Results of Sulfate Tests on Prototype Vehicles

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INTRODUCTION

In January, 1976, the Office of Mobile Source Air Pollution Control (OMSAPC) of the EPA distributed a report on the results of the sulfuric acid baseline program. The report contained results of tests on 56 non-catalyst and catalyst equipped vehicles designed to meet various light duty vehicle emission standards. Since that time, EPA-OMSAPC has continued testing various prototype vehicles with advanced emission control systems. This report discusses the results of OMSAPC testing since completion of the last baseline program report.

Fourteen vehicles were tested for gaseous and sulfate emissions during this period. The objective was to further characterize sulfuric acid emissions from vehicles with technologically advanced emission control systems.

TEST SCHEDULE

The vehicles were tested on one of two test sequences. The first seven cars were tested using the following two day test sequence:

1. 1975 Federal Test Procedure - Cold Start (FTP)
2. Congested Freeway Driving Schedule - Run twice (formerly SET-7)
3. Highway Fuel Economy Test Schedule (HFET)
4. Congested Freeway Driving Schedule - Run twice (CFDS)
5. Repeat 1-4 once on next day

This is the sequence that was used during the baseline program for sulfuric acid emissions.

Six of the last seven vehicles were tested using the slightly different test sequence listed below:

1. 1975 FTP - Cold start
2. CFDS
3. HFET
4. CFDS
5. Repeat 1-4 once on next day

The first three tests of the above sequence is the sequence being considered in the EPA sulfate test procedure development program aimed at developing a uniform sulfate test procedure.

One vehicle in this series, the Ford LTD-930, was not tested using either of the above sequences. This car was tested as part of a correlation program with Ford. Therefore, the test sequence used at Ford was also used at EPA-OMSAPC. The daily sequence (run twice at EPA) was as follows:

1. 1975 FTP - Cold start
2. CFDS - run four times
3. HFET

In general, the catalyst vehicles were tested using .030 (± 0.002) weight percent sulfur fuel. There was one exception to this. The Gould NOx catalyst was found by the manufacturer to be sensitive to high fuel sulfur levels. Gould, therefore, requested that TAEB test the two dual catalyst vehicles Novas 781 and 711 with a reduced sulfur level gasoline. At the time this request was received, TAEB had already completed testing on Nova 781 with .030 weight percent sulfur gasoline. Nova 711 was tested with the gasoline in the vehicle's tank which was reported by Gould to be .011 weight percent sulfur. The diesel vehicles were tested on diesel fuel containing .270 wt percent sulfur.

VEHICLE DESCRIPTION

The fourteen vehicles tested in this series are listed in Table 1 with a brief description of each. A more complete description of each car is given in Appendix A.

TABLE 1: VEHICLES FOR SULFATE EMISSION TESTING

Category	Description	Vehicle & ID No.
I. Catalyst Vehicles	1. Pellet w/pulsed air injection	Cosworth Vega-468
	2. Dual catalyst w/air injection	Nova-781
	3. Monolith w/air injection	Pinto-537A
	4. Base metal monolith w/air injection	Pinto-537B*
	5. Dual catalyst w/air injection	Nova-711
	6. Monolith no air, lean burn, spark advance	Fury Custom-035
	7. Monolith w/air injection	VW Rabbit-318
	8. Monolith w/pulsed air injection	VW Rabbit-504
	9. Monolith w/air injection	Ford LTD-930
II. Non Catalyst Vehicles	1. Diesel	Pinto-159
	2. Diesel	Postal Van-957
	3. Diesel	VW Rabbit-714
	4. Diesel	Coronet-937
	5. Lean burn, thermal reactor	Toyota-276

*Same vehicle as Pinto-537A but with a different catalyst.

The series included nine catalyst vehicles, one of which, the Cosworth Vega-468, had a pelleted catalyst. The rest of the catalyst test vehicles were equipped with monolithic catalysts. The prototype lean burn Fury Custom-035 was the only catalyst vehicle without air injection.

The other five cars in the series were non-catalyst vehicles. Four of these had diesel engines, while the fifth car was a lean burn Toyota with modified combustion chamber design. This consisted of a small side-chamber (a turbulence generating pot) off the side of each main combustion chamber. The fuel is ignited at the mouth of the turbulence generating pot and as the fuel burns, the pressure inside the pot increases. According to Toyota, this causes a flame torch to project into the main combustion chamber, giving more complete combustion in much the same way a stratified charge engine works.

In general, the preconditioning consisted of 1000 miles of modified AMA operation for pelleted catalyst vehicles and 500 miles of modified AMA operation for monolithic catalyst vehicles. Fuel containing 0.030 weight percent sulfur was used for the preconditioning. This assured that the catalyst was stabilized for 0.030 weight percent sulfur fuel and would not give any unusual storage and/or release of sulfur compounds due to a different fuel sulfur level. Since pelleted catalysts have a larger storage capacity than monolith catalysts, more preconditioning was necessary for the pelleted catalyst vehicles. Generally, the preconditioning was done under EPA contract on the Dana Corporation test track in Ottawa Lake, Michigan. Two exceptions to this routine were that the two Novas with dual catalysts were not subjected to any special preconditioning but were tested as received.

The non-catalyst cars received no preconditioning, since stabilization of the vehicle to a particular fuel sulfur level is assumed to be required only when a catalyst is present.

Cooling for the cars during the tests was provided by 5300 cfm fans. Usually, the smaller cars were cooled using two fans placed in front of the car. The larger cars were cooled with four fans - one fan on the driver side at floor level directed towards the rear wheel and fuel tank and three fans placed in front of the car. This cooling is more than is usually used for the FTP. There has been some concern expressed that the standard cooling used in the FTP (generally, a single 5300 cfm fan) may be inadequate for sulfate testing. OMSAPC plans to conduct further work to determine the cooling required for sulfate tests.

RESULTS

The results of this series of tests are briefly summarized in Table 2. Appendix B includes a more detailed summary table and a complete list of all gaseous and sulfuric acid emission values for all tests on each car.

