Program for Advanced Vehicle Evaluation
PAVE
at AUBURN UNIVERSITY

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TMC RP-1109/SAE J1321
Type IV Fuel Consumption Test

Conducted for

Omega-Tec, LLC.
152 Medford Parkway Drive
Canton, MS 39046
Representing MEC-AS

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ABSTRACT

The Program for Advanced Vehicle Evaluation (PAVE) was established at Auburn University as a complementary research program at the National Center for Asphalt Technology's (NCAT) Pavement Test Track (www.pavetrack.com). In order to damage experimental pavements on the 1.7-mile test oval, it is necessary to run a fleet of heavy trucks over ¾ million miles a year. Trucking operations at the Track and the close proximity to federal and interstate highways provide a unique opportunity to study issues that are important to the trucking industry in a highly controlled and cost effective manner. The purpose of the evaluation described herein was to determine the impact of the Omega-Tec (Molecular Fuel Economizer, U.S. Patent 7,650,877) product on fuel economy when used on the 14L diesel engine of class 8 tractors. This technology is developed, produced, and owned by Magnetic Emission Control AS, Norway (MEC-AS). In America, Omega-Tec, LLC is the exclusive distributer of the product on behalf of MEC-AS.

In this evaluation, fuel usage in a test vehicle was measured with and without the Molecular Fuel Economizer installed in both the fuel and air inlet systems. A second similar tractor/trailer combination was used as a control vehicle. The test plan for the evaluation included a baseline segment and a test segment. Although this was an on-highway test, the fueling station and all necessary equipment were stationed at the NCAT Pavement Test Track and operated by Track personnel.

The "Type IV Fuel Economy Test Procedure" published by the Technology and Maintenance Council (TMC) was used to perform this evaluation (RP-1109). Fuel use was measured by the volume method, correcting measured values to 60°F. All test runs were executed on an on-highway test route (UI-226) between November 17th and December 2nd of 2010. The UI-226 test route is a combination of 16% rolling, divided federal four lane highway (US 280) and 81% Interstate highway (I-85/I-65). The total route was designed to include 8 to 10 stops with an average rolling speed of approximately 56 mph. Both trucks (one control vehicle and one test vehicle) ran at a target speed of 60 mph on US 280 and 62 mph on the interstate with the cruise control engaged. The gross combined weight (GCW) of the tractor-trailers used for the evaluation was approximately 76,100 pounds.

The measured specific gravity of the #2 diesel fuel used for testing was 0.838 at 60°F. The same driver remained with the control vehicle and test vehicle for the duration of testing. The cooling system fans on both trucks were locked in the on position during all phases of testing to eliminate the fans as a possible confounding variable.

Both the test and control vehicles were 2004 Freightliner Columbia tractors powered with 14L Detroit Diesel Series 60 engines pulling 48 ft. x 102 in. van trailers. The test vehicle was considered to have a 'dirty' combustion chamber at the start of the evaluation. The Molecular Fuel Economizer was installed on the air inlet between the air cleaner and the turbo as well as on the fuel supply line before the fuel filters. No vehicle or operational issues were encountered during any phase of testing. Between the baseline and test segments, a conditioning period of 2,900 miles was run on the test tractor while pulling a 155,000 lb. GCW standard triple trailer set on the NCAT Pavement Test Track.

The results of this test showed an improvement of 2.6% in fuel economy on the UI-226 test route/duty cycle. The valid test-to-control (T/C) ratios for fuel usage for all runs in the baseline and treatment segments were 0.9% and 1.5%, respectively. This is well inside the 2% filter, which is indicative of a highly controlled test.

TABLE OF CONTENTS

INTRODUCTION

Recent historical increases in the cost of diesel fuel have resulted in an unprecedented interest in products that have the potential to improve fuel economy. At the request of Omega-Tec, LLC, the PAVE research program at Auburn University recently conducted a fuel economy test. The purpose of the evaluation described herein was to determine the impact of the Omega-Tec (Molecular Fuel Economizer, U.S. Patent 7,650,877) product on fuel economy when used on the 14L diesel engine of class 8 tractors. This technology was developed under US Patent 7,650,877 and is owned by Magnetic Emission Control AS, Norway (MEC-AS).

The procedure chosen for this evaluation was the TMC's *RP-1109 Type IV Fuel Economy Test Procedure* incorporating the *TMC/SAE Type II Fuel Economy Test Procedure* methodology. These procedures were developed specifically to meet the needs of the trucking industry, and they are an integral part of TMC's *Guidelines for Qualifying Products Claiming a Fuel Economy Benefit* (RP 1115).

TEST PROCEDURE

Vehicle Identification

Both the test and control vehicles were 2004 Freightliner Columbia tractors powered with 14L Detroit Diesel Series 60 engines pulling 48 ft. x 102 in. van trailers. The test vehicle was considered to have a 'dirty' combustion chamber at the start of the evaluation. The Molecular Fuel Economizer was installed on the air inlet between the air cleaner and the turbo (Figure 1) as well as on the fuel supply line before the fuel filters (Figure 2). Between the baseline and test segments, a conditioning period of 2,900 miles was run on the test tractor while pulling a standard triple trailer set (155,000 lb. GCW) on the NCAT Pavement Test Track. A full tractor-trailer unit is shown in Figure 3 in operation on the UI-226 test route.

