



JEVIC NZ LTD

EMISSIONS TAIL PIPE TEST TRIAL

FINAL REPORT

CLIENT: MINISTRY OF TRANSPORT



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1. INTRODUCTION

Japan Export Vehicle Inspection Center Co., Ltd (JEVIC) is pleased to present to the Ministry of Transport (MoT) the final report related to the trial emission testing in Japan on used vehicles destined for New Zealand.

The purpose of this assignment was to provide the Ministry with the relevant information and data from vehicles undergoing Emissions Tail Pipe Testing in Japan.

JEVIC acknowledges that this work/engagement and subsequent analysis of this work is intrinsically linked to the development of any changes to emission control standards and requirements on imported vehicles to New Zealand.

2. JAPANESE SECOND HAND VEHICLE TRADE AND NEW ZEALAND MARKET

The Total Cars at Auction in Japan per year are 4,000,000. Japan exports approximately 1,000,000 used vehicles worldwide per annum. The Japan Customs figures for the 2005 year (April '05-March '06) for used export vehicles from Japan show that NZ is ranked second in the number of units taken;

Japan Customs Export Statistics

2005 Japan Customs Figures of Used Vehicles To NZ, and Top 5 Export Destinations	
Passenger:	817,067 units
Commercial:	198,139 units
Total (2005):	<u>1,015,206 units</u>
Top 5 Export Destinations:	
Russia:	303,340
NZ:	122,131 (113,244 Passenger and 8907 Commercial) ¹
UAE:	118,421
UK:	30,019
Pakistan:	25,890

Note 1: These figures are different from the NZ arrivals, as this is the financial yr (March 05 to April 06)

In 2005 New Zealand imported vehicles from over 80 different countries:

- 176,000 used vehicles and 110,000 new vehicles
- 90% of used vehicles were imported from Japan



The key processing point for these vehicles, apart from the auction system, is at the port. For New Zealand bound vehicles the exporter / importer can choose to have their vehicles pre-inspected in Japan, conducting the Ministry of Agriculture and Forestry Quarantine Service biosecurity and Land Transport New Zealand safety border inspections prior to the vehicle being loaded on to a vessel. This reduces the time lag in New Zealand upon discharge (see Appendix 2 for the schematic diagram). The majority of vehicles exported from Japan undergo this industry-led pre-inspection process.

Used Japanese Imports arrivals and registered

Year	Total Registered	Total Arrived ¹
2002	146,944	153,626
2003	169,771	178,717
2004	169,292	170,506
2005	166,466	175,669
2006 to July	83,705	81,473

Top 10 used import cars by model April – June 2006

Make	Model	Total
Subaru	Legacy	1657
Honda	Odyssey	1139
Nissan	Primera	966
Subaru	Impreza	884
Mazda	Familia	868
Toyota	RAV4	857
Nissan	Pulsar	764
Mitsubishi	Legnum	743
Toyota	Caldina	735
Toyota	Corolla	660

It is worth noting that New Zealand does not have a stand-alone Government sponsored pre-inspection program for emissions. One example is that Kenya requires mandatory pre-shipment emission testing of vehicles prior to export.

The KENYA BUREAU OF STANDARDS requires Pre-Export Verification of Conformity for used vehicles imported in to Kenya. All vehicles, with exception for specialist units, shall be inspected for Road Worthiness, safety and other requirements to the Kenya Standard Code of Practice for Inspection of Road Vehicles [KS 1515:2000]. This includes items such as lighting testing, brake tests, functionality, damage inspections and emission testing.

¹ A number of vehicles that arrive in the country are not then registered in the NZ fleet. This is due to some being used as parts and others being housed in warehouses for later release and sale.



3. JAPANESE IN SERVICE VEHICLE TESTING “THE SHAKEN TEST”

Shaken (車検) is the name of the regulatory periodic vehicle inspection program in Japan. When a vehicle turns 3 years old, it must get an inspection every two years thereafter. The shaken is the Japanese equivalent of a New Zealand Warrant of Fitness.

All new cars are sold with a three-year "shaken" (warrant of fitness). Consequently, most vehicles available on the used market are 3,5,7 and 9 years old as they are usually traded in or sold by the user when the "shaken" expires, not as a result of a failed test.