TABLE 2: SUMMARY OF CFDS TEST RESULTS FOR GASEOUS AND SULFATE EMISSIONS

Vehicle	Control System	Tests Run	HC	CO g/km(g/mile)	NOx	H_2SO_4 mg/km(mg/mile)
I. Catalyst Vehicles						
1. Vega-468	Pulsed air	4	0.02 (0.04)	0.23 (0.37)	0.83 (1.34)	1.1 (1.8)
2. Nova-781	Dual Cat w/air	8	0.09 (0.14)	0.01 (0.01)	0.31 (0.50)	38.3 (61.7)
3. Pinto-537A	Mon., w/air	8	0.11 (0.18)	0.19 (0.31)	1.55 (2.50)	17.1 (27.5)
4. Pinto-537B*	Base Mon., w/air	11	0.31 (0.50)	0.93 (1.49)	1.37 (2.21)	4.0 (6.5)
5. Nova-711**	Dual Cat., w/air	8	0.10 (0.16)	0.15 (0.24)	0.26 (0.42)	7.0 (11.2)
6. Fury Custom-035	Cat., Lean Burn	8	0.16 (0.26)	0.42 (0.68)	1.59 (2.56)	24.8 (39.9)
7. Rabbit-318	Mon., w/air	4	0.11 (0.18)	0.09 (0.14)	0.80 (1.29)	1.2 (1.9)
8. Rabbit-504	Mon., w/pulsed air	4	0.09 (0.14)	1.50 (2.41)	0.57 (0.91)	0.4 (0.6)
9. LTD-930	Mon., w/air	8	0.11 (0.18)	0.70 (1.12)	0.73 (1.18)	26.2 (42.1)
II. Non-Catalyst Vehicles						
1. Pinto-159	Diesel	8	0.12 (0.20)	0.77 (1.24)	0.42 (0.68)	5.3 (8.6)
2. Postal Van-957	Diesel	8	0.09 (0.15)	0.68 (1.09)	1.43 (2.31)	6.3 (10.2)
3. Rabbit-714	Diesel	8	0.09 (0.14)	0.45 (0.72)	0.45 (0.73)	3.4 (5.4)
4. Coronet-937	Diesel	4	0.40 (0.64)	1.12 (1.80)	0.88 (1.42)	7.6 (12.2)
5. Toyota-276	Lean, Thm reactor	1	0.22 (0.35)	0.77 (1.24)	0.77 (1.24)	0.3 (0.4)

* Same vehile as 537A but with a different catalyst.

** Tests run on 0.011 weight percent sulfur level.

The Cosworth Vega-468 was equipped with a conventional pelleted catalyst and pulsed air injection. The sulfuric acid emissions from this car on the congested freeway driving schedule were very low (average = 1.1 mg/km (1.8 mg/mi)).

Eight monolithic catalyst vehicles were tested in this series. All but one (lean burn Fury Custom-035) had air injection. The results from this group of vehicles were extremely varied. The sulfuric acid emissions ranged from 0.4 to 38.3 mg/km (0.6-61.7 mg/mi) with an average of 15 mg/km (24 mg/mi) on the CFDS. This is the level expected for cars of this type with high exhaust oxygen levels that generally (but not always) result from the use of air pumps.

This group included two Novas with Gould NOx catalysts and GM pelleted oxidation catalysts that were designed to give identical emissions. However, Nova-781 emitted 38.3 mg/km (61.7 mg/mi) of sulfates while Nova-711 emitted 7.0 mg/km (11.2 mg/mi), or less than one-fifth the emission rate from Nova-781. There are several possible explanations for this wide variation. The Nova-781 was preconditioned by Gould for about 3000 miles with 0.030 weight percent sulfur fuel before it was discovered that the catalyst was sensitive to sulfur. Nova-711 was preconditioned for about 200 miles with low sulfur fuel (0.001 weight percent). Therefore, Nova-711 probably was able to store more sulfur when it was tested in Ann Arbor. Another reason for the higher sulfuric acid emission rate from Nova-781 is that this car was tested with 0.030 weight percent sulfur fuel, while Nova-711 was tested with 0.011 weight percent sulfur fuel. This situation cannot be rectified by simply normalizing the results from Nova-711 to 0.030 weight percent sulfur fuel, since the validity of this numerical manipulation is questionable. Although the relationship between fuel sulfur level and sulfate emission rate is linear, as reported by Exxon Research and Engineering (1)*, the slope of this line can be extremely variable for different cars. Therefore, multiplying the sulfate emissions by the ratio of the fuel sulfur levels may not yield an accurate result, especially over such a large range (0.011-0.030).

These two cars also showed significant variation in the NOx emissions. This might have been due to the different types of EGR valves on the two cars. Nova-781, which emitted 0.61 g/km (0.98 g/mi) NOx, was equipped with a backpressure EGR valve. Nova-711, which emitted 0.39 g/km (0.63 g/mi) NOx, had a dual diaphragm EGR value.

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*Numbers in parenthesis indicate reference at end of report.

The two Pintos (537A and 537B) listed in Table 2 are actually the same vehicle with provisions for changing catalysts, so that the same car can be used to test different catalysts. Pinto-537A was equipped with a production catalyst made by Engelhard. Pinto-537B had an experimental base metal catalyst produced by Union Carbide. The production catalyst emitted much higher levels of sulfuric acid (17.1 mg/km vs. 4.0 mg/km), but the gaseous emissions were lower (0.22, 1.68, 1.18 g/km HC, CO, NOx vs. 0.51, 2.98, 1.32 g/km HC, CO, NOx) on the FTP. The Union Carbide catalyst emitted much less sulfuric acid, but at the expense of some gaseous emission control.

The Fury Custom-035 was a prototype lean burn vehicle with electronic spark advance and a monolithic catalyst without air injection. This car had a higher sulfuric acid emission rate than is normally seen from catalyst vehicles that do not have air injection (24.8 mg/km, (39.9 mg/mi)). This was possibly due to the lean mixture resulting in high exhaust oxygen levels, and thus higher sulfate emissions.

The two Volkswagen Rabbits in this category were very similar vehicles with one difference. Rabbit-318 was a production car with a monolith catalyst and air pump. Rabbit-504 was basically the same car, except that it was equipped with pulsed air injection. The sulfuric acid emissions were very low for both vehicles, although a little lower for Rabbit-504 (1.2 mg/km for Rabbit-318 and 0.4 mg/km for Rabbit-504). However, Rabbit-504 emitted about seven times as much CO as Rabbit-318 (5.96 gm/km vs. 0.86 gm/km) in the FTP. This could be a direct result of the pulsed air injection which gives little air at idle conditions, and thus, less oxidation of CO.

As previously mentioned, the Ford LTD-930 was tested as part of a correlation program with Ford Motor Company. This car was equipped with a monolithic catalyst and air injection. Table 3 shows the results of the testing at both EPA-OMSAPC and at Ford. (The numbers in brackets indicate the sample size).

TABLE 3: Comparison of Test Results Between Ford Motor Co. and EPA-OMSAPC for LTD-930

	FTP Emissions (g/km)			Avg. SO_4=Emissions on CFDS (mg/km)		
	HC	CO	NOx	Avg.	Std. Dev.	Coeff.Var.(%)
EPA-OMSAPC	0.40	2.98	0.69	26.2[8]	9.0	34
Ford	0.51	4.74	0.57	22.6[12]	5.9	26

The above results indicate an agreement between laboratories considered to be fair.

Included in this series of tests were five non-catalyst vehicles, four of which were equipped with diesel engines. These four diesels demonstrated sulfuric acid emission rates ranging from 3.4 to 7.6 mg/km (5.4-12.2 mg/mi) with an average of 5.7 mg/km (9.1 mg/mi) on the CFDS tests. These emission rates are higher than those normally obtained from non-catalyst vehicles. This is, in part, due to diesel fuel containing 0.270 weight percent sulfur or about nine times as much sulfur as the fuel used to test catalyst cars.

The fifth non-catalyst car tested was the Toyota-276 equipped with a lean burn engine and the turbulence generating pot. This vehicle demonstrated a very low sulfuric acid emission rate (0.3 mg/km) as is expected from a non-catalyst gasoline-fueled vehicle.

