CASE STUDY 1612C

FUEL ECONOMY TESTING

INCREASE IN FUEL ECONOMY BY CLEANING THE INTERNAL ENGINE COMPONENTS AND REDUCING FRICTION

THIRD PARTY	The Ohio State University Center for Automotive Research	THE OHIO STATE UNIVERSITY CENTER FOR AUTOMOTIVE RESEARCH
TEST SUBJECT	FREIGHTLINER® Cummins	2006 FREIGHTLINER P500, (COMMERCIAL FEDEX TRUCK)
PRODUCT TESTED		HSS **STICTION ELIMINATOR**

LUBRICATION SPECIALTIES INC

Where Innovation Lives

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EXECUTIVE SUMMARY

OIL ADDITIVE

EPA based fuel economy testing was completed at the Ohio State University Center for Automotive Research. The purpose of the testing was to take a commercial Fedex truck and have 3rd party fuel economy and emissions testing completed before and after HSS STICTION ELIMINATOR was added to the tank. The test truck was a 2006 Freightliner P500 with 247,631 miles. The fleet owner has never used oil or fuel additives in the past. Two standard EPA fuel economy tests were performed to simulate driving conditions in the city and highway driving. Fuel economy measured on a dyno is viewed as having a +/- 2% repeatability. We have taken the following steps to increase the repeatability for this test. A professional driver was used to conduct the tests, baseline and product testing were conducted on the same day with the same weather conditions and fuel consumed was measured gravimetrically with 4 significant digits. The baseline and test runs were completed 4 times to ensure repeatability. The product was tested at the standard 1 quart per 10 quarts of engine oil as directed on the bottle.

UDDS (CITY DRIVING TEST RESULTS)

		Total Hydro Carbon		Carbon Monoxide		NOx		Fuel Economy	
# of tests	Condition	g/mile	±	g/mile	±	g/mile	±	(miles/ gal)	±
4	Baseline	0.43	0.02	2.06	0.09	4.54	0.04	14.18	0.13
4	w/ Stiction Eliminator	0.61	0.01	2.05	0.10	4.59	0.04	14.49	0.10

IMPACT OF STICTION ELIMINATOR ON EMISSIONS AND FUEL ECONOMY UDDS RESULTS

	THC	CO	NOx	Fuel Economy Increase
Oil Additive vs. Baseline	42.4%	-0.60%	1.2%	2.20%

55 MPH (STEADY STATE HIGHWAY DRIVING TEST)

		Total Hydro Carbon		Carbon Monoxide		NOx		Fuel Economy	
# of tests	Condition	g/mile	±	g/mile	±	g/mile	±	(miles/ gal)	±
4	Baseline	0.10	0.01	0.53	0.01	2.06	0.01	23.92	0.22
4	w/Stiction Eliminator	0.16	0.00	0.63	0.00	2.05	0.02	24.78	0.26

IMPACT OF STICTION ELIMINATOR ON EMISSIONS & FUEL ECONOMY STEADYSTATE TEST RESULTS

	THC	CO	NOx	Fuel Economy Increase
Oil Additive vs. Baseline	54.9%	18.7%	-0.5%	**3.6%**

CONCLUSION

The results showed a notable increase in fuel economy of 2.2% in the city driving test and 3.6 % in the highway driving with a +/- 1% repeatability. Regained fuel economy is likely due to a combination of cleaning of internal engine components like turbo bearings in addition to the reduction of friction from the nano lubricant contained in the oil product.

Executive Summary completed by:
Kevin Adams – Chemical Engineer – LSI Labs, December 15, 2016

INTRODUCTION

The Ohio State University Center for Automotive Research was retained by Lubrication Specialties, Inc. to complete an independent evaluation of a product for emissions and fuel economy improvements. The oil product was labeled Hot Shot's Secret STICTION ELIMINATOR Diesel Oil Additive. The Engineering Services group (CAR-ES) was fully responsible for the design of the test plan and completion of the test program. The additive product was delivered directly to CAR-ES by the customer. The test vehicle was provided by the customer.