The Shaken test is not significantly different than the New Zealand Warrant of Fitness test but the cost of the test is significantly higher. (NZD\$2500)

The Japanese legislation that governs Japanese in-service testing is:

- Article 31 from the Vehicle Act 2005 – New road transport vehicle safety standards, Ministerial ordinances and notices.
- Automobile NOx/PM Law – Vehicle Type Regulations issued jointly by the Ministry of the Environment and the Ministry of Land, Infrastructure and Transport

Japanese emission limits for the Shaken test are:

PETROL		
Category of motor vehicles	Carbon monoxide	Hydro-carbons
A. Motor vehicles with a two-cycle engine	4.5%	7,800 ppm
B. Motor cycles with or without sidecar with a four-cycle engine	4.5%	2,000 ppm
C. Mini-sized motor vehicles with a four-cycle engine (except motor cycles with or without sidecar)	2%	500 ppm
D. Motor vehicles other than those posted in Items A through C	1%	300 ppm
DIESEL		
The degree of pollution by diesel smoke from the exhaust pipe to the atmosphere shall be 25% or less (40% or less in the case of large-sized special motor vehicles and small-sized special motor vehicles).		



4. EMISSION TESTING

JEVIC undertook a tail-pipe emissions test and data analysis on behalf of the Ministry of Transport on used vehicles bound for New Zealand. JEVIC completed the tail pipe emissions test to the in-service Shaken (Japanese regulatory periodic vehicle inspection) test currently completed on vehicles in Japan.

The tail-pipe emissions tests were completed during a four (4) week period beginning the 1st of September 2006 and 3132 vehicles were inspected. The testing was completed concurrently at the three (3) JEVIC port facilities at Yokohama (Tokyo), Nagoya and Osaka. These ports are the main export gateways for used vehicles to New Zealand.

New Zealand Automobile Association (NZAA) completed Quality Assurance of the tail pipe testing process and undertook the marketing and publicity of this testing, in conjunction with the MoT.

5. VEHICLE MARKING

Vehicles that passed the emission testing according to the Japanese Shaken test standard were marked with an Emissions Tested sticker.

Emissions Test Sticker



6. WHY TEST TO THE JAPANESE STANDARD?

Current (New Zealand) rules only require vehicles imported into New Zealand to have been built to the emissions standards that applied when they were first manufactured, but don't require them to show that they still meet these standards when they are inspected and achieve compliance in New Zealand or at W.O.F.

There is little information currently available on the quality of second hand vehicles arriving in New Zealand from Japan.

The Ministry of Transport requested that the vehicles tested in this project were tested to the current in service Japanese emissions test rather than any other test to identify evidence that the vehicles still meet the current Japanese emission standards.



This emissions trial tested Japanese vehicles that were first registered in Japan and built to Japanese type designation build standards; with the current Japanese in service emission test, which is part of the Shaken periodic regulatory inspection.

This emission test trial used the current Shaken emission testing standards to measure the performance of vehicles that had been deregistered for export from Japan to New Zealand.

Most of these vehicles would have passed the Japanese Shaken test within the past two (2) years.

7. SUMMARY OF TESTING RESULTS

The total number of Emission Inspections undertaken as part of this trial was 3,132 vehicles; this was made up of 108 diesel vehicle tests and 3024 petrol vehicle tests.

It should be noted that the sample group of Diesel tests was small (108 inspections) due to the limited number of diesel vehicles available for inspection at the Yokohama testing facility during the testing period.

Of the total 3132 (diesel and petrol) inspections undertaken, 2511 vehicles passed the emissions testing. Of the 3024 petrol vehicle tests, 2447 passed the test.

To follow are some initial high level summary of the testing results.

It should be noted that JEVIC was not asked to provide detailed analysis of the results as part of this assignment.



Failures by type and port

Port	Total Inspections	Diesel failures	Total Petrol Failures	Overall Total Failures		
ALL VEHICLES	3132	44 (40%)	577 (19%)	621 (20%)		
DIESEL						
Yokohama	108	44 (40%)				
PETROL	3024		577 (19%)			
				CO Failures	HC Failures	Failed both tests
Osaka	1326			59 (4%)	266 (20%)	35
Nagoya	806			56 (6%)	128 (15%)	30
Yokohama	892			18 (2%)	50 (5%)	7
				133	444	72

Extreme Results

Make	Model	Mileage	Reading
Diesel Failures			
Isuzu	Bighorn	134,000	66.5%
Isuzu	MU	82,000	53%
CO Failures			
Nissan	Sunny	68,000	8.9%
VW	Polo	42,000	8.35%
Nissan	Laurel	100,000	8.26%
HC Failures			
Ford	Festiva	80,000	3550 ppm
Mitsubishi	Mirage	82,000	3510 ppm
Mitsubishi	Lancer	36,000	2600 ppm



8. HC FAILURES

The current pass level for the Japanese in service emission test is 300ppm (standard size petrol passenger vehicle).