CONCLUSIONS

The data for oxidation catalyst vehicles in the baseline study for sulfuric acid emission seem to indicate a trend toward higher sulfuric acid emissions with lower gaseous emissions.(23) This trend was not apparent in the series of fourteen vehicles tested since the end of the baseline program. The highest CO emitter in the group, the Rabbit-504, was also the lowest sulfate emitter and conversely, the lowest CO emitter, the Nova-781, was the highest sulfate emitter. However, the rest of the vehicles showed no definite trend. A possible explanation is that this group, unlike the baseline study, was composed mainly of experimental vehicles. One can speculate that these cars could operate rich during accelerations and emit high levels of CO, but operate rather lean during cruise and thus emit high levels of sulfates. On the other hand, the control on exhaust oxygen level might be very good and thus the vehicle would emit low levels of both CO and sulfates. In general, this study neither confirms nor contradicts the results of the baseline study.

The results of this series of tests demonstrate that vehicles equipped with air injected oxidation catalysts emit higher levels of sulfuric acid than non-catalyst cars. Sulfuric acid emission rates for these cars averaged about 15 mg/km (24 mg/mi).

This study also shows that diesel cars emit higher levels of sulfuric acid than conventional non-catalyst cars, but not as high as oxidation catalyst vehicles. The primary reason for this higher level of sulfuric acid emissions (average of 5.7 mg/km (9.1 mg/mi) is assumed to be that diesel fuel contains much higher levels of sulfur than gasoline does.

REFERENCE

(1) K. C. Bachman, E. L. Holt, W. R. Leppard, E. E. Wigg, "Assessment of Automotive Sulfate Emission Control Technology," Exxon Research and Engineering, Contract 6803-04-97, 1976.

(2) Joseph H. Somers, Robert J. Garbe, Curtis E. Fett and Thomas M. Baines, "Automotive Sulfate Emissions - A Baseline Study," ACS Paper (To be Published August, 1976).

(3) "Test Report Automotive Sulfuric Acid Baseline Program," Report by Characterization and Applications Branch of Emission Control Technology Division of Office of Mobile Source Air Pollution Control EPA, January, 1976.

APPENDIX A

VEHICLE DESCRIPTIONS

EPA Sulfate Test Vehicle Information

1. Vehicle

V.I.N. IV77A4V137468 Make/Model Chev. / Cosworth-Vega.

Curb Weight, lbs. _____. Inertia Weight, lbs. 3,000.

Actual Dyno HP 10.3. Air Cond. Incl? (y or N) y.

Transmission/Speeds Man / 4. Engine Miles 5,000.

Immediate preconditioning:

Type Mod. AMA.

Miles 1,000.

Fuel sulfur level% 0.030.

2. Engine

Displacement, in^3 122. Rated Power, BHP _____.

Configuration (e.g. v-8) In-Line 4. Compression Ratio _____.

Timing (°BTDC (-), °ATDC (+)) - 12. Timing RPM 1600.

Idle RPM 1600. Idle CO, % (N or D) (N).

Point gap, in. _____. Plug gap, in. _____.

Mileage at last check of engine specs _____.

Date of last tune up _____.

3. Emission Control System

Type of control (e.g. 3 way catalyst) fuel injection, catalyst with air injection.

For Catalyst Systems:

Type (mono or pel) Pelleted.

Substrate or pellet material (type and amount) _____.

Not Available

Composition and loading of active material _____.

Method of air supply (e.g. air pump, carburetion) _____.

Catalyst age and mileage _____.

EPA Sulfate Test Vehicle Information

1. Vehicle

V. I. N. 1X27L5L115781. Make/Model Chev. / Nova.

Curb Weight, lbs. _____. Inertia Weight, lbs. 4,000.

Actual Dyno HP 12.0. Air Cond. Incl? (Y or N) N.

Transmission/Speeds Auto / _____. Engine Miles 6,000.

Immediate preconditioning:

Type Mod. AMA.

Miles 2,000.

Fuel sulfur level % 0.030.

2. Engine

Displacement, in^3 350. Rated Power, BHP _____.

Configuration (e.g. v-8) V-8. Compression Ratio _____.

Timing (°BTDC (-), °ATDC (+)) _____. Timing RPM _____.

Idle RPM _____. Idle CO,% (N or D) _____.

Point gap, in. _____. Plug gap, in. _____.

Mileage at last check of engine specs _____.

Mileage at last tune up In good tune.

Date of last tune up _____.

3. Emission Control System

Type of control (e.g. 3 way catalyst) exhaust recycle, Gould catalyst with air injection.

For Catalyst Systems:

Type (mono or pel) monolith.

Substrate or pellet material (type and amount) High temp. Ni alloy.

Composition and loading of active material Ni-Cu alloy.

Method of air supply (e.g. air pump, carburetion) air pump.

Catalyst age and mileage 2,000.

Total wt = 4 lbs.

EPA Sulfate Test Vehicle Information

1. Vehicle

V. I. N. F6X11Y114537A. Make/Model Ford / Pinto.

Curb Weight, lbs. _____. Inertia Weight, lbs. 3,000.

Actual Dyno HP 10.3. Air Cond. Incl? (Y or N) N.

Transmission/Speeds Auto / _____. Engine Miles 5800.

Immediate preconditioning:

Type Mod. AMA.

Miles 500.

Fuel sulfur level % 0.030.

2. Engine

Displacement, in^3 140. Rated Power, BHP 88.

Configuration (e.g. v-8) in-line 4. Compression Ratio 9.0.

Timing (°BTDC (-), °ATDC (+)) -20. Timing RPM 550.

Idle RPM _____. Idle CO,% (N or D) _____.

Point gap, in. _____. Plug gap, in. _____.

Mileage at last check of engine specs _____.

Mileage at last tune up in good tune.

Date of last tune up _____.

3. Emission Control System

Type of control (e.g. 3 way catalyst) exhaust recycle, Engelhard catalyst with air injection.

For Catalyst Systems:

Type (mono or pel) monolith.

Substrate or pellet material (type and amount) Corning.

Composition and loading of active material Pt/Pd.

Method of air supply (e.g. air pump, carburetion) air pump.

Catalyst age and mileage Low Mileage.

Cat. volume = 52 in^3

EPA Sulfate Test Vehicle Information

1. Vehicle

V. I. N. F6X11Y114537B. Make/Model Ford / Pinto.

Curb Weight, lbs. _____. Inertia Weight, lbs. 3,000.

Actual Dyno HP 10.3. Air Cond. Incl? (Y or N) N.

Transmission/Speeds Auto / _____. Engine Miles 5,000.

Immediate preconditioning:

Type Mod. AMA.

Miles 500.

Fuel sulfur level % 0.030.

2. Engine

Displacement, in^3 140. Rated Power, BHP 88.

Configuration (e.g. v-8) in-line 4. Compression Ratio 90.

Timing (°BTDC (-), °ATDC (+)) -20. Timing RPM 550.

Idle RPM _____. Idle CO,% (N or D) _____.

