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EPA Laboratory Evaluation of PetroMoly HP Motor Oil

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Vehicle Programs Group
Vehicle Programs and Compliance Division
Office of Mobile Sources
U. S. Environmental Protection Agency

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Introduction

This report describes EPA laboratory fuel economy and exhaust emission testing of PetroMoly HP 5W-30 motor oil (hereafter, PetroMoly) at EPA's National Vehicle and Fuel Emissions Laboratory (NVFEL) in Ann Arbor, Michigan. PetroMoly, a product of Worldwide PetroMoly Corporation, is described in their Product Data Sheet as a high performance oil which, when used as a replacement for a conventional motor oil, offers "Increased fuel economy up to 10%" and "Reduced toxic emissions up to 60%" in addition to other claimed benefits. The testing reported herein was volunteered and paid for by Worldwide PetroMoly Corporation.

Lubricants (i.e., motor oils) and lubricant additives are excluded from EPA testing under 40 CFR Part 610.11. EPA engineers recognize that lubricants and lubricant additives have the potential to impact fuel economy as measured in the FTP and HFET test protocols. EPA's Vehicle Programs and Compliance Division (VPCD) agreed to test PetroMoly on one vehicle because evidence from independent laboratory testing conducted on two vehicles exhibited a statistically significant improvement in fuel economy of four to five percent in city driving and two to three percent in highway driving (see the following documents in the Appendix: Application for EPA Evaluation, Independent Test Lab Report, and Table A-1 and Table A-2 for the EPA preliminary analysis of the independent test laboratory data).

The conclusions drawn from EPA evaluation tests are necessarily of limited applicability. An all encompassing evaluation of the effectiveness of a product in achieving performance improvements on the many types of vehicles that are in actual use would require a large sample of test vehicles. This is not economically feasible in the evaluation projects conducted by EPA. Therefore, the conclusions from such tests can be considered to be quantitatively valid only for the specific test cars used; however, it is reasonable to extrapolate the results from EPA tests to other types of vehicles in a directional manner; i.e., to suggest that similar results are likely to be achieved on other similar types of vehicles.

Test Program

The purpose of the EPA test program was to conduct a controlled technical evaluation of PetroMoly in a manner that would address the manufacturer's specific claims for significant improvements in fuel economy and reduction in emissions. An invitation was extended to Worldwide PetroMoly Corporation to have a representative present for all phases of maintenance and testing.

Among the product claims made by the manufacturer of PetroMoly the following were of the greatest interest to EPA:

1. Increased fuel economy over conventional motor oils.
2. Reduce "toxic" emissions

The confirmatory test plan developed by EPA (see Appendix document: Test Plan Agreement) and agreed to by the manufacturer used a 1996 Chevrolet Lumina as a test vehicle. A description of the test vehicle is as follows: Vehicle Identification Number (VIN) 2G1WL52M8T1162331, Engine Family Code TGM3.1V8GFEK, 3.1 liter, with automatic transmission and 22,748 miles on the odometer at the start of testing. The test vehicle was inspected and maintenance performed identical to that employed on consumer owned vehicles in the VPCD in-use emissions program. The vehicle was tuned to manufacturer's specifications, and any malfunctioning part was replaced as necessary. Engine oil and filter change is included in the maintenance procedure. At the time that this test program was performed, the laboratory was using 5W-30 commercial engine oil made by Valvoline. Once the testing program was started, no adjustments were made to the vehicle.

The test phases were:

1. Three Federal Test Procedure tests (FTP, the simulated city drive test) and three Highway Fuel Economy Tests (HFET) with the vehicle in stock configuration were performed to establish the emissions and fuel economy characteristics prior to the installation of PetroMoly. No adjustments were made to any engine components between tests.

2. After stock configuration testing with the recommended commercial weight oil (5W-30, in this case Valvoline brand) was completed it was removed from the engine and the oil filter was replaced with a new one, PetroMoly was added and triplicate FTP and HFET tests were conducted to measure emissions and fuel economy characteristics with PetroMoly in the engine. No adjustments were made to any engine components between tests.

3. PetroMoly was removed after testing the product, the oil filter was replaced with a new one and the recommended commercial weight oil (5W-30, in this case Valvoline brand) was added prior to conducting another triplicate set of stock configuration tests. Again, no adjustments were made to any engine components between tests.