High level analysis of the raw data from the emission testing has highlighted the number of vehicles that are failing the HC emissions test component with a range of between 300 and 400ppm. It is worth noting that the European standard for HC testing is 1000ppm.

The following table shows that from the sample group of 444 HC failures, that 239 (53%) failed in the range of 300 to 400ppm.

This highlights that a number of the vehicles tested in this trial are marginally failing the HC emission test.

It may be possible that some of these vehicles, with corrective maintenance such as an engine tune up and spark plug replacement could in fact pass the HC emissions test.

HC failure analysis - failure range of 300 to 400ppm

Site	300-400 ppm failures	% of all failures (444)	failures 300 to 349 ppm	% of total	failures 350 to 400 ppm	% of total
Osaka	138	51%	75	54%	63	46%
Nagoya	72	56%	36	50%	36	50%
Yokohama	29	58%	17	58%	12	42%
TOTAL	239	53%	128	53%	111	47%



9. RAW DATA

JEVIC has collated the raw data collected during this emission testing trial. The information has been entered into a spreadsheet format and has been presented to the Ministry of Transport under a separate cover.

No data is available on pass/fail rates in Japan. We have been unable to compare the results of this emissions test initiative with any comparative Japanese information. It is recommended that Ministry officials request this information from the MLIT when in Japan in November 2006.

JEVIC have conducted an internal quality assurance review of the data collection and reporting of the raw data. A 10% QA sample was undertaken and no errors were present related to the recording of emission test data. However two examples of odometer transposition of numbers required correction.

10. INSPECTOR TRAINING

A specific Procedure Manual (in English and Japanese) was created solely for this exercise, which included the areas of;

Resources:

Training:

Vehicle Selection:

Testing:

Health and Safety:

Data Recording:

Quality Control:

Vehicle Marking:



All Yokohama inspection staff and supervisory staff from Nagoya and Osaka were present for the training provided by the suppliers of the equipment, which included training in calibration, maintenance and practical use of the equipment.

11. QUALITY ASSURANCE AND AUDIT

At the request of the MoT, the NZAA was asked to complete quality assurance and media coverage. The NZAA supplied a senior engineer who travelled to Japan to visit all three testing sites, observed testing in progress and reviewed procedures and training. The purpose of the audit was to measure the operational performance of the test sites in relation to the procedures established for the trial.

All requirements were addressed and at the conclusion of the audit the New Zealand Automobile Association and the Ministry of Transport were satisfied with the results stating all of the testing sites were compliant with the process.



12. EMISSION TESTING EQUIPMENT

The following equipment was used for this trial (See Appendix 1 for the equipment specifications):

- The gas emission testing machines for petrol light vehicles will measure the CO and HC levels. Equipment used was the **Horiba MEXA 324L**. The gas emission testing machines for diesel light vehicles is a smoke meter and results printed by the meter machine. Equipment used was the **Anzen DSM-2000**.
- The equipment was leased for this trial, and JEVIC was provided with brand new equipment. Included was training in the calibration, maintenance and practical use of the equipment.



- All units were calibrated as required following the manufacturers instructions, for the Horiba MEXA equipment this required the use of a reference gas mixture. With the Anzen equipment, calibration was by use of the reference filter.
- Purchase costs of the machines;
Petrol: Horiba MEXA 324L (approximately) JPY¥600,000 (NZ\$7,500).
Anzen DSM-2000 (approximately) JPY¥458,000 (NZ\$5,800).

13. OSH ISSUES

The inspection staff did find it necessary to wear face masks during the Diesel testing due to the required purge cycle. None of the inspections were conducted in an enclosed space. This resulted in the inspections being undertaken in open spaces and not in the standard inspection area, or while the vehicles were on the inspection ramps.

There are potential implications for future diesel testing related to the facilitation of the logistical inspection cycle and the need to move these vehicles from the regulatory inspection area to a separate dedicated emissions testing area. This resulted in a longer test time and impacted on the ability to test these vehicles in a timely manner.

It is recommended that the Ministry raise these OSH issues with the MLIT at the meetings in Japan in November to gain an understanding of how excessive soot and emissions are dealt with during the Shaken test and how any OSH compliance initiatives can be integrated into the port inspection process.

