30 June 2007

Ministry of Transport
Attn: Russell Bates
89 The Terrace
P O Box 3175,
WELLINGTON

Dear Russell

Re: **Trial Vehicle Scrappage Scheme in Auckland**

Please find attached the results of the emission testing completed at the Broken Car Collection Company at your request.

Testing commenced on Monday morning the 25th of June 2007.

Testing on **Monday** were:
Paul Hyde (Board Member of ETNZ) AVI number: A03173.
Kevin Hamer (Board Member of ETNZ)
Geoff Parkin (Board Member of ETNZ)
Herbert Leijen (Board Member of ETNZ)
Neville Hawker AVI Number: AO 2648
Sharn Connor AVI Number: AO 3346

Testing on **Tuesday** were:
Paul Hyde
Neville Hawker
Kelvin Patten

After the equipment was set up, inspectors briefed and a test environment created, 163 tests were performed.

Parking of the vehicles was performed by the staff of the Broken Car Collection Company on the first day. Our inspectors parked the cars after testing on the second day.

Oil Temperature

The vehicles were presented in the test lane predominantly already up to operating temperature (oil temperature > 60° C).

The European emission inspection specifies an oil temperature > 80° C, but the nature of these vehicles meant that there would be many with faulty cooling systems and/or thermostats removed, thus not reaching this temperature. No vehicle in the data list was tested with an oil temperature of less than 60° C.

Test Protocol

The emission tests were performed to a consistent standard.

Petrol
For petrol vehicles the two speed idle test:-
1. CO (carbon monoxide) and HC (hydrocarbon) at idle and
2. CO, HC and Lambda at high idle (between 2500 and 3500 RPM).

The two speed idle test, is the test most closely representing congested city driving; light load; throttle position < 20% (less than 1/5th throttle).

Diesel
For diesel vehicles we used the snap acceleration method:-
1. Bringing the engine under full throttle to the governed cut-off speed for three test accelerations, after several clean out accelerations as requested by the test equipment.
2. Taking the average of the three opacity measurements and calculating this back to a K value (opacity coefficient), automatically performed by the test equipment.

Both the petrol and diesel vehicles were also inspected to the current WoF **visual inspection** standard. The Inspectors performing the visual inspections are all current AVIs.

Condition of Vehicles Offered

The condition of the vehicles offered was below the standard found in the current NZ vehicle fleet. This was to be expected from end of life vehicles. However the vehicles were generally in good condition. The majority would have had no problem passing a warrant of fitness after minor repairs. A small percentage of vehicles were in particularly good condition and a corresponding percentage were in very bad condition.

We all agreed that the vehicles were of a standard commonly (and currently) found in the lower socio-economic areas of New Zealand.

Typically repair costs to rectify the mechanical / WOF failure items would exceed the value of the vehicle. We as workshop owners find that owner(s) of these vehicles often do not have the financial resources or the desire to have the remedial work completed.

Certainly there is no pecieved need to have remedial work done when it is emissions related.

Damage to Engines

One vehicle received engine damage during the emission test.

One diesel powered vehicle had a particularly bad engine knock before the tests were performed and on the second snap acceleration test, the engine "blew up" causing an oil spill. This result was expected due to the condition of the engine. In a workshop setting the vehicle would have been refused for an emission test "due to maintenance issues".

One petrol powered vehicle seized it's motor and broke a conrod (major engine damage) upon retrieval from the car park, before testing.

No timing belt breakages occurred.

Environment

The emission tests were completed in a large empty warehouse. Stud height approx. 10 metres. Two large roller doors (B train + size) providing the entry and exit for the test lane.

Air movement through the open doors was considerable (windy conditions), the ambient temperature varied from +/-11 degrees to +/-15 degrees Celsius.

Most vehicles were started and left running (to allow appropriate oil temperatures to be reached) with the tailpipe outside, on the downwind side of the building.

The air pollution in this very large building was creating dizziness and headaches for most present. The haze in the upper building was thick and grey brown, not unlike pictures published of Auckland during a smog day.

The stench of the high levels of hydro carbons was even present the next day in the clothes worn during testing.

Equipment

Two different emission testers were used.

AVL Dicom4000
The equipment used was the German built AVL Dicom4000. The AVL tester is a Daimler Chrysler homologated emission tester. It is used extensively for legal (WoF) testing around the world. Over the past 8 years the AVL has been one of the most commonly sold testers in Germany, Holland, France and Belgium.

Brainbee AGS 200 & OPA 100
The second tester was the Italian built Brainbee AGS 200 and OPA 100 combination.

Both testers were calibrated with a BOC gas mix of 3.5 vol% CO, 2000PPM HC, 14 vol% CO_2 and the remainder of N_2.

A "post testing" testing calibration check will be performed on the emission testing equipment to ensure accuracy, Friday the 6th of July 2007. A report will be forwarded to Mr Russell Bates of the MOT.

Time

42 man hours were spent setting up, instructing, calibrating and performing the 163 vehicle emission tests. This averaged to 15.5 minutes per test.

At peak output, we were able to process 8 inspections per hour with 1 inspector per vehicle (7.5 minutes per test). This included the recording of vehicle details and emission values in a spreadsheet, undertaking the visual inspection and recording its results in a spreadsheet.