Figure 1 – Molecular Fuel Economizer on Air Inlet

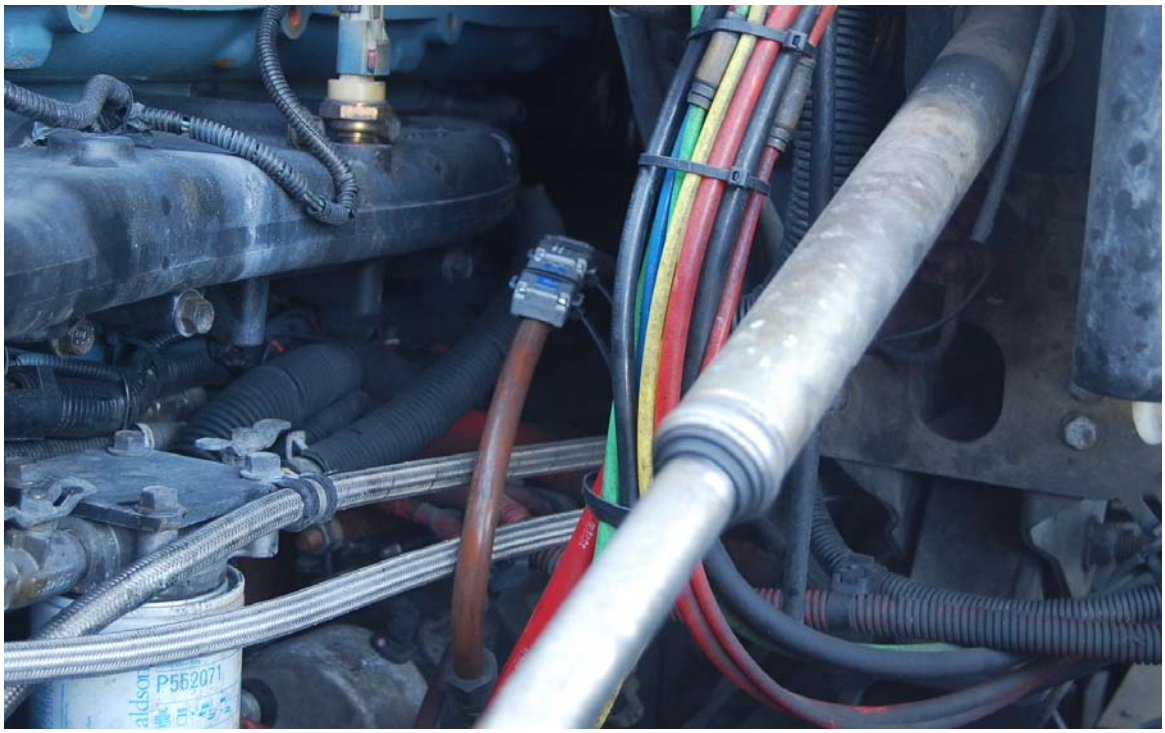

Figure 2 – Molecular Fuel Economizer on Fuel Supply Line

Figure 3 – Truck Configuration Used During the Testing Process

All fuel used was off-road (non-taxed) ultra low sulfur #2 diesel from a single source. At the time of testing, the corrected specific gravity of the diesel fuel was 0.838 at 60° F. Any accessories that would have pulled auxiliary power were used in an identical manner in each tractor during all stages of Type IV testing. Cooling fans were locked in the on position for the duration of testing. Mirrors and windows were maintained in the same position at all times. Before the warm-up period, cold tire pressure was set at 110 psi in the steer tires and 100 psi in all other positions. The trailers were loaded with bulk concrete deadweights, giving the tractor-trailer configurations a gross combined weight (GCW) of 76,100 pounds. No vehicle or operational issues were encountered during any phase of testing.

Test Route

All test runs were executed on an on-highway test route (UI- 226) between November 17th and December 2nd of 2010 (shown in Figure 4). The UI-226 test route is a combination of 16% rolling, divided federal four lane highway (US 280) and 81% Interstate highway (I-85/I-65). The total route was designed to include 8 to 10 stops with an average rolling speed of approximately 56 mph. Beginning and ending elevation for each test run is 640 ft with the rolling southbound lane of US 280 having changes in elevation of 50 to 100 ft with base elevations in the 600 ft range (Figure 5).

Both trucks (one control vehicle and one test vehicle) ran at a target speed of 60 mph on US 280 and 62 mph on the interstate with the cruise control engaged. The staging area (start/stop point) was located at the National Center for Asphalt Technology's (NCAT) Pavement Test Track in Opelika, Alabama. Exit 200 on Interstate 65 was used as a turn around point. It was determined during the planning process that traffic along this section of Interstate 85 and Interstate 65 would facilitate reliable testing without significant traffic disruptions.