TEST PLAN

The approach to testing was to generate baseline data for the test vehicle over a series of tests. The test sequence was then repeated using the customer's oil additive product. The baseline data was directly compared to data generated over the same test cycles using the customer's oil additive product. Both test sequences were conducted using the same test vehicle with the same test driver provided by CAR- ES. The vehicle dynamometer loading conditions and fuel supply were consistent throughout the program.

Two test cycles were used for this program. The EPA Heavy-Duty Urban Dynamometer Driving Schedule (UDDS) and a five minute steady-state 55 mph cruise. The UDDS was developed for the chassis dynamometer testing of heavy-duty vehicles (40 CFR 86 App. I). The 55 mph steady-state cruise test was used to provide a test cycle which had no driver/throttle interaction.

The vehicle was tested in the following sequence for the evaluation program:

1. The vehicle was installed on the chassis dynamometer and secured.
2. An external fuel tank was installed to allow gravimetric measurement of fuel consumed during testing.
3. The vehicle was warmed up and Coastdown tests were completed to determine appropriate dynamometer simulation settings per Petrushov (SAE 970408).

BASELINE TESTING

4. Vehicle warmup for 20 minutes.
5. UDDS Test Cycle #1
6. UDDS Test Cycle #2
7. UDDS Test Cycle #3
8. UDDS Test Cycle #4
9. Steady-State Test Cycle #1
10. Steady-State Test Cycle #2
11. Steady-State Test Cycle #3

PRODUCT TESTING – OIL ADDITIVE

12. Add oil additive product to external fuel tank following bottle instructions.
    Product was added to the vehicle via the oil fill port. 1.5 quarts of engine oil was removed prior to the additive addition to avoid overfilling the engine.
13. 60-Minutes of vehicle operation in alternating 10-minute intervals of 55 and 45 mph to ensure full vehicle exposure to the fuel product.
14. UDDS Test Cycle #1
15. UDDS Test Cycle #2
16. UDDS Test Cycle #3
17. UDDS Test Cycle #4
18. Steady-State Test Cycle #1
19. Steady-State Test Cycle #2
20. Steady-State Test Cycle #3

END OF TEST PROGRAM

TEST VEHICLE

The test vehicle was provided by the customer; a 2006 Freightliner P500 equipped with a 6.7 Cummins engine. This vehicle was a representative “in-use” vehicle which fulfilled the customer’s target vehicle type. The vehicle was checked for road and dyno worthiness prior to starting the test program. All fluids were verified to be at manufacturer specified levels and the tires and exhaust system were found to be in good condition and leak free. There were no mechanical problems or check engine lights present during the program.

During testing the vehicle simulation was set for a vehicle mass of 11,000 lbs. which represents a partial cargo load for this model.

Make	Freightliner
Model	P500
Model Year	2006
VIN #	4UZAANBW16CV95203
Odometer Mileage (prior to testing)	247,631

