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FINAL REPORT

Emission and Fuel Economy Testing
Toyota Car Carrier Tractors
Powered by Caterpillar C-12 Diesel Engines

Equipped with Rentar In-line Fuel Catalysts

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Conducted for
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Executive Summary

This report summarizes the emission and fuel consumption improvements resulting from mileage accumulation with Rentar In-line Fuel Catalyst installations. Two Toyota provided car-carrier tractors were emission tested on the chassis dynamometer to obtain baseline data and again after a Rentar In-line Fuel Catalyst had been installed for several thousand miles of typical operation. The same fuel was used for the baseline and Rentar device testing and the testing protocol was identical. Purportedly no engine tune-up or other modifications were conducted during the mileage accumulation interval.

The improvements with the Rentar device installed were as follows:

Table 1
Data Summary
Improvement in emissions and fuel consumption with the Rentar In-line Fuel Catalyst

Vehicle 63146 – After 12,538 miles

UDDS-HD Transient Cycle Testing

	HC	CO	NOx	CO_2	PM	Fuel
% Improvement	11.0	8.2	3.8	1.8	-6.2	1.9

40 mph Steady State Testing

	HC	CO	NOx	CO_2	PM	Fuel
% Improvement	20.2	7.0	9.7	3.3	9.3	3.2

Vehicle 13142 – After 18,755 miles

UDDS-HD Transient Cycle Testing

	HC	CO	NOx	CO_2	PM	Fuel
% Improvement	23.7	2.6	5.3	0.5	-1.9	0.5

40 mph Steady State Testing

	HC	CO	NOx	CO_2	PM	Fuel
% Improvement	18.0	0	10.5	1.4	-7.8	1.4

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Introduction

Two Toyota car carrier tractors powered by Caterpillar C-12 diesel engines were tested to determine the emission and fuel consumption benefits of the Rentar In-line Fuel Catalyst device.

Test Vehicles (VIN Nos. 13142 and 63146)

The test vehicles were provided by Toyota and were taken from normal service operations. These Caterpillar powered tractors are used to haul Toyota automobiles with the tractor and trailer load reaching 80,000 pounds GVW. They are powered by C-12 Caterpillar diesel engines and fueled by California specification No. 2 diesel fuel.

The tractors were modified by Toyota prior to arrival by removing the drive-line to the rear set of drive wheels. This allowed all of the power to be transmitted to the chassis dyno rolls through the front set of rear wheels only. Also, for the testing after mileage accumulation, Toyota modified the fuel delivery and return system to permit use of the same fuel that was used for the baseline testing.

Test Protocol and Procedures

All testing was done on the EETL chassis dynamometer with vehicle inertia set at 8,875 pounds (the limit for this dyno) and rear wheel horsepower absorption of 45HP at 50mph. A baseline test sequence was conducted for each truck and then repeated after mileage accumulation with the Rentar device installed. These two test sequences involved triplicate UDDS-HD transient cycles and triplicate steady-state operation at 40mph. The UDDS-HD transient cycles is schematically shown in the Appendix. It consists of driving 5.55 miles at an average speed of 18.86 mph while continuously sampling exhaust emissions through a dilute constant volume sampler into a bag for composite emission analysis. Simultaneously a dilute exhaust sample is captured on a filter media to determine the weight of particulate matter (PM). The same sampling system and sampling procedure was used after reaching temperature equilibrium while operating the truck tractor at 40 mph steady-speed and constant load.

All emission data were corrected in accordance with the applicable CFR and CARB protocols. Fuel consumption was calculated by the conventional EPA specified carbon balance method. Triplicate tests were averaged for the baseline data and again for the data obtained after mileage accumulation with the Rentar device installed to provide the calculated improvements shown in Table 1 of the Executive Summary.

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Test Fuel

Fuel composition can be an important variable in the measurement of exhaust emissions. Accordingly it is important that the same fuel was used for both the baseline testing and the testing after mileage accumulation. To eliminate the composition variable, 15 gallons of tank fuel were pumped from each test vehicle into respective drums prior to baseline testing. The same fuel was then used for the subsequent testing after mileage accumulation that had been used for baseline testing.

Results

The emission and fuel consumption results are summarized in Table 1 and all of the triplicate emission/fuel consumption test data are provided in the Appendix. Averages, standard deviations and the 95% confidence limits for each triplicate set of data are provided. The 95% confidence limits define the plus/minus range within which the true average can expect to exist.

In addition to the data measured and analyzed by ETS, exhaust samples at 40 mph steady speed were captured for laboratory analysis of other compounds from one of the tractors. These triplicate exhaust samples have been analyzed by Truesdail Laboratories and are the subject of a separate report.

Appendix

1. UDDS-HD graphical depiction of test cycle.
2. Table 2 – test data from Toyota vehicle 63146.
3. Table 3 – test data from Toyota vehicle 13142.

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Emission Test Cycle

EPA Urban Dynamometer Driving Schedule (UDDS) for Heavy-Duty Vehicles

Time-speed data points

The EPA UDDS schedule has been developed for chassis dynamometer testing of heavy-duty vehicles (*CFR 40, 86, App.I*). Sometimes referred to as "cycle D". It should not be confused with the FTP-72 cycle for light-duty vehicles, which is also termed UDDS.

The following are basic parameters of the cycle:

- Duration: 1060 seconds
- Distance: 5.55 miles = 8.9 km
- Average speed: 18.86 mi/h = 30.4 km/h
- Maximum speed: 58 mi/h = 93.3 km/h

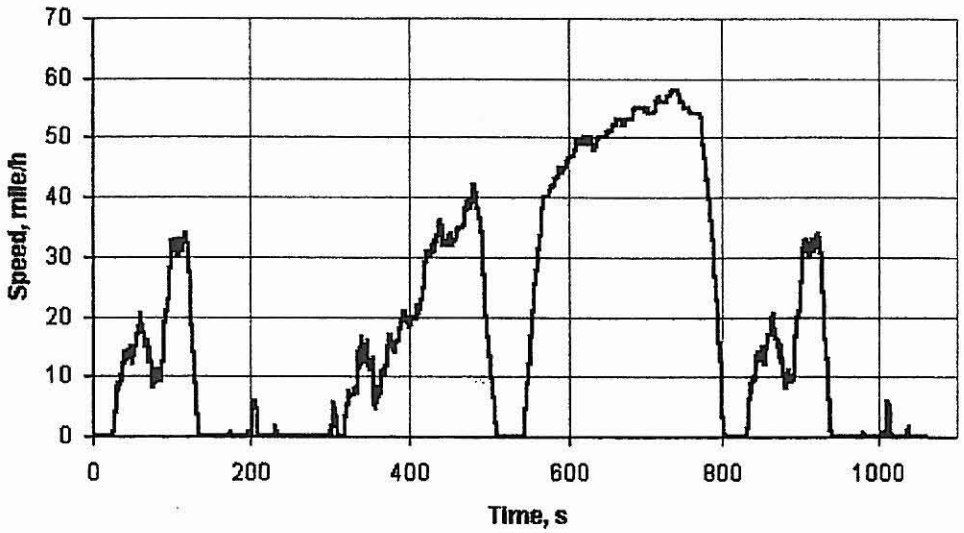

Figure 1. *HD UDDS Cycle*

The UDDS schedule was a basis for the development of the FTP transient engine dynamometer cycle.

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