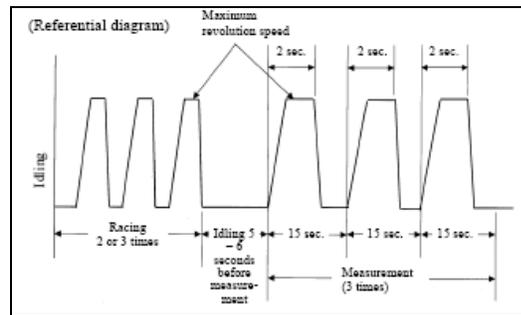


The photo below shows an example of an area used for testing.

Area used for Diesel Testing



Diesel Purge Testing Cycle



14. LOGISTICS

JEVIC undertook to integrate the emissions testing into the current vehicle inspection regime. This was to utilise the inspection cycle, minimise the number of vehicle movements and to ensure all available units were tested in the trial.

It was envisaged that the tests could be conducted (1) prior to an external quarantine inspection or (2) during an external quarantine inspection which is carried out by the Ministry of Agriculture and Forestry Quarantine Service (MAFQS). This would achieve the goals utilising the current inspection cycle and minimising vehicle movements, the end result being cost effective.

Due to each vehicle being required to be brought up to operating temperature, it was realised that at either of the stages the vehicle would not be at the correct operating temperature which ultimately would result in an inaccurate reading. Thus, during the trials completed by JEVIC, vehicles were individually brought up to operating temperature and inspected separately from all other inspections.

If further implementation was to be considered, JEVIC would prefer to implement such an inspection at the end of the external quarantine inspection where the vehicle would have had ample time to be brought up to operating temperature and no additional movement of the vehicle required. Time of the actual inspection and labour would be the only addition to the current inspection cycle.



15. TECHNICAL CHALLENGES

The following are a summary of the technical challenges encountered during this trial:

Basic economies of scale with regard to mandatory treatment would cause the reduction of costs, as issues such as process, vehicle/client selections, logistical movement within the facilities and data reporting would be able to be streamlined into the current processes.

Sub-trial on the relevance of the engine temperature and the effect of purging prior to testing:

Upon the completion of two weeks of testing it was evident from the testing results that the majority of vehicles that failed the emissions test, failed the HC test. JEVIC raised this failure rate on HC issue with the Ministry and we agreed the following. JEVIC conducted the following quality assurance procedure to validate the HC testing in Japan.

Ten petrol vehicles were placed through a regime of:

- 1st inspection: testing when cold,
- 2nd Inspection testing at operating temperature
- 3rd again after a purge (operated under the same conditions as for the diesel testing).

The results showed:

- 7 of the 10 units showed a reduction in the HC levels, with two units (units 6 and 7) showing enough reduction to move from “failing” to “passing” the testing.
- The Purge (revving of engine) used was the same as the Diesel Testing purge (3 accelerations of engine speed).
- All but one (1) unit also showed a reduction in the CO% (results not shown).

Hydrocarbon Readings from Petrol Vehicle Purge Trial

HC Readings after purge trial (22-08-06)				
Unit	Cold	Warm	After Purge	Reduction
1	250	28	32	No
2	232	192	210	No
3	433	97	69	Yes
4	320	244	231	Yes
5	227	234	64	Yes
6	337	333	244	Yes
7	351	335	159	Yes
8	430	442	447	No
9	249	58	33	Yes
10	150	192	158	Yes

This sub-trial, along with independent advice provided by the Ministry of Transport suggests the high HC results are a result of vehicles sitting idle at the port inspection facilities and not driven for a number of weeks before testing. Minor changes in the facilitation of the testing procedure might result in a number of the vehicles that failed to pass.



The results of the purge testing were provided to the Ministry of Transport for review. The Ministry advised JEVIC that the results did not cause any issues and the Ministry confirmed that they would not require any change to the testing procedure in light of the new information. The new data gave the Ministry the comfort that the test was being carried out properly and that the findings were valid for this type of test.

There was a limit to the portability of the equipment used due to the following;

- The Horiba MEXA equipment required constant power supply, and is sensitive to weather conditions, such as heavy rain conditions.
- The Anzen equipment is not portable, requiring power supply and compressed air.

16. COSTING

The Ministry has asked JEVIC to provide some indicative costing calculations based on the implementation of emission testing in Japan.

The costing for emission testing in Japan is extremely difficult to equate as there are many variables.

With this in mind JEVIC can offer two different scenarios.