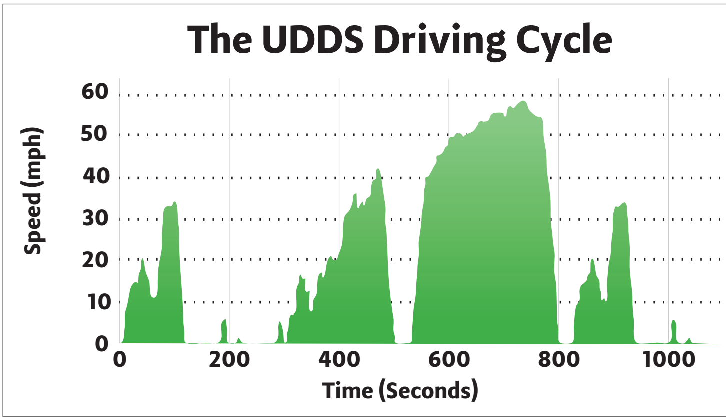
TEST PROCEDURES

DESCRIPTION OF TESTING

UDDS TEST Each UDDS test completed during this program was performed with the vehicle warmed up and running in idle at the start of the test. Engine crank emissions were not collected during this program. The UDDS simulates typical city driving and raw emissions were continuously sampled to calculate a grams/mile emissions result for total hydrocarbons (THC), carbon monoxide (CO), and oxides of nitrogen (NOx). Fuel economy, in miles per gallon, is determined via gravimetric measurement of the auxiliary external fuel tank.

STEADY-STATE TEST The steady-state test included five minutes of vehicle operation at 55 mph using the vehicle cruise control. Prior to sample collection the vehicle was operated at the test condition for five minutes. The sampled portion of the cycle was repeated three times and all emissions measurements are taken as described for UDDS Testing. Fuel economy, in miles per gallon, is again determined via gravimetric measurement of the auxiliary external fuel tank.

ACCURACY OF REPEAT MEASUREMENTS Fuel economy measured on a chassis dynamometer using an external gravimetric tank are viewed as repeatable within ±2%. Any variation within ±2% can be influenced by test-to-test measurement scatter. Emissions measurements do not have an established industry test-to-test variance. The "±" listed for each result in this report is based on a 95% confidence interval.



The oil product was added to the oil reservoir following the packaging directions.

TREATMENT PLAN

Use approximately 4 OZ per 1 QT of oil for initial cleanup, 2 OZ per 1 QT of oil for maintenance. Add STICTION ELIMINATOR during a fresh oil change and leave in during entire oil change interval.

USE IN ALL ENGINES Semi-trucks, pick-up trucks, farm equipment & autos. Effective in all diesel engines including: Ford Powerstroke, Dodge Cummins, GM Duramax, Saab, Volkswagen, Audi.

ADD TO ENGINE OIL	DO NOT USE simultaneously with any other oil additive.
SAFE WITH SYNTHETIC OILS	

TEST RESULTS

The UDDS and Steady-State emissions and fuel economy results are summarized in the following tables.

UDDS TEST RESULTS

		Total Hydro Carbon		Carbon Monoxide		NOx		Fuel Economy	
# of tests	Condition	g/mile	±	g/mile	±	g/mile	±	(miles/ gal)	±
4	Baseline	0.43	0.02	2.06	0.09	4.54	0.04	14.18	0.13
4	Oil Additive	0.61	0.01	2.05	0.10	4.59	0.04	14.49	0.10

IMPACT OF PRODUCT ON EMISSIONS AND FUEL ECONOMY UDDS TEST RESULTS

	THC	CO	NOx	Fuel Economy Increase
Oil Additive vs. Baseline	42.4%	-0.6%	1.2%	**2.2%**

UDDS RESULTS DISCUSSION

The use of the oil additive product resulted in negligible changes in CO and NOx emissions during the UDDS tests completed as compared to the baseline results. These emissions results are within the 95% data confidence and can be viewed as standard test-to-test variance. THC emissions were significantly higher with the use of the oil additive product. The fuel economy slightly exceeded the ±2% band which is considered standard test-to-test variance.

STEADY-STATE TEST RESULTS

		Total Hydro Carbon		Carbon Monoxide		NOx		Fuel Economy	
# of tests	Condition	g/mile	±	g/mile	±	g/mile	±	(miles/ gal)	±
3	Baseline	0.10	0.01	0.53	0.01	2.06	0.01	23.92	0.22
3	Oil Additive	0.16	0.00	0.63	0.00	2.05	0.02	24.78	0.26

IMPACT OF PRODUCT ON EMISSIONS AND FUEL ECONOMY STEADYSTATE TEST RESULTS

	THC	CO	NOx	Fuel Economy Increase
Oil Additive vs. Baseline	54.9%	18.7%	-0.5%	**3.6%**

STEADY-STATE RESULTS DISCUSSION

The use of the oil additive product during the steady-state tests resulted in increases in THC and CO emissions levels and a negligible decrease in NOx emissions during the tests completed as compared to the baseline results. The THC and CO emission level increases were significant. The measured fuel economy increase of 3.6% did exceed the ±2% range of test-to-test variance when both products were used during the steady-state tests.

