



Gas Technology Services

1136 NEPEAN HIGHWAY
HIGHETT VICTORIA 3190 AUSTRALIA

PO BOX 83
HIGHETT VICTORIA 3190 AUSTRALIA

TELEPHONE +61 3 9556 6222
FACSIMILE +61 3 9555 7616

EMAIL
gastech@gastechnology.com.au

WEBSITE
<http://www.gastechnology.com.au>

Emissions Testing Conducted For Linfox Transport Using Dipetane Fuel Treatment

April 2000 to November 2000

Approved:

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Executive Summary

Gas Technology Services is one of the acknowledged leaders in the supply of support services to the Australasian energy industry. We operate a NATA accredited and ISO9001 endorsed laboratory and educational facilities, which set the industry standard.

Services range from field and laboratory testing to consulting, training and information research. Our expertise is built on more than 150 years of gas industry experience with a staff who collectively represent the greatest concentration of gas technology knowledge in Australia.

A full description of Gas Technology Services and accreditation's is contained in Section 2 of this report.

Gas Technology Services were commissioned to conduct a range of independent emissions testing on two trucks owned and operated by the Linfox Group of Companies. The vehicles upon which the testing has been conducted are two 1994 FLC 112 Mercedes Benz prime movers, using diesel, which pull B-Double trailers. These vehicles, identified as Fox 781 and Fox 783, are dedicated to full time use on the Coca-Cola contract services provided by Linfox. The vehicles operate from the Linfox Clayton site in Victoria.

The emission testing was conducted as part of an independent study to determine the effects of a fuel technology known as Dipetane Fuel Treatment. We understand that the study was being undertaken by Linfox in order to assess the capabilities of Dipetane to reduce both fuel consumption and emissions.

The study was conducted over a period of 8 months (April 2000 to November 2000). Our involvement in the study has consisted of two stages, which have been conducted on the following basis:

Stage 1 - April 2000.

Sampling and on-line analysis of exhaust gases – *prior to the addition of Dipetane*

Stage 2 - November 2000.

Sampling and on-line analysis of exhaust gases - *after the addition and ongoing use of Dipetane for 8 months*

The fully detailed independent findings from this study show a significant reduction in emissions between Stage 1 and Stage 2. Testing was completed at 0 RPM and 2000 RPM. The test results are summarised as follows:

Emission Type	Max % Reduction Achieved
Carbon Dioxide - CO ₂	23.0%
Carbon Monoxide – CO	9.5%
Nitrogen Oxides - NO _x	35.4%
Sulphur Oxides - SO _x	26.8%
Smoke Density – Opacity	61.5%

Gas Technology Services Materials

The study also showed an increase in the level of Oxygen output between Stage 1 and Stage 2 up to 4.8%.

A detailed description of the test results is contained in Section 1 of this report.

The emission tests performed on the Linfox prime movers, Fox 781 and Fox 783, showed a significant reduction of air contaminants in the exhaust gases and increased the level of oxygen output.

The testing conducted by Gas Technology Services did not include an assessment of the reduction in emissions due to less fuel being used in the testing period. It is only a measure of emissions from the amount of fuel being combusted. Any reduction in fuel consumption over the testing period (not taken into account in this report) would also result in a corresponding reduction in emissions.

The reductions in emissions suggest that, with all other parameters remaining constant, Dipetane would be producing an improvement and efficiencies in the combustion chamber.

The reduction in emissions would be considered a flow on effect from a more efficient combustion process. Greater efficiency in the combustion of fuel will result in a reduction in consumption and therefore greater fuel economy.

Section 1

GTS Emissions Testing

Methodology

SUMMARY

Gas Technology Services (GTS) has conducted testing of a range of emissions from two heavy duty diesel Linfox prime movers, both before and after the addition of a product known as Dipetane Fuel Treatment (Dipetane).

The trucks chosen for the study were Fox 781 and Fox 783. Both are 1994 FLC 112 Mercedes Benz prime movers pulling B-Double trailers dedicated to the Coca Cola contract operated by Linfox from a depot based at Clayton, Victoria.

Measurements were executed by direct reading methods from sampling points at the Linfox Clayton site, and by collection of emission gas samples with subsequent analysis in the GTS laboratory. Copies of photos indicating testing conditions on site is contained in Attachment 1 to the rear of this report.

OVERVIEW OF EMISSIONS TESTING

GTS was initially instructed in February 2000 to conduct a full range of emissions tests on the two Linfox vehicles. GTS provided advice as to the most suitable parameters for testing including measurement of Carbon Dioxide, Carbon Monoxide, Oxygen, Sulphur Oxides, Nitrogen Oxides concentrations and smoke / particulate testing. This basis incorporates the range of exhaust gases and particulate emitted by the diesel trucks.

The testing has been conducted following the requirements of Environmental Protection Authority (EPA) standard methods and internationally recognised ASTM (American Society for Testing and Materials) standards and using the NATA calibrated instrumentation and ISO 9001 endorsed GTS Work Instructions.