Point gap, in. _____. Plug gap, in. _____.

Mileage at last check of engine specs _____.

Mileage at last tune up in good tune.

Date of last tune up _____.

3. Emission Control System

Type of control (e.g. 3 way catalyst) exhaust recycle, Union Carbide base metal catalyst with air injection.

For Catalyst Systems:

Type (mono or pel) monolith.

Substrate or pellet material (type and amount) same as active material.

Composition and loading of active material Mixture of base metals(Fe,Al,Cr) non-Pt

Method of air supply (e.g. air pump, carburetion) air pump.

Catalyst age and mileage 2 years old (sitting on shelf). Low mileage

EPA Sulfate Test Vehicle Information

1. Vehicle

V. I. N. 1X27L5L119711. Make/Model Chev. / Nova.

Curb Weight, lbs. _____. Inertia Weight, lbs. 4,000.

Actual Dyno HP 12.0. Air Cond. Incl? (Y or N) N.

Transmission/Speeds Auto / _____. Engine Miles 3,500.

Immediate preconditioning:

Type Mod. AMA.

Miles 200.

Fuel sulfur level % 0.001.

2. Engine

Displacement, in^3 350. Rated Power, BHP _____.

Configuration (e.g. v-8) V-8. Compression Ratio _____.

Timing (°BTDC (-), °ATDC (+)) _____. Timing RPM _____.

Idle RPM _____. Idle CO,% (N or D) _____.

Point gap, in. _____. Plug gap, in. _____.

Mileage at last check of engine specs _____.

Mileage at last tune up in good tune.

Date of last tune up _____.

3. Emission Control System

Type of control (e.g. 3 way catalyst) exhaust recycle, Gould catalyst with air injection.

For Catalyst Systems:

Type (mono or pel) monolith.

Substrate or pellet material (type and amount) High temp. Ni alloy.

Composition and loading of active material Ni-Cu alloy.

Method of air supply (e.g. air pump, carburetion) air pump.

Catalyst age and mileage 200.

Total wt. = 4 lbs.

EPA Sulfate Test Vehicle Information

1. Vehicle

V. I. N. RH23J5G197035. Make/Model Plymouth / Fury Custom.

Curb Weight, lbs. 4300. Inertia Weight, lbs. 4500.

Actual Dyno HP 14.0. Air Cond. Incl? (Y or N) Y.

Transmission/Speeds Auto / 3. Engine Miles 50,000.

Immediate preconditioning:

Type MOD. AMA.

Miles 500.

Fuel sulfur level % 0.030.

2. Engine

Displacement, in^3 360. Rated Power, BHP 190.

Configuration (e.g. v-8) V-8. Compression Ratio 8.4.

Timing (°BTDC (-), °ATDC (+)) - 8. Timing RPM 625.

Idle RPM 625. Idle CO,% (N or D) 0.1 (D).

Point gap, in. NA. Plug gap, in. .035.

Mileage at last check of engine specs 50,241.

Mileage at last tune up 44,824.

Date of last tune up 1/7/76.

3. Emission Control System

Type of control (e.g. 3 way catalyst) Lean combustion mixture, electronic spark advance, catalyst.

For Catalyst Systems:

Type (mono or pel) monolith.

Substrate or pellet material (type and amount) Cordierite, Mullite and Alpha Alumina (two 45 cu. in. Monolith 2.2 lbs each).

Not Available

Composition and loading of active material 100% Pt.

Method of air supply (e.g. air pump, carburetion) None.

Catalyst age and mileage _____.

EPA Sulfate Test Vehicle Information

1. Vehicle

V. I. N. 1763076318 . Make/Model Volkswagen/ Rabbit .

Curb Weight, lbs. _____. Inertia Weight, lbs. 2250 .

Actual Dyno HP 7.3 . Air Cond. Incl? (Y or N) N .

Transmission/Speeds Man. / 4 . Engine Miles 5,000 .

Immediate preconditioning:

Type Mod. AMA .

Miles 500 .

Fuel sulfur level % 0.030 .

2. Engine

Displacement, in^3 9 . Rated Power, BHP _____.

Configuration (e.g. v-8) in-line 4 . Compression Ratio 8.0 .

Timing (°BTDC (-), °ATDC (+)) +3 . Timing RPM 925 .

Idle RPM 925 . Idle CO,% (N or D) 1.5 (N) .

Point gap, 47 ± 3 deg . Plug gap, in. .028 .

Mileage at last check of engine specs _____.

Mileage at last tune up tuned when new, 1000 mile check .

Date of last tune up _____.

3. Emission Control System

Type of control (e.g. 3 way catalyst) exhaust recycle, catalyst with air injection.

For Catalyst Systems:

Type (mono or pel) monolith .

Substrate or pellet material (type and amount) Ceramic - non-metal .

Composition and loading of active material Pt/Rh .

Method of air supply (e.g. air pump, carburetion) _____.

Catalyst age and mileage 5,000 .

Six inches long

EPA Sulfate Test Vehicle Information

1. Vehicle

V. I. N. 1763062504. Make/Model Volkswagen / Rabbit.

Curb Weight, lbs. _____. Inertia Weight, lbs. 2250.

Actual Dyno HP 7.3. Air Cond. Incl? (Y or N) N.

Transmission/Speeds Man / 4. Engine Miles 5300.

Immediate preconditioning:

Type Mod. AMA.

Miles 500.

Fuel sulfur level % 0.030.

2. Engine

Displacement, in^3 97. Rated Power, BHP _____.

Configuration (e.g. v-8) in-line 4. Compression Ratio 8.0.

Timing (°BTDC (-), °ATDC (+)) + 3. Timing RPM 925.

Idle RPM 925. Idle CO,% (N or D) 1.5 (N).

Point gap, 47 ± 3 deg. Plug gap, in. .028.

Mileage at last check of engine specs _____.

Mileage at last tune up tuned when new, 1000 mile check.

Date of last tune up _____.

3. Emission Control System

Type of control (e.g. 3 way catalyst) exhaust recycle, catalyst with pulsed air injection.

For Catalyst Systems:

Type (mono or pel) monolith.

Substrate or pellet material (type and amount) Ceramic - non-metal.

Composition and loading of active material Pt/Rh.

Method of air supply (e.g. air pump, carburetion) _____.

Catalyst age and mileage 5300.

Three inches long

EPA Sulfate Test Vehicle Information

1. Vehicle

V. I. N. 5J635127930. Make/Model Ford / LTD.

Curb Weight, lbs. _____. Inertia Weight, lbs. 5,000.

Actual Dyno HP 14.7. Air Cond. Incl? (Y or N) Y.

Transmission/Speeds Auto / _____. Engine Miles 11,000.

Immediate preconditioning:

Type 2-Test Sequences (1 FTP, 4 CFDS, 1 HFET)

Miles 150.

Fuel sulfur level % 0.030.

2. Engine

Displacement, in^3 400. Rated Power, BHP _____.

Configuration (e.g. v-8) V-8. Compression Ratio _____.

Timing (°BTDC (-), °ATDC (+)) -6. Timing RPM 500.