SUMMARY

The Ohio State University Center for Automotive Research has observed a measureable increase in vehicle THC emissions coupled with a slight increase in fuel economy during testing of the customer's oil additive product over the UDDS test cycle.

During steady-state testing a measurable increase in fuel economy was coupled with a significant THC emissions increase when the oil additive product was used during testing.

The duration of the test program was short by design and did not include extensive mileage accumulation or operation after the product was introduced into the vehicle oil. No observations on the possible effects of extended product use can be drawn from this data set.

OSU, CAR-ES Test Report for Lubrication Specialties, Inc. fuel product completed by:
Walt Dudek – OSU Center for Automotive Research, December 8, 2016
CAR.OSU.EDU

> "THE RESULTS SHOWED A **NOTABLE INCREASE** IN FUEL ECONOMY OF **2.2%** IN THE CITY DRIVING TEST AND **3.6%** IN THE HIGHWAY DRIVING..."

KEVIN ADAMS *(Chemical Engineer, LSI Labs)*

INDIVIDUAL TEST RESULTS SUMMARY

			mm:ss	miles	ppm	ppm	ppm	grams	m3/ min	m3	ft3	THC	THC	CO	CO	Nox	Nox	FE	FE
Test	#	Condition	Time	Distance	THC	CO	Nox	Fuel	Exhaust Volume	Exhaust Volume	Exhaust Volume	g	g/ mile	g	g/ mile	g	g/ mile	gallons	mpg
UDDS	1	Baseline	17:55	5.56	84.13	232.40	288.73	1288	2.61	46.69	1648.73	2.27	0.41	12.63	2.27	25.78	4.63	0.40	13.99
UDDS	2	Baseline	17:55	5.53	93.46	218.27	284.13	1285	2.58	46.23	1632.45	2.49	0.45	11.75	2.12	25.12	4.54	0.40	13.95
UDDS	3	Baseline	17:55	5.55	84.39	196.10	284.36	1243	2.55	45.65	1612.17	2.22	0.40	10.42	1.88	24.83	4.48	0.38	14.46
UDDS	4	Baseline	17:55	5.53	97.20	204.80	284.80	1250	2.55	45.61	1610.82	2.56	0.46	10.88	1.97	24.85	4.49	0.39	14.34
			Average	**5.54**	**89.79**	**212.89**	**285.51**	**1266.5**	**2.57**	**46.04**	**1626.04**	**2.38**	**0.43**	**11.42**	**2.06**	**25.14**	**4.54**	**0.39**	**14.18**
			Stdev	**0.01**	**6.57**	**15.89**	**2.17**	**23.30**					**0.03**		**0.17**		**0.07**		**0.25**
			+/-	**0.01**	**3.29**	**7.94**	**1.08**	**11.65**					**0.02**		**0.09**		**0.04**		**0.13**
UDDS	1	Oil Add	17:55	5.56	120.04	189.71	288.21	1225	2.59	46.45	1640.37	3.22	0.58	10.26	1.84	25.61	4.60	0.38	14.72
UDDS	2	Oil Add	17:55	5.52	128.26	196.41	287.06	1254	2.60	46.53	1643.36	3.44	0.62	10.64	1.93	25.55	4.63	0.39	14.25
UDDS	3	Oil Add	17:55	5.53	131.44	224.76	281.06	1236	2.56	45.93	1622.10	3.48	0.63	12.02	2.18	24.69	4.47	0.38	14.48
UDDS	4	Oil Add	17:55	5.53	128.85	231.37	292.47	1234	2.57	46.03	1625.64	3.42	0.62	12.40	2.24	25.75	4.66	0.38	14.52
			Average	**5.53**	**127.15**	**210.56**	**287.20**	**1237.25**	**2.58**	**46.24**	**1632.87**	**3.39**	**0.61**	**11.33**	**2.05**	**25.40**	**4.59**	**0.38**	**14.49**
			Stdev	**0.02**	**4.94**	**20.57**	**4.71**	**12.15**					**0.02**		**0.19**		**0.08**		**0.19**
			+/-	**0.01**	**2.47**	**10.29**	**2.35**	**6.07**					**0.01**		**0.10**		**0.04**		**0.10**