Our recommendation for a sole inspector responsible for all functions, would be +/- 10 minutes per test.

Engine Size

We expected the larger engines to be in better condition as they operate under a lighter load. However, this conclusion could not be substantiated from the data.

CO and HC Levels at Idle Petrol

The measurements of CO (half burnt fuel) and HC (various chemical combinations of unburnt fuel) were taken, firstly at idle, as this represents congested urban traffic conditions. It is also part of the world wide applied emission testing protocol.

The maximum level of CO 2.5 Vol% and HC of 250PPM was set based on 20 year old Californian gross polluter limits.

The CO and HC levels measured to pass an emission test in California 20 years ago, were significantly lower than the two levels used in the sample fleet testing we conducted. In California, levels were set according to engine size and vehicle weight.

It is my understanding that 20 years ago exceeding the gross polluter limits resulted in an instant fine, as polluting grossly carried social health risks.

It should be noted that:
Of the 163 vehicles 78 Vehicles exceeded the CO Idle limit **(47.85% fail rate)**
Of the 163 vehicles 98 Vehicles exceeded the HC idle limit **(60.12% fail rate)**

I need to reiterate that the engines were at operating temperature.

CO and HC Levels at Part Load

Petrol
The measurement of CO and HC were taken, secondly at part load, as this represents dense urban traffic conditions. It is also part of the world wide applied emission testing protocol.

It should be noted that the emissions in urban areas are of most concern as this is where both the population and the traffic are dense.

Of the 163 vehicles, 53 Vehicles exceeded the CO part load limit **(32.51% fail rate)**.
Please note some of the staggeringly high values!
11 vehicles exceeded 7 vol% CO!!!

These incredibly high values have detrimental health effects on staff in a workshop setting. Such as headaches, nausea, pins and needles in arms and legs etc.

Of the 163 vehicles, 43 Vehicles exceeded the HC part load limit **(26.38% fail rate)**.

Some of the HC values measured were so much higher than expected, we started to doubt the equipment. For this reason cross checks were performed (indicated in the results table).

Half burnt fuel and unburnt fuel in the emissions indicates common problems such as worn or contaminated injectors, poorly maintained or defective ignition systems, and in some cases mechanical engine failure to name a few.

It should be noted that most of the vehicles had reasonably sound engines, in our opinion (without measuring compressions and other facts). Our opinion is based on a very high level of experience and expertise with these vehicles.

A percentage of the engines had cooling system problems, which can result in expensive repairs, however some of these engines still had good emission levels.

Lambda (λ) Level at Part Load

The lambda level at part load was measured as it represents the mixture preparation process of the engine.

Lambda 1 indicates a good stochiometric mixture (air/fuel ratio). Even if something goes wrong with the combustion process, lambda levels indicate that the engine management system is capable of getting the mixture quantities correct before combustion.

The window of >λ0.95 and < λ 1.05 is more liberal than most countries where emission testing is in place. Standard values for conventional (non-lean burning) engines is > λ 0.97 and < λ 1.03.

Of the 163 vehicles 82 vehicles **failed** the lambda test. The failure rate was **50.31%**
No lean burn engines (Mitsubishi GDI, Nissan QD or Toyota D4) were tested.

Pass Fail Rates Petrol

The proposed pass and fail rates are based on overseas limits and our collective technical expertise with regard to the New Zealand fleet.

Of the 163 vehicles that were tested:

- 129 **failed** the overall limits **(79.14% fail rate)**
- 121 **failed** the emission limits **(74.23% fail rate)**
- 82 **failed** the Lambda calculation test **(50.31% fail rate)**

Visual inspection Petrol

We had three AVI (Authorised Vehicle Inspectors) present, accordingly the decision was made to include the current visual emission inspection data in the results.

Of the 163 vehicles tested only 16 **failed** the visual inspection **(9.8% fail rate)**.
Two (!) of those vehicles have **passed** the relaxed ETNZ tailpipe emission testing standards.

There is in the writer's opinion no relation between harmful emissions and the current visual inspection.

Some of the worst emitters (e.g. 1.5 ltr Mazda BG5S111941) pass the visual inspection, at considerable health risk to the inspector, who has to stand behind the running vehicle to complete the inspection, day in - day out.

Vehicles should not be allowed to run inside buildings (garages) without extraction equipment attached to the exhaust, which makes the visual inspection impossible.

Emission Inspection Diesel

A very low number of diesel vehicles were offered to us for testing (9 of 163).
We performed 9 emission inspections for diesel vehicles, of which one vehicle was tested twice for a cross check.

Perhaps the owner(s) retain ownership longer, due to the lower fuel cost.

Only one vehicle passed the K value inspection as it was lower than K=4 (relaxed ETNZ limit) and it was lower than K=2.5 (European non turbo limit).
No visual inspection data was recorded as all were emitting dense smoke. A discussion amongst the inspectors did not resolve what constituted too much smoke.

It should be noted that any engine over K=4 has a mechanical fault, effecting engine efficiency.

Thank you for the opportunity to perform these inspections. We look forward to being of further assistance.

If you have any questions or need any clarification on this report, please do not hesitate to contact us.

Yours sincerely
For ETNZ ltd
Herbert Leijen (Director)

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