Idle RPM 675. Idle CO,% (N or D) (N).

Point gap, in. _____. Plug gap, in. _____.

Mileage at last check of engine specs _____.

Mileage at last tune up in good tune.

Date of last tune up _____.

3. Emission Control System

Type of control (e.g. 3 way catalyst) exhaust recycle, Engelhard catalyst with air injection.

For Catalyst Systems:

Type (mono or pel) monolith.

Substrate or pellet material (type and amount) Corning.

Composition and loading of active material Pt/Pd.

Method of air supply (e.g. air pump, carburetion) air pump.

Catalyst age and mileage Low mileage.

EPA Sulfate Test Vehicle Information

1. Vehicle

V. I. N. 1R10X165159. Make/Model Ford / Pinto.

Curb Weight, lbs. 2480. Inertia Weight, lbs. 2750.

Actual Dyno HP 9.9. Air Cond. Incl? (Y or N) N.

Transmission/Speeds Man. / 4. Engine Miles 100,000.

Immediate preconditioning:

Type None.

Miles _____.

Fuel sulfur level % _____.

2. Engine

Displacement, in^3 NA. Rated Power, BHP _____.

Configuration (e.g. v-8) NA. Compression Ratio _____.

Timing (°BTDC (-), °ATDC (+)) NA. Timing RPM _____.

Idle RPM _____. Idle CO,% (N or D) _____.

Point gap, in. _____. Plug gap, in. _____.

Mileage at last check of engine specs _____. DIESEL ENGINE

Mileage at last tune up nA.

Date of last tune up _____.

3. Emission Control System

Type of control (e.g. 3 way catalyst) _____

_____.

For Catalyst Systems:

Type (mono or pel) _____.

Substrate or pellet material (type and amount) _____.

Composition and loading of active material _____.

Method of air supply (e.g. air pump, carburetion) _____.

Catalyst age and mileage _____.

EPA Sulfate Test Vehicle Information

1. Vehicle

V. I. N. 6100957. Make/Model Am. Gen. / Postal Van.

Curb Weight, lbs. 2736. Inertia Weight, lbs. 3,000.

Actual Dyno HP 10.3. Air Cond. Incl? (Y or N) N.

Transmission/Speeds Auto / _____. Engine Miles 200.

Immediate preconditioning:

Type None.

Miles _____.

Fuel sulfur level % _____.

2. Engine

Displacement, in^3 165. Rated Power, BHP 70.

Configuration (e.g. v-8) in-line 4. Compression Ratio 21.0.

Timing (°BTDC (-), °ATDC (+)) NA. Timing RPM _____.

Idle RPM _____. Idle CO,% (N or D) _____. DIESEL ENGINE

Point gap, in. _____. Plug gap, in. _____.

Mileage at last check of engine specs _____.

Mileage at last tune up NA.

Date of last tune up _____.

3. Emission Control System

Type of control (e.g. 3 way catalyst) _____

_____.

For Catalyst Systems:

Type (mono or pel) _____.

Substrate or pellet material (type and amount) _____.

Composition and loading of active material _____.

Method of air supply (e.g. air pump, carburetion) _____.

Catalyst age and mileage _____.

EPA Sulfate Test Vehicle Information

1. Vehicle

V. I. N. 1763188714. Make/Model Volkswagen/ Rabbit.

Curb Weight, lbs. _____. Inertia Weight, lbs. 2250.

Actual Dyno HP 7.3. Air Cond. Incl? (Y or N) Y.

Transmission/Speeds Man. / 4. Engine Miles 400.

Immediate preconditioning:

Type None.

Miles _____.

Fuel sulfur level % _____.

2. Engine

Displacement, in^3 90. Rated Power, BHP _____.

Configuration (e.g. v-8) in-line 4. Compression Ratio 23:1.

Timing (°BTDC (-), °ATDC (+)) _____. Timing RPM _____.

Idle RPM 850. Idle CO,% (N or D) _____. DIESEL ENGINE

Point gap, in. _____. Plug gap, in. _____.

Mileage at last check of engine specs _____.

Mileage at last tune up tuned when new.

Date of last tune up _____.

3. Emission Control System

Type of control (e.g. 3 way catalyst) _____

_____.

For Catalyst Systems:

Type (mono or pel) _____.

Substrate or pellet material (type and amount) _____.

Composition and loading of active material _____.

Method of air supply (e.g. air pump, carburetion) _____.

Catalyst age and mileage _____.

EPA Sulfate Test Vehicle Information

1. Vehicle

V. I. N. WT41G5A206937. Make/Model Dodge / Coronet.

Curb Weight, lbs. 4073. Inertia Weight, lbs. 4500.

Actual Dyno HP 13.9. Air Cond. Incl? (Y or N) Y.

Transmission/Speeds Auto / _____. Engine Miles 100.

Immediate preconditioning:

Type None.

Miles _____.

Fuel sulfur level % _____.

2. Engine

Displacement, in^3 198. Rated Power, BHP _____.

Configuration (e.g. v-8) in-line 6. Compression Ratio 22.0.

Timing (°BTDC (-), °ATDC (+)) NA. Timing RPM _____.

Idle RPM _____. Idle CO,% (N or D) _____.

Point gap, in. _____. Plug gap, in. _____. DIESEL ENGINE

Mileage at last check of engine specs _____.

Mileage at last tune up NA.

Date of last tune up _____.

3. Emission Control System

Type of control (e.g. 3 way catalyst) fuel injection.

_____.

For Catalyst Systems:

Type (mono or pel) _____.

Substrate or pellet material (type and amount) _____.

Composition and loading of active material _____.

Method of air supply (e.g. air pump, carburetion) _____.

Catalyst age and mileage _____.

EPA Sulfate Test Vehicle Information

1. Vehicle

V. I. N. TE51501276. Make/Model Toyota / Corolla Liftback

Curb Weight, lbs. 2260. Inertia Weight, lbs. 2500.

Actual Dyno HP 9.4. Air Cond. Incl? (Y or N) N.

Transmission/Speeds Man. / 5. Engine Miles 2,200.

Immediate preconditioning:

Type None.

Miles _____.

Fuel sulfur level % _____.

2. Engine

Displacement, in^3 96.9. Rated Power, BHP 68.

Configuration (e.g. v-8) in-line 4. Compression Ratio 8.5.

Timing (°BTDC (-), °ATDC (+)) - 10. Timing RPM 850.

Idle RPM 850. Idle CO,% (N or D) (N).

Point gap, in. _____. Plug gap, in. _____.

Mileage at last check of engine specs _____.

Mileage at last tune up in good tune.

Date of last tune up _____.

3. Emission Control System

Type of control (e.g. 3 way catalyst) Lean Burn Engine with dividing chamber (Turbulence Generating Pot -TGP) Exhaust Port Liners, and Heat Shielded Exhaust Manifold.

For Catalyst Systems:

Type (mono or pel) _____.

Substrate or pellet material (type and amount) _____.

Composition and loading of active material _____.

Method of air supply (e.g. air pump, carburetion) _____.