			mm:ss	miles	ppm	ppm	ppm	grams	m3/ min	m3	ft3	THC	THC	CO	CO	Nox	Nox	FE	FE
Test	#	Condition	Time	Distance	THC	CO	Nox	Fuel	Exhaust Volume	Exhaust Volume	Exhaust Volume	g	g/ mile	g	g/ mile	g	g/ mile	gallons	mpg
SS	1	Baseline	5:01	4.61	53.35	120.70	275.00	634	3.56	17.84	629.94	0.55	0.12	2.51	0.54	9.38	2.03	0.20	23.57
SS	2	Baseline	5:00	4.61	44.38	117.44	280.73	614	3.55	17.76	627.27	0.45	0.10	2.43	0.53	9.54	2.07	0.19	24.32
SS	3	Baseline	5:01	4.62	43.64	117.46	282.83	627	3.53	17.70	625.08	0.45	0.10	2.42	0.52	9.58	2.07	0.19	23.87
			Average	**4.61**	**47.12**	**118.53**	**279.52**	**625.00**	**3.55**	**17.77**	**627.43**	**0.48**	**0.10**	**2.45**	**0.53**	**9.50**	**2.06**	**0.19**	**23.92**
			Stdev	**0.01**	**5.40**	**1.87**	**4.05**	**10.15**					**0.01**		**0.01**		**0.02**		**0.38**
			+/-	**0.00**	**3.12**	**1.08**	**2.34**	**5.86**					**0.01**		**0.01**		**0.01**		**0.22**
SS	1	Oil Add	5:00	4.56	77.19	143.78	275.03	592	3.48	17.41	614.96	0.78	0.17	2.92	0.64	9.16	2.01	0.18	24.94
SS	2	Oil Add	5:01	4.56	72.08	141.45	282.04	588	3.48	17.48	617.41	0.73	0.16	2.88	0.63	9.43	2.07	0.18	25.15
SS	3	Oil Add	5:07	4.67	71.65	140.71	285.06	623	3.46	17.73	626.03	0.73	0.16	2.90	0.62	9.67	2.07	0.19	24.27
			Average	**4.60**	**73.64**	**141.98**	**280.71**	**601.00**	**3.48**	**17.54**	**619.46**	**0.74**	**0.16**	**2.90**	**0.63**	**9.42**	**2.05**	**0.19**	**24.78**
			Stdev	**0.06**	**3.08**	**1.60**	**5.15**	**19.16**					**0.01**		**0.01**		**0.03**		**0.46**
			+/-	**0.04**	**1.78**	**0.92**	**2.97**	**11.06**					**0.00**		**0.00**		**0.02**		**0.26**

HOT SHOT'S SECRET

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HIGH PERFORMANCE ADDITI

LUBRICATION
SPECIALTIES INC

Lubrication Specialties, Inc. began in 1997 and since the development of Hot Shot's Secret Stiction Eliminator in 2004 has continued to solve issues for the largest companies across the country. Dedicated to producing the most concentrated and effective solutions on the market, third party testers and our own in-house chemists constantly reevaluate our products. Lubrication Specialties, Inc. is a proud member of the Better Business Bureau.

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