Results

Use of PetroMoly in the single test vehicle demonstrated the following when compared directly to the stock configuration test using a basic 5W-30 SAE motor oil as recommended by the vehicle manufacturer:

There was a two percent improvement in fuel economy on the city drive test. On the city drive test, there was a five percent increase in oxides of nitrogen (NOx), a nine percent reduction in hydrocarbons (HC) and a ten percent reduction in carbon monoxide (CO) when compared to the stock configuration test.

There was a three percent improvement in highway fuel economy.

After removing the PetroMoly and replacing it with the recommended commercial weight oil

(5W-30, in this case Valvoline brand) as used in the first stock configuration test series, the three additional returned to stock configuration tests showed three percent improvement in highway fuel economy relative to the original tests with commercial engine oil. There was a one percent improvement in city fuel economy compared to the first stock configuration test series. The exhaust emissions were two, four and one percent lower for HC, NOx and CO respectively when comparing the second stock configuration series with the first.

EPA used the same statistical analysis program for evaluating data results from independent laboratory and EPA laboratory testing.

Complete consolidated results on emissions and fuel economy for each test along with the average of each series are presented in Tables 1-3. Individual test bag results are to be found in Table 4.

Conclusions

Data submitted in the application from independent (non EPA) laboratory testing of two different vehicles demonstrated an improvement of four to five percent in the city driving test and two to three percent in the highway driving test associated with PetroMoly. EPA analysis of these data showed that the improvements were statistically significant. One of the two vehicles tested also showed a thirteen percent reduction in oxides of nitrogen which was statistically significant. There were no other statistically significant differences in emissions.

The three percent improvement in highway fuel economy and two percent improvement in city fuel economy measured in the EPA confirmatory testing of PetroMoly were statistically significant improvements for testing a single vehicle. The improvements in fuel economy appear to be retained for at least some short period after PetroMoly is replaced with a commercial engine oil. Testing performed by EPA does not allow quantifying the duration of this “carry-over”period.

Although EPA testing showed reductions of nine percent and ten percent in hydrocarbon and carbon monoxide exhaust emissions respectively, these changes were not statistically significant. The five percent increase in oxides of nitrogen exhaust emissions measured in EPA testing when PetroMoly was employed is a statistically significant difference.

Fuel economy improvements were measured, but were not as large as those measured by an independent laboratory for Worldwide PetroMoly. With exception of NOx, changes in exhaust emissions were not significant. On the vehicle tested by EPA a statistically significant NOx penalty of five percent was measured. A statistically significant NOx reduction of thirteen percent was measured on one of the two vehicles tested by an independent laboratory for Worldwide PetroMoly.

TABLE 1

PetroMoly vs Commercial Engine Oil -- Prior to Use of PetroMoly										
Pollutant/ Fuel Economy	Commercial Engine Oil (Valvoline 5W30). Before use of PetroMoly				PetroMoly				Percent Difference	Statistically Significant
	Test 1	Test 2	Test 3	Average	Test 1	Test 2	Test 3	Average		
HC (g/mile)	0.1966	0.1713	0.1785	0.1821	0.1711	0.1667	0.1606	0.1661	-9	NO
CO (g/mile)	2.065	1.933	2.067	2.022	1.973	1.854	1.661	1.830	-10	NO
NOx (g/mile)	0.2292	0.2147	0.2168	0.2202	0.2365	0.2281	0.2306	0.2318	+5	YES
"City" Fuel Economy (mpg)	23.02	22.80	22.91	22.91	23.77	23.53	23.13	23.48	+2	YES
"Highway" Fuel Economy (mpg)	38.50	38.51	38.82	38.61	40.05	40.03	39.15	39.74	+3	YES

TABLE 2

PetroMoly vs Commercial Engine Oil -- After Use of PetroMoly										
Pollutant/ Fuel Economy	PetroMoly				Commercial Engine Oil (Valvoline 5W30). After use of PetroMoly				Percent Difference	Statistically Significant
	Test 1	Test 2	Test 3	Average	Test 1	Test 2	Test 3	Average		
HC (g/mile)	0.1711	0.1667	0.1606	0.1661	0.1672	0.1621	0.2039	0.1777	-7	NO
CO (g/mile)	1.973	1.854	1.661	1.830	1.831	1.809	2.379	2.007	-9	NO
NOx (g/mile)	0.2365	0.2281	0.2306	0.2318	0.1900	0.2209	0.2239	0.2116	+10	NO
"City" Fuel Economy (mpg)	23.77	23.53	23.13	23.48	23.23	23.05	23.23	23.17	+1	NO
"Highway" Fuel Economy (mpg)	40.05	40.03	39.15	39.74	39.50	39.53	40.04	39.69	0	NO