Catalyst age and mileage _____.

APPENDIX B

DATA SUMMARY SHEETS

KEY FOR TEST SHEETS

FTP

HFET

CFDS-SET

TABLE 1: SUMMARY OF TEST RESULTS IN S.I. UNITS

Car	FTP Gaseous Emissions (g/km) HC	CO	NOx	Avg. Sulfate Emis. (mg/km) FTP	FET	CFDS Sulfate Avg.	Stand. Dev.
I. Catalyst vehicle							
1) Vega-468	0.18	2.71	0.71	0.7	1.0	1.1	0.6
2) Nova-781	0.22	0.91	0.61	4.1	50.1	38.3	4.8
3) Pinto-537A	0.22	1.68	1.18	9.1	22.3	17.1	3.7
4) Pinto-537B	0.51	2.98	1.32	1.1	4.7	4.0	0.9
5) Nova-711	0.17	0.42	0.39	1.4*	17.8*	7.0*	2.3
6) Fury Custom-035	0.32	2.92	1.24	18.4	32.2	24.8	6.3
7) Rabbit-318	0.16	0.86	0.78	1.6	3.0	1.2	0.3
8) Rabbit-504	0.29	5.96	0.49	0.4	0.6	0.4	0.2
9) LTD-930	0.40	2.98	0.69	3.6	44.7	26.2	9.0
II. Non-Catalyst Vehicles							
1) Pinto-159	0.15	0.75	0.47	5.0	4.4	5.3	1.5
2) Postal Van-957	0.09	0.91	1.58	8.5	7.1	6.3	0.6
3) Rabbit-714	0.17	0.71	0.50	5.0	4.6	3.4	0.4
4) Coronet-937	0.16	0.76	1.13	9.0	10.7	7.6	0.9
5) Toyota-276	0.71	3.95	1.03	0.3	0.4	0.3	-

Coeff. Var. (%)	Emissions (mg/km) Max.	Min.	No. of CFDS run	Fuel Economy (KPL) FTP	FET
57	1.7	0.5	4	6.8	11.2
13	47.1	33.1	8	5.4	7.7
22	24.5	12.8	8	9.5	12.3
23	6.3	2.1	11	9.7	12.6
33	10.3	4.3	8	5.7	7.7
26	33.4	16.0	8	4.7	7.4
21	1.5	0.9	4	9.9	15.2
50	0.6	0.3	4	10.3	15.9
34	38.0	11.9	8	4.3	6.8
28	7.8	3.5	8	19.0	23.1
9	6.8	5.0	8	12.7	16.0
11	3.9	2.9	8	17.2	21.9
12	8.5	6.4	4	9.5	11.0
-	-	-	1	12.9	15.7

*0.011 Wt. % sulfur fuel used for tests.

TABLE 2: SUMMARY OF TEST RESULTS IN ENGLISH UNITS

	FTP Gaseous Emissions g/mi			Avg. Sulfate Emis. mg/mi		CFDS	
	HC	CO	NOx	FTP	FET	Avg.	Stand. Dev.
I. Catalyst Vehicles							
1) Vega-468	0.29	4.36	1.15	1.1	1.6	1.8	1.0
2) Nova-781	0.35	1.46	0.98	6.6	80.7	61.7	7.7
3) Pinto-537A	0.35	2.70	1.90	14.7	35.9	27.5	6.0
4) Pinto-537B	0.82	4.80	2.12	1.8	7.6	6.5	1.5
5) Nova-711	0.28	0.68	0.63	2.3*	28.6*	11.2*	3.7
6) Fury Custom-035	0.51	4.70	2.05	29.6	51.9	39.9	10.2
7) Rabbit-318	0.25	1.38	1.26	2.6	4.9	1.9	0.4
8) Rabbit-504	0.46	9.59	0.79	0.6	0.9	0.6	0.3
9) LTD-930	0.65	4.79	1.11	5.8	71.9	42.1	14.5
II. Non-Catalyst Vehicles							
1) Pinto-159	0.24	1.20	0.75	8.1	7.1	8.6	2.4
2) Postal Van-957	0.15	1.46	2.55	13.6	11.5	10.2	0.9
3) Rabbit-714	0.27	1.15	0.93	8.1	7.4	5.4	0.6
4) Coronet-937	0.26	1.22	1.82	14.5	17.2	12.2	1.4
5) Toyota-276	1.15	6.36	1.66	0.4	0.6	0.4	-

	Emissions mg/mi			Fuel Economy MPG	
Coeff. Var. (%)	Max.	Min.	No. of CFDS run	FTP	FET
57	2.7	0.8	4	16.2	26.8
13	75.8	53.3	8	12.9	18.4
22	39.4	20.6	8	22.7	29.3
23	10.1	3.3	11	23.1	30.2
33	16.5	6.9	8	13.6	18.3
26	54.3	25.7	8	11.3	17.7
21	2.4	1.4	4	23.6	36.3
50	1.0	0.4	4	24.7	38.1
34	61.2	19.2	8	10.3	16.3
28	12.5	5.6	8	45.4	55.3
9	10.9	8.0	8	30.4	38.2
11	6.2	4.6	8	41.0	52.3
12	13.6	10.3	4	22.7	26.3
-	-	-	1	30.7	37.4

*0.011 wt. % sulfur fuel used for tests

SULFATE PROJECT
VEHICLE ID : 1V77A4U137468 COSWORTH VEGA

TEST NO.	TEST DATE	ANAL DATE	ODOM	H2SO4 MG/MI	SO2 MG/MI	% FUEL SULFUR SO4	SO2	RECOV	DRV	ANAL	EMISSIONS (G/MI.) HC	CO	CO2	NOX	MPG	COMMENTS (TEST TYPE)
771301	4-12-76	4-16	5621	1.1		0.9		0.9	110	139	0.17	1.78	463	1.57	19.0	RC 5468-75-100[1]
771302	4-12-76	4-16	5632	2.7		2.7		2.7	139	139	0.06	0.59	378	1.35	23.4	468-SC-100
771303	4-12-76	4-16	5645	1.5		1.7		1.7	123	139	0.02	0.36	329	1.20	26.9	468-HE-100 CELL OPERATOR
771304	4-12-76	4-16	5655	2.6		2.5		2.5	123	139	0.04	0.16	379	1.38	23.4	468-SC-200 CELL OPERATOR
771308	4-13-76	4-16	5670	1.1		0.8		0.8	220	172	0.33	4.47	524	1.11	16.7	468-75-200 CELL OPERATOR
771309	4-13-76	4-16	5682	1.0		1.0		1.0	220	172	0.04	0.49	385	1.28	23.0	468-SC-300 SEC OVERTIME [MALFUNCTION. (
771310	4-13-76	4-16	5695	1.7		1.9		1.9	220	172	-.00	0.37	332	1.13	26.7	468-HE-200 CELL OPERATOR
771311	4-13-76	4-16	5705	0.8		0.8		0.8	220	172	0.01	0.24	376	1.33	23.6	468-SC-400 CELL OPERATOR
771344	4-14-76	4-16	5717	1.2		0.8		0.8	220	172	0.25	4.24	559	1.19	15.7	468-75-300 CELL OPERATOR

