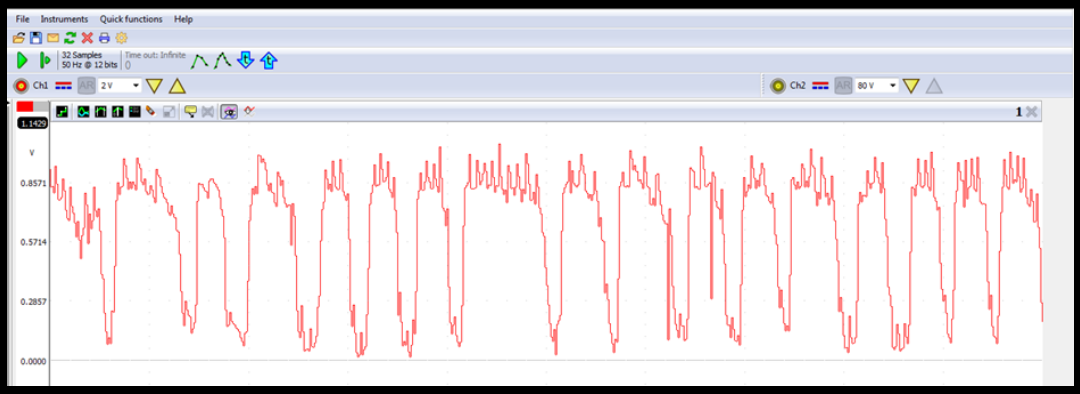
Emission tester

An emission tester of around $6,000 can also generate a yet again smaller portion of that income. You can look at the actual emissions, but a large number of modern systems actually run very clean in limp home mode (when a large fault occurs).

The worn oxygen sensor case I used as a sample can often be seen on the emission tester. Pinpointing that the actual oxy sensor is faulty is nearly impossible. The HC will be higher, the Oxygen will be higher, the CO will be higher, and the CO2 will be lower. The Lambda will possibly be the same, but this could be the result of a whole raft of problems.

Training

It is safe to say that without training none of the equipment is of any use. In for example the EMS 1-1 we spend about 6 hours on just oxygen sensors, and that is honestly just lifting the lid.



Sample oxygen pattern of a good oxygen sensor in a car with inaudible misfire.

The ignition in this sample is not bad enough to make the vehicle misfire completely (detectable by the EOBD system), which would create for example a P030X fault code.

Yet the combustion starts well after top dead centre as a result of a correctly timed, but poor quality spark. The resulting chemical reaction in the combustion chamber sets off too late and partially takes place in the catalyst. The large portion of the fuel does not assist in pushing the car forward; it just contributes to heating the atmosphere around the catalyst.

Scan tool

A scan tool will show in a case like this an off set in the long fuel trim (live data) towards rich. The short fuel trim will show nothing out of the ordinary.

Emission tester

A portion of the unused fuel exits the exhaust as HC's and CO's, straight through the catalyst. Also, unused oxygen will be measured. The overall mixture measurement (Lambda) will show the car is running not too lean and not too rich (λ=1).

No need to say that the fuel consumption of this vehicle will be high

Customer sell

In this case, the vehicle owner needs to be advised that for starters the ignition system needs to be analysed, as his vehicle runs inefficient (fuel consumption high). He also needs to be advised that running like this will damage his catalyst.

In this case, I would use a scope as tool of first choice. One simple measurement tells me enough, it will show me where to measure next, or what I need to replace. In some cases, the problem will be in the HT system but more often is the actual fault in the 12 volt portion of the ignition system.

I would use a scan tool to reset the long fuel trim. I would use the emission tester to check if the catalyst is still working correctly, and has not been damaged by the poor ignition system.

For just the analysis, most workshops AECS are involved with, charge around 1.5 hrs. labour. The actual repair of the problem (wiring or component replacements) usually gets charged as per actuals.

It is easy to show the before and after scope recording with print outs to the customer, which is as good as showing them old parts but is a lot cleaner and has a 'shelf life'.

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