TABLE 3

Commercial Engine Oil, After Use of PetroMoly vs Commercial Engine Oil, Prior to Use of PetroMoly										
Pollutant/ Fuel Economy	Commercial Engine Oil (Valvoline 5W30). Before Use of PetroMoly				Commercial Engine Oil (Valvoline 5W30). After Use of PetroMoly				Percent Difference	Statistically Significant
	Test 1	Test 2	Test 3	Average	Test 1	Test 2	Test 3	Average		
HC (g/mile)	0.1966	0.1713	0.1785	0.1821	0.1672	0.1621	0.2039	0.1777	-2	NO
CO (g/mile)	2.065	1.933	2.067	2.022	1.831	1.809	2.379	2.007	-1	NO
NOx (g/mile)	0.2292	0.2147	0.2168	0.2202	0.1900	0.2209	0.2239	0.2116	-4	NO
"City" Fuel Economy (mpg)	23.02	22.80	22.91	22.91	23.23	23.05	23.23	23.17	+1	YES
"Highway" Fuel Economy (mpg)	38.50	38.51	38.82	38.61	39.50	39.53	40.04	39.69	+3	YES

TABLE 4

INDIVIDUAL GAS BAG DATA FOR PETROMOLY FROM EPA LABORATORY TESTS

Test	Test Date	Bag 1 HC	Bag 1 CO	Bag 1 NOx	Bag 1 FE	Bag 2 HC	Bag 2 CO	Bag 2 NOx	Bag 2 FE	Bag 3 HC	Bag 3 CO	Bag 3 NOx	Bag 3 FE	FTP HC	FTP CO	FTP NOx	FTP FE	HFE HC	HFE CO	HFE NOx	Final HFE
BL 1-1	5/13/98	0.713	7.619	0.596	23.3	0.021	0.236	0.067	21.6	0.138	1.326	0.259	26.1	0.197	2.065	0.229	23.0	0.009	0.194	0.124	38.5
BL 1-2	5/14/98	0.664	8.038	0.562	23.2	0.011	0.068	0.040	21.3	0.103	0.849	0.282	26.0	0.171	1.933	0.215	22.8	0.010	0.160	0.156	38.5
BL 1-3	5/15/98	0.685	7.582	0.583	23.6	0.014	0.237	0.058	21.3	0.107	1.358	0.240	26.0	0.178	2.067	0.217	22.9	0.011	0.243	0.152	38.8
PM-1	6/16/98	0.672	7.425	0.639	23.8	0.018	0.267	0.072	21.9	0.083	1.085	0.245	28.4	0.171	1.973	0.236	23.8	0.014	0.205	0.122	40.1
PM-2	6/17/98	0.620	7.197	0.593	23.9	0.019	0.205	0.059	21.9	0.104	0.947	0.272	27.0	0.167	1.854	0.228	23.5	0.014	0.264	0.115	40.0
PM-3	6/18/98	0.634	6.665	0.570	23.9	0.010	0.106	0.043	21.4	0.087	0.820	0.328	26.5	0.161	1.661	0.231	23.1	0.016	0.278	0.108	39.1
BL 2-1	7/09/98	0.621	7.395	0.552	23.3	0.011	0.078	0.039	21.6	0.119	0.936	0.200	26.8	0.167	1.831	0.190	23.2	0.017	0.264	0.090	39.5
BL 2-2	7/16/98	0.626	7.179	0.588	23.4	0.015	0.127	0.050	21.4	0.089	0.926	0.266	26.6	0.162	1.809	0.221	23.1	0.010	0.166	0.120	39.5
BL 2-3	7/21/98	0.798	9.682	0.661	23.2	0.012	0.161	0.049	21.6	0.117	1.048	0.223	27.1	0.204	2.379	0.224	23.2	0.014	0.260	0.100	40.0

HC = Hydrocarbons, grams per mile
NOx = Oxides of nitrogen, grams per mile
CO = Carbon monoxide, grams per mile
FE = City fuel economy, miles per gallon

BL 1 = Baseline
PM = With PetroMoly installed
BL 2 = Baseline after removal of PetroMoly

APPENDIX

1. Application for EPA Evaluation

2. EPA Analysis of Independent Laboratory Test Data, FTP (city drive test), Table A-1

3. EPA Analysis of Independent Laboratory Test Data, FTP (highway drive test), Table A-2

4. Independent Test Lab Report (Environmental Research &Development Corp.)

5. Test Plan Agreement

TABLE A-1
Statistical Analysis of Independent Test Lab Data on PetroMoly Oil Using FTP (simulated city driving)