1 CVS Filter Leaking on Bags 1 and 2.

SULFATE PROJECT
VEHICLE ID : 1X27L5L115781 NOVA

TEST NO.	TEST DATE	ANAL DATE	ODOM	H2SO4 MG/MI	SO2 MG/MI	% FUEL SULFUR SO4	SO2	RECOV	DPV	ANAL	EMISSIONS (G/MI.) HC	CO	CO2	NOX	MPG	COMMENTS (TEST TYPE)
770177	1-22-76	1-29	6066	6.7		3.8		3.8	0	0	0.2	0.02	659	0.96	7.3	781-75-100*
770178	1-22-76	1-29	6077	69.6		45.3		45.3	0	0	0.1	0.01	527	0.52	16.8	781-SC-100
770179	1-22-76	1-29	6090	58.8		39.3		39.3	0	0	0.1	0.0	511	0.42	17.3	781-SC-200
770180	1-22-76	1-29	6103	88.8		62.9		62.9	0	0	0.1	0.0	485	0.27	18.3	781-HE-100
770181	1-22-76	1-29	6113	61.2		4.0		4.0	0	0	0.1	0.03	515	0.49	17.2	781-SC-300
770182	1-22-76	1-29	6126	75.8		50.8		50.8	0	0	0.1	0.01	511	0.62	17.3	781-SC-400
770191	1-23-76	1-29	6142	6.5		3.1		3.1	0	0	0.3	1.46	682	0.98	12.9	781-75-200
770192	1-23-76	1-29	6153	63.1		41.3		41.3	0	0	0.1	0.01	525	0.52	16.9	781-SC-500
770193	1-23-76	1-29	6166	58.1		38.9		38.9	0	0	0.1	0.01	513	0.45	17.3	781-SC-600
770194	1-23-76	1-29	6180	72.6		51.2		51.2	0	0	0.1	-0.0	483	0.29	18.4	781-HE-200
770195	1-23-76	1-29	6190	53.7		35.5		35.5	0	0	0.1	0.0	519	0.44	17.1	781-SC-700

SULFATE PROJECT
VEHICLE ID : 1X27L5L115781 NOVA Cont.

10:50:35 SEP

TEST NO.	TEST DATE	ANAL DATE	ODOM	H2SO4 MG/MI	SO2 MG/MI	% FUEL SULFUR SO4	SO2	RECOV	DEV	ANAL	EMISSIONS (G/MI.) HC	CO	CO2	NOX	MPG	COMMENTS (TEST TYPE)
770196	1-23-76	2-02	6203	53.3		34.9		34.9	0	0	0.1	0.01	525	0.51	16.9	781-SC-800

SULFATE PROJECT
VEHICLE ID : F6X11Y114537A FORD PINTO

TEST NO.	TEST DATE	ANAL DATE	ODOM	H2SO4 MG/MI	SO2 MG/MI	% FUEL SULFUR SO4	SO2	RECOV	DRV	ANAL	EMISSIONS (G/MI.) HC	CO	CO2	NOX	MPG	COMMENTS (TEST TYPE)
770212	1-27-76	1-29	5799	19.7		15.0		15.0	0	0	0.4	3.29	384	1.90	22.7	537-75-400, OEI E)
770213	1-27-76	2-02	5810	20.6		21.2		21.2	0	0	0.2	0.33	333	2.50	26.6	537-SC-1300, OE
770214	1-27-76	2-02	5823	23.2		24.7		24.7	0	0	0.2	0.23	322	2.51	27.5	537-SC-1400, OE
770215	1-27-76	2-02	5837	33.0		37.4		37.4	0	0	0.2	0.17	302	2.41	29.3	537-HE-400, OEI
770216	1-27-76	2-02	5847	25.9		26.7		26.7	0	0	0.2	0.27	332	2.50	26.6	537-SC-1500, OE
770217	1-27-76	2-02	5860	30.4		32.0		32.0	0	0	0.2	0.28	325	2.46	27.2	537-SC-1600, OE
770247	1-28-76	2-02	5875	9.7		7.3		7.3	0	0	0.3	2.11	387	1.90	22.7	537-75-500, OEI
770248	1-28-76	2-02	5886	21.9		23.3		23.3	0	0	0.2	0.29	321	2.52	27.5	537-SC-1700 , (
770249	1-28-76	1-29	5901	29.4		30.1		30.1	0	0	0.2	0.32	333	2.59	26.5	537-SC-1800 [2],
770250	1-28-76	1-29	5915	38.7		43.8		43.8	0	0	0.2	0.18	303	2.55	29.2	537-HE-500 , OE
770251	1-28-76	1-29	5925	39.4		41.7		41.7	0	0	0.2	0.26	324	2.46	27.3	537-SC-1900 , (

SULFATE PROJECT
VEHICLE ID : F6X11Y114537B FORD PINTO UC CATALYST

TEST NO.	TEST DATE	ANAL DATE	ODOM	H2SO4 MG/MI	SO2 MG/MI	% FUEL SULFUR SO4	SO2	RECOV	DRV	ANAL	EMISSIONS (G/MI.) HC	CO	CO2	NOX	MPG	COMMENTS (TEST TYPE)
763518	12-22-75	12-29	4934	2.5		1.9		1.9	0	0	1.0	3.79	395	2.40	22.0	537-75-100
763519	12-22-75	12-25	4945	6.2		5.0		5.0	0	0	0.6	1.81	340	1.62	25.7	537-SC-100
763520	12-22-75	12-29	4958	3.3		3.4		3.4	0	0	0.6	1.68	323	1.76	27.1	537-SC-200
763521	12-22-75	12-29	4971	8.5		9.2		9.2	0	0	0.5	0.88	303	1.35	29.0	537-HE-100
763522	12-22-75	12-29	4981	5.4		5.8		5.8	0	0	0.6	1.24	307	1.74	28.5	537-SC-300
763523	12-22-75	12-29	4994	7.1		7.5		7.5	0	0	0.6	1.45	313	1.86	28.0	537-SC-400
763544	12-30-75	12-31	5009	2.2		1.7		1.7	0	0	0.7	5.64	365	1.82	23.6	537-75-200
763545	12-30-75	12-31	5020	4.3		4.7		4.7	0	0	0.4	1.71	303	2.40	28.9	537-SC-500
763546	12-30-75	12-31	5035	5.4		5.6		5.6	0	0	0.4	1.47	312	2.61	28.1	537-SC-600
763547	12-30-75	12-31	5049	4.3		4.7		4.7	0	0	0.4	0.93	302	2.76	29.1	537-HE-200
763548	12-30-75	12-31	5059	9.1		9.7		9.7	0	0	0.4	1.63	309	2.64	28.4	537-SC-700

SULFATE PROJECT
VEHICLE ID : F6X11Y114537B FORD PINTO UC CATALYST Cont.