The basis of testing derived to best understand the performance of Dipetane was a before and after basis. Therefore full emissions testing both on site and laboratory based from onsite samples were conducted before treating the diesel with Dipetane and after the treatment and ongoing use of Dipetane treated diesel in the trucks.

The emission tests performed on both Fox 781 and Fox 783 (before and after Dipetane) were conducted at 0 rpm (idle) and at a constant 2000 rpm. These tests were conducted under static load conditions (stationery vehicles).

Initial sampling and on-line analysis of exhaust gases (before adding Dipetane) was performed on April 07, 2000 at the Linfox Clayton site. We recorded the indicative odometer readings of each truck at this point in time. The vehicles had completed the following approximate kilometres:

Fox 781 – 690,000 km's
Fox 783 – 640,000 km's

Upon completion of the initial phase of testing, Linfox conducted a controlled program of adding Dipetane to the diesel tanks of both trucks for a period of 8 months. This program was conducted under the direct responsibility of the Workshop Manager at the Clayton site. We are informed that the product was added at a ratio of 1 litre of Dipetane for every 200 litres of diesel during the 8-month trial period.

A final set of sampling and on-line analysis of exhaust gases, after continuous addition of Dipetane to the fuel, was carried out on November 20, 2000. Each truck at this point in time had travelled the following approximate kilometres:

Fox 781 – 730,000 km's (Approx. 40,000 kilometres travelled during Dipetane trial)
Fox 783 – 690,000 km's (Approx. 50,000 kilometres travelled during Dipetane trial)

Analysis, Findings & Discussion

Carbon Dioxide Determination

Carbon Dioxide determination was carried out according to Environment Protection Authority (Victoria) Standard Analytical Method B4 'Carbon Dioxide (NDIR)'. The concentration of carbon oxides was determined by use of an ADC CO/CO₂ Analyser.

A principle of non-dispersive infrared (NDIR) spectrophotometric method was utilised and undertaken. This includes the sample passing into a measuring cell of an instrument where it absorbs energy in the infrared region. The difference in absorption between the sample and reference cells is detected by detector cells and converted to the concentration units.

The results of the CO₂ concentration measurements are shown in Table 1 and Figure 1:

Table 1: Results of Carbon Dioxide Determination

Vehicle	Rpm 0 = idle	CO ₂ % volume		% Reduction of CO ₂ concentration after use of Dipetane
		Before use of Dipetane	After use of Dipetane	
FOX 781	0	1.52	1.17	23.0%
	2000	2.23	1.89	15.2%
FOX 783	0	1.68	1.39	17.3%
	2000	2.34	2.02	13.7%