1. Emission testing is completed in conjunction with no other inspection. This would require:
 - additional labour
 - longer time per inspection, as vehicles would be in stack position and would need to be brought up to operating temperature
 - additional equipment to make the inspection tools mobile

Cost: Estimate includes:

- Labour
- Equipment
- Internal Quality Audits
- Administration
- NZ\$45 – NZ\$50 per vehicle

2. Emission testing is completed in conjunction with other inspections (NZ MAF). This would be the recommendation of JEVIC for vehicles that are currently completed in Japan.

Cost: Estimate includes:

- Labour
- Equipment
- Internal Quality Audits
- Administration
- NZ\$25 – NZ\$30 per vehicle



17. CONCLUSIONS

The purpose of this assignment was to provide the Ministry with relevant information and data from vehicles undergoing Emissions Tail Pipe testing in Japan.

The information contained in the raw data has achieved this purpose.

The facilitation of the diesel and petrol emission testing across three port inspection facilities in Japan has also identified a number of opportunities and issues for the Ministry which require consideration for future development of policies that focuses on emission testing.

The current used vehicle pathway allows for NZMAF / LTNZ pre clearance to be undertaken by applying the "border" in Japan at the wharf or in New Zealand upon arrival. Approximately 65% of all vehicles are pre-cleared in Japan with 35% completed upon arrival.

The emissions testing was undertaken in Japan to replicate potential conditions should an inspection be introduced at the border (in Japan) for used Japanese vehicles that are being exported to New Zealand. It is JEVIC's opinion that the testing of vehicle emissions can be integrated into the current regime of pre-shipment inspection in Japan.

A key decision point for the Ministry will be what policies will be applied to vehicles that fail the emission test? Different policies and rules for petrol and diesel may need to be implemented.

The diesel testing failures from this trial indicated that the vehicles failing can be considered gross emitters and may have major engine or exhaust failures. It should be noted that the number of diesel vehicles being inspected at JEVIC inspection facilities has been declining. This is in part driven by the exporters having no demand from New Zealand importers to source these types of vehicles due to recent trends in New Zealand, such as the demand for smaller engine petrol vehicles due to the recent high price of fuel.

There is also a recent trend in a reduction of used commercial vehicles (including diesel vehicles) imported from Japan to New Zealand. This segment of the market is on average down 15% to 20% on YTD figures.

The petrol testing failures point to a number of the vehicles failing on the Hydro Carbon test. Possible remedies may include minor mechanical maintenance such as tuning and spark plug replacement. Thus allowing the vehicles to be re-tested and certified. This work could be completed either pre-export or upon arrival in NZ.

Should emission testing be introduced, the quality of vehicles being exported to New Zealand could potentially improve, as a result of an increase in later model vehicles being imported into New Zealand in order to meet the standard.



With the condition that emission testing was undertaken in Japan as a part of the certification process:

- It is possible to consider that some exporters would chose not to export vehicles to New Zealand which require substantial repair thus resulting in the vehicle being cancelled for export.
- The importers may see this as a valuable tool, in assessing the quality of the vehicles engine, but it is unknown to what extent that a failure for emissions standards would equate to an expensive engine re-condition or merely a change of spark plugs.

With the implementation of specific objectives and backing from the Ministry and LTNZ, voluntary emissions testing might be able to be formed into to a product if there were clear benefits to both the importer and end user. A working example is the Japanese Environmental Performance Certification for low-emission vehicles. This offers financial concessions to the registered user.



Appendix 1: Technical Specifications of the equipment used in the Emissions Testing.

Equipment for Petrol vehicle emissions measurement:

Specification	MEXA 324- 2 Gas Petrol Emissions Tester
Ranges	CO: 0-10% vol HC: 0-10,000 or 0-20,000 ppm, depending on model
Resolution	CO: 0.01% vol HC: <u>For 0-10K range:</u> 0-2k ppm: 1 ppm 2K-10K ppm: 10 ppm <u>For 0-20K range:</u> 0-4K ppm: 2 ppm 4K-20K ppm: 10 ppm
Response Time	Td + T ₉₀ : less than 10 s Td + T ₉₅ : less than 15 s
Dimensions and Weight	W x H x D 271 x 143 x 366 mm 10.6 x 5.6 x 14.4 in 4 kgs / 8.8 lbs.

Equipment for Diesel vehicle emissions measurement:

Specification	Anzen DSM-2000- Diesel Black Smoke Tester
Range And Display Type	0-100%
Accuracy	full scale +/-3%
Aspiration Time And Volume	1.4 +/-0.2 seconds 330 +/-15ml
Weight	16.5kg net



Appendix 2: Schematic of the used vehicle pathway for vehicles exported from Japan to New Zealand