PetroMoly vs Commercial Engine Oil- Independent Lab Test Vehicle 1										
Pollutant/ Fuel Economy	Commercial Engine Oil Before use of PetroMoly				PetroMoly				Percent Difference	Statistically Significant
	Test 1	Test 2	Test 3	Average	Test 1	Test 2	Test 3	Average		
HC (g/mile)	0.1421	0.1584	0.1638	0.1548	0.1470	0.1700	0.1825	0.1665	+8	NO
CO (g/mile)	1.9638	2.3838	2.4890	2.2789	1.8812	2.4157	2.7616	2.3528	+3	NO
NOx (g/mile)	0.2549	0.2325	0.2451	0.2442	0.2109	0.2119	0.2121	0.2116	-13	YES
"City" Fuel Economy (mpg)	20.33	20.26	20.15	20.25	21.07	21.12	21.14	21.11	+4	YES

PetroMoly vs Commercial Engine Oil- Independent Lab Test Vehicle 2										
Pollutant/ Fuel Economy	Commercial Engine Oil Before use of PetroMoly				PetroMoly				Percent Difference	Statistically Significant
	Test 1	Test 2	Test 3	Average	Test 1	Test 2	Test 3	Average		
HC (g/mile)	0.1353	0.1426	0.1651	0.1477	0.1251	0.1462	0.1595	0.1436	-3	NO
CO (g/mile)	1.5538	1.8295	1.6475	1.6769	1.3385	1.8334	2.0420	1.7380	+4	NO
NOx (g/mile)	0.1757	0.1816	0.1836	0.1803	0.1688	0.1888	0.1710	0.1762	-2	NO
"City" Fuel Economy (mpg)	19.88	19.20	19.86	19.65	20.78	20.87	20.23	20.63	+5	YES

Vehicle 1 was a 1997 Dodge Stratus, 2.4 liter, Engine Family VCR2.4VJGKEK, VIN 1B3EJ46X1VN676211, with 8133 on the odometer miles at the start of the tests.

Vehicle 2 was a 1997 Dodge Stratus, 2.4 liter, Engine Family VCR2.4VJGKEK, VIN 1B3EJ46X0VN706007, with 3039 miles on the odometer at the start of the tests.

TABLE A-2
Statistical Analysis of Independent Test Lab Data on PetroMoly Oil Using HFET (simulated highway driving)

PetroMoly vs Commercial Engine Oil- Independent Lab Test Vehicle 1										
Pollutant/ Fuel Economy	Commercial Engine Oil Before use of PetroMoly				PetroMoly				Percent Difference	Statistically Significant
	Test 1	Test 2	Test 3	Average	Test 1	Test 2	Test 3	Average		
HC (g/mile)	0.1149	0.1275	0.1158	0.1194	0.1216	0.1267	0.1189	0.1224	+3	NO
CO (g/mile)	2.6632	3.0881	2.7715	2.8409	2.943	3.157	2.8865	2.9955	+5	NO
NOx (g/mile)	0.1506	0.1673	0.1498	0.1559	0.1463	0.1589	0.1535	0.1529	-2	NO
"Highway" Fuel Economy (mpg)	35.21	35.11	35.18	35.17	35.86	35.80	36.01	35.89	+2	YES

PetroMoly vs Commercial Engine Oil- Independent Lab Test Vehicle 2										
Pollutant/ Fuel Economy	Commercial Engine Oil Before use of PetroMoly				PetroMoly				Percent Difference	Statistically Significant
	Test 1	Test 2	Test 3	Average	Test 1	Test 2	Test 3	Average		
HC (g/mile)	0.0942	0.0843	0.1002	0.0929	0.098	0.089	0.088	0.092	-1	NO
CO (g/mile)	1.4630	1.4799	1.7029	1.5486	1.7103	No Data	1.7583	1.7343	+12	NO
NOx (g/mile)	0.0451	0.0565	0.0561	0.0526	0.0560	0.0511	0.0598	0.0556	+6	NO
"Highway" Fuel Economy (mpg)	34.83	34.12	34.73	34.56	35.88	35.77	35.27	35.64	+3	YES

Vehicle 1 was a 1997 Dodge Stratus, 2.4 liter, Engine Family VCR2.4VJGKEK, VIN 1B3EJ46X1VN676211, with 8133 on the odometer miles at the start of the tests.

Vehicle 2 was a 1997 Dodge Stratus, 2.4 liter, Engine Family VCR2.4VJGKEK, VIN 1B3EJ46X0VN706007, with 3039 miles on the odometer at the start of the tests.