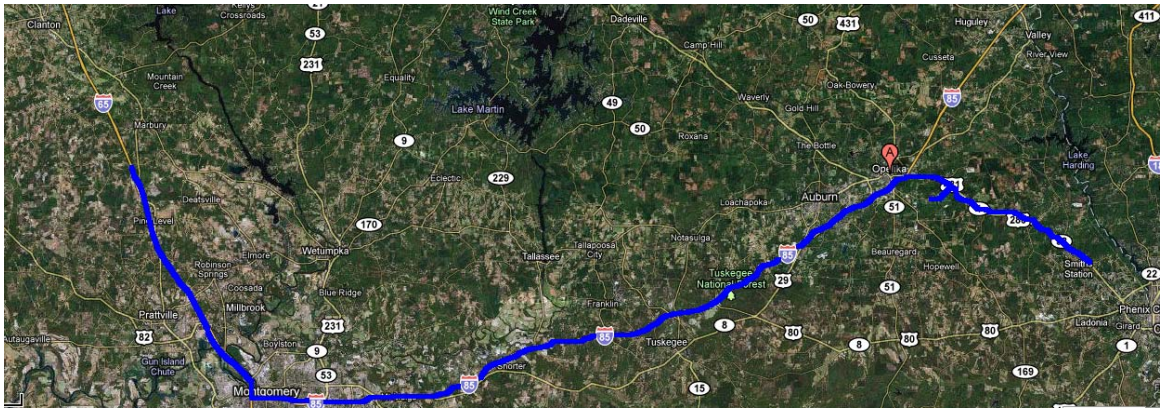

Figure 4 – Section of I-85, I-65 and US 280 Used for Test Route UI-226

Figure 5 – US 280 Rolling Terrain

Research Methodology

A work plan was developed based upon TMC's *RP-1109 Type IV Fuel Economy Test Procedure,* incorporating the *TMC/SAE Type II Fuel Economy Test Procedure* methodology. The Type II test-to-control (T/C) ratios were used to qualify runs as a valid test run. A valid test run creates a data point that is within two percent of two other data points. A single valid test segment is comprised of three data points within the two percent filter. The average baseline and test T/C ratios were used to determine the percent improvement for fuel economy. The Type IV procedure was used for the volumetric fuel measurement process as well as test run length. For the purpose of this study, a test run was defined as at least 200 miles of driving on the interstate-based test route. All test runs for this evaluation were valid.

During testing, fuel consumption was measured using the volumetric method after each 226-mile run. An adjustable tri-square was used to visually measure the level of fuel in the tank. The fuel tank was filled to a specified height at the beginning of each test run. The volume of fuel consumed after each test run was measured using a calibrated fuel dispensing pump. Temperature measurements were made each time the fuel tank was refilled. All fuel measurements were corrected to 60 degrees Fahrenheit (°F). The fuel measuring process is shown in Figure 6. Vehicle operation was synchronized using handheld radios and digital stopwatches to ensure precisely identical duty cycles. Weather conditions during testing were monitored onsite and from the weather station at the local airport.

Figure 6 –Fuel Tank with Adjustable Tri-Square

Test Data

All raw experimental data collected in the field during the testing process are provided in Table 1. Testing was completed on December 2, 2010.

Run Date	Test Segment	226-mile Test Runs	Corrected $Fuel_T$ (gals)	Corrected $Fuel_C$ (gals)
11/18/2010	Baseline	1	41.21	44.36
		2	40.62	43.92
		3	39.90	43.35
12/2/2010	Test 10-11	1	42.10	46.57
		2	41.60	46.56
		3	41.14	45.35

Table 1 –Test Raw Data

Calculations

All fuel measurements were corrected to 60°F. The total usable capacity of the vehicles' fuel tanks was 100 gallons. Temperature Correction Factors were obtained from Table 1 in the TMC Type IV Test procedure.

For this test only the runs of test segments that passed through the test procedure's 2% filter and met the requirements of the test procedure were used to compute fuel savings (in accordance with the testing specifications). All test runs for this test fell within these parameters. Table 2 shows the T/C ratios as well as total fuel used for each test.

Run Date	Test Segment	Test Runs	$Fuel_T$ (gals)	$Fuel_C$ (gals)	T/C (All)	T/C (Band)	T/C (Filt)	T/C (Avg)	% Improved
11/18/2010	Baseline	1	41.21	44.36	0.9290	x	0.9290		
		2	40.62	43.92	0.9249	x	0.9249		
		3	39.90	43.35	0.9204	x	0.9204	0.9248	
12/2/2010	Test 10-11	1	42.10	46.57	0.9040	x	0.9040		
		2	41.60	46.56	0.8935	x	0.8935		
		3	41.14	45.35	0.9072	x	0.9072	0.9016	**2.57%**

Table 2 –Fuel Economy Test Calculations

DISCUSSION OF RESULTS

Fuel usage data collected during this test showed an improvement of 2.6% in fuel economy on the UI-226 test route/duty cycle. The valid test-to-control (T/C) ratios for fuel usage for all runs in the baseline and treatment segments were 0.9% and 1.5%, respectively. This is well inside the 2% filter, which is indicative of a highly controlled test. No vehicle or operational issues were encountered during any phase of testing.