Figure 1: Results of Carbon Dioxide Measurements

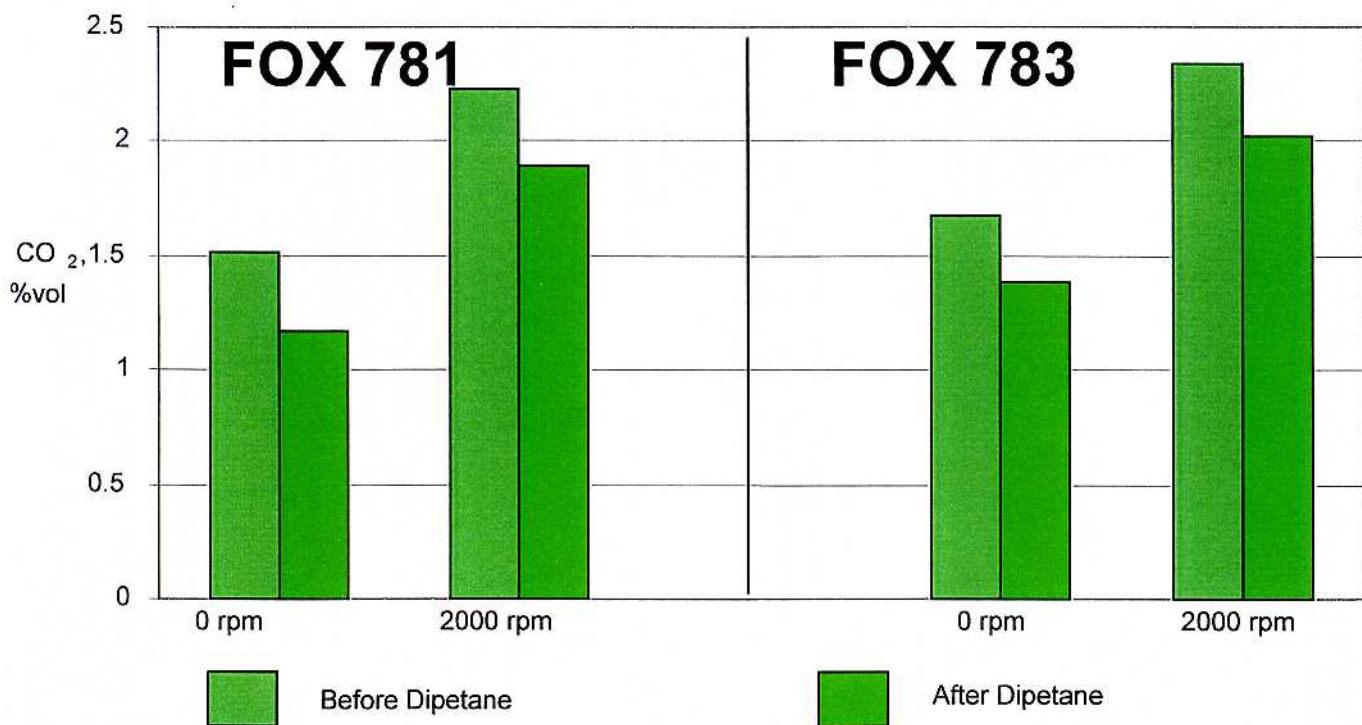
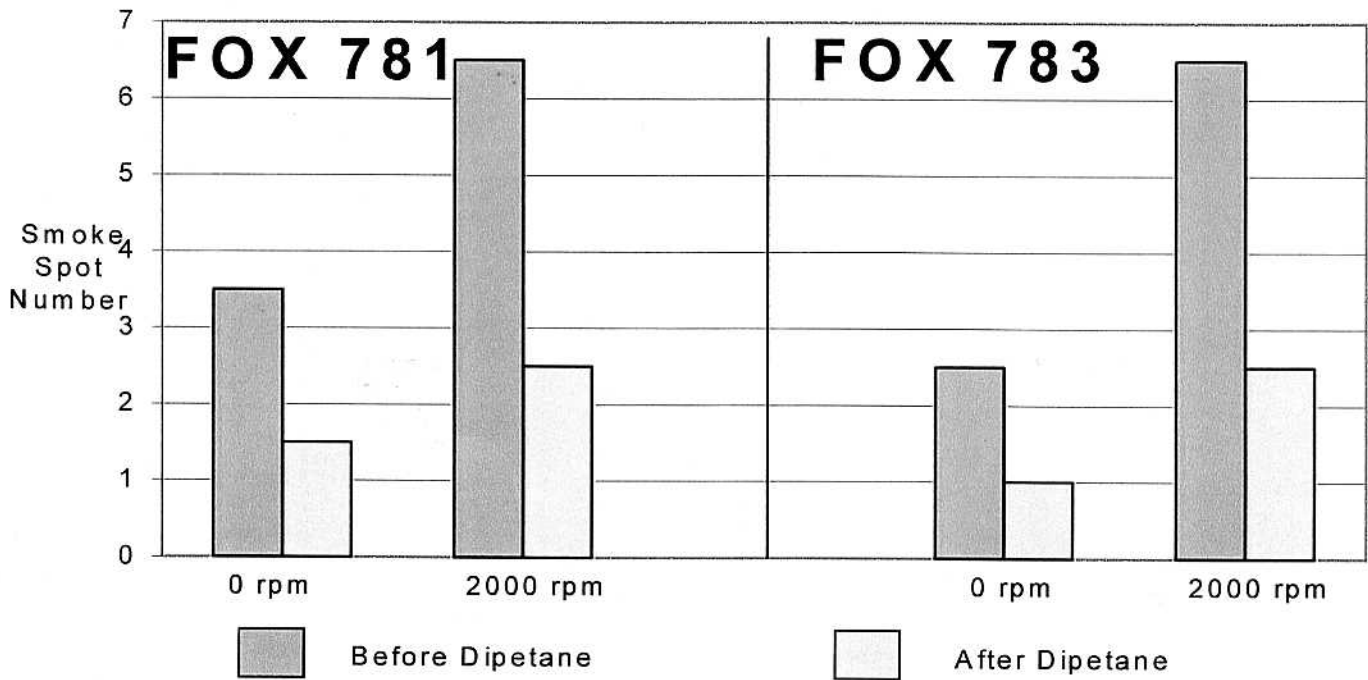


Figure 6: Results of Smoke Density Determination



SUMMARY OF ALL DATA

The following table represents a summary of the percentage change in the before and after Dipetane test results for all forms of emission testing and analysis conducted for Linfox between April 2000 and November 2000

Vehicle	Rpm 0 = idle	% Reduction of CO ₂ after use of Dipetane	% Reduction of CO after use of Dipetane	% Increase of O ₂ after use of Dipetane	% Reduction of NO _x after use of Dipetane	% Reduction of SO _x after use of Dipetane	% Reduction of Smoke after use of Dipetane
Fox 781	0	23.0%	9.5%	3.6%	28.8%	22.9%	57.1%
	2000	15.2%	7.4%	3.9%	35.4%	26.8%	61.5%
Fox 783	0	17.3%	0.0%	4.8%	34.0%	19.9%	60.0%
	2000	13.7%	3.6%	4.5%	32.4%	25.7%	61.5%

ATTACHMENT 1

Onsite Testing Conditions - Linfox Workshop (Clayton)