TEST NO.	TEST DATE	ANAL DATE	ODOM	H2SO4 MG/MI	SO2 MG/MI	% FUEL SULFUR SO4	SO2	RECOV	DRV	ANAL	EMISSIONS (G/MI.) HC	CO	CO2	NOX	MPG	COMMENTS (TEST TYPE)
763549	12-30-75	12-31	5072	6.2		7.0		7.0	0	0	0.4	1.58	291	2.47	30.1	537-SC-800
763577	12-31-75	12-31	5093	0.7		0.6		0.6	0	0	0.7	4.97	364	2.13	23.7	537-75-300
763578	12-31-75	12-31	5104	7.0		8.0		8.0	0	0	0.4	1.35	292	2.41	30.0	537-SC-900
763579	12-31-75	12-31	5117	7.0		8.4		8.4	0	0	0.4	1.37	282	2.22	31.0	537-SC-1000
763580	12-31-75	12-31	5130	10.1		12.3		12.3	0	0	0.4	0.75	271	2.42	32.4	537-HE-300
763581	12-31-75	12-31	5140	7.6		8.4		8.4	0	0	0.4	1.32	298	2.41	29.4	537-SC-1100
763582	12-31-75	12-31	5153	7.5		8.1		8.1	0	0	0.4	1.31	304	2.33	28.8	537-SC-1200

SULFATE PROJECT
VEHICLE ID : 1X27LSL119711 NOVA

TEST NO.	TEST DATE	ANAL DATE	ODOM	H2SO4 MG/MI	SO2 MG/MI	% FUEL SULFUR SO4	SO2	RECOV	DRV	ANAL	EMISSIONS (G/MI.) HC	CO	CO2	NOX	MPG	COMMENTS (TEST TYPE)
770326	2- 5-76	2-25	3504	1.6		2.1		2.1	0	0	0.3	0.68	631	0.61	14.0	711-75-100*
770327	2- 5-76	2-25	3515	6.9		12.8		12.8	0	0	0.2	0.21	503	0.45	17.6	711-SC-100
770328	2- 5-76	2-25	3528	7.6		14.1		14.1	0	0	0.2	0.55	507	0.41	17.5	711-SC-200
770329	2- 5-76	2-25	3542	31.2		60.0		60.0	0	0	0.1	0.19	487	0.40	18.2	711-HE-100
770330	2- 5-76	2-25	3552	8.2		15.0		15.0	0	0	0.2	0.18	509	0.41	17.4	711-SC-300
770331	2- 5-76	2-25	3565	11.8		21.8		21.8	0	0	0.2	0.11	507	0.40	17.5	711-SC-400
770363	2- 6-76	3-08	3582	3.0		3.9		3.9	0	0	0.3	0.68	668	0.64	13.2	711-75-200
770364	2- 6-76	2-25	3593	16.5		30.0		30.0	0	0	0.2	0.26	515	0.46	17.2	711-SC-500
770365	2- 6-76	2-25	3606	15.8		28.2		28.2	0	0	0.2	0.24	523	0.41	16.9	711-SC-600
770366	2- 6-76	2-25	3619	25.9		50.3		50.3	0	0	0.1	0.09	482	0.40	18.4	711-HE-200
770367	2- 6-76	2-25	3629	9.6		17.3		17.3	0	0	0.2	0.21	518	0.41	17.1	711-SC-700

SULFATE PROJECT
VEHICLE ID : 1X27L5L119711 NOVA Cont.

TEST NO.	TEST DATE	ANAL DATE	ODOM	H2SO4 MG/MI	SO2 MG/MI	% FUEL SULFUR SO4	SO2	RECOV	DRV	ANAL	EMISSIONS (G/MI.) HC	CO	CO2	NOX	MPG	COMMENTS (TEST TYPE)
770368	2- 6-76	2-25	3642	13.4		24.1		24.1	0	0	0.2	0.12	517	0.41	17.1	711-SC-800

SULFATE PROJECT
VEHICLE ID : P423J5G197035 FURY

TEST NO.	TEST DATE	ANAL DATE	ODOM	H2SO4 MG/MI	SO2 MG/MI	% FUEL SULFUR SO4	SO2	RECOV	DRV	ANAL	EMISSIONS (G/MI.) HC	CO	CO2	NOX	MPG	COMMENTS (TEST TYPE)
77 729	3-10-76	3-15	50996	35.2		15.7		15.7	123	139	0.53	5.37	791	1.81	11.1	035-75-100
77 730	3-10-76	3-15	51007	31.8		20.1		20.1	123	172	0.24	0.74	560	2.95	15.8	035-SC-100
77 731	3-10-76	3-15	51020	25.7		16.2		16.2	123	172	0.24	0.72	559	2.84	15.8	035-SC-200
77 732	3-10-76	3-15	51033	43.0		30.8		30.8	123	172	0.23	0.61	493	3.14	17.9	035-HE-100
77 733	3-10-76	3-15	51043	30.9		20.0		20.0	123	172	0.26	0.73	547	3.00	16.2	035-SC-300
77 734	3-10-76	3-15	51056	36.2		23.0		23.0	123	172	0.24	0.73	558	2.70	15.9	035-SC-400
77 735	3-11-76	3-15	51071	23.9		10.9		10.9	172	123	0.49	4.03	772	2.28	11.4	035-75-200
77 736	3-11-76	3-15	51081	54.3		34.6		34.6	172	123	0.22	0.60	557	2.25	15.9	035-SC-500*
77 737	3-11-76	3-15	51094	46.5		29.8		29.8	172	123	0.26	0.59	552	2.29	16.0	035-SC-600
77 738	3-11-76	3-15	51107	60.7		42.3		42.3	172	123	0.26	0.61	508	2.55	17.4	035-HE-200
77 739	3-11-76	3-15	51117	50.0		31.6		31.6	172	123	0.30	0.65	560	2.18	15.8	035-SC-700
77 740	3-11-76	3-15	51131	44.0		27.8		27.8	172	123	0.29	0.64	560	2.23	15.8	035-SC-800

* Test Time Estimated from Counts

SULFATE PROJECT 13:39:47 JUL
VEHICLE ID : 1763076318 RABBIT

TEST NO.	TEST DATE	ANAL DATE	ODOM	H2SO4 MG/MI	SO2 MG/MI	% FUEL SULFUR SO4	SO2	RECOV	DRV	ANAL	EMISSIONS (G/MI.) HC	CO	CO2	NOX	MPG	COMMENTS (TEST TYPE)
771752	5-11-76	6-08	5218	4.2		4.1		4.1	22027	13933	0.3	1.63	378	1.22	23.3	318-75-100
771753	5-11-76	6-08	5229	1.9		2.7		2.7	22027	13933	0.1	0.14	257	1.30	34.4	318-SC-100 *
771754	5-11-76	6-08	5242	5.3		7.8		7.8	22027	13933	0.1	0.08	247	1.87	35.9	318-HE-100
771755	5-11-76	6-08	5252	2.4		3.5		3.5	22027	13933	0.1	0.11	251	1.33	35.2	318-SC-200
771789	5-12-76	6-08	5266	1.0		1.0		1.0	22027	17216	0.2	1.12	369	1.30	23.9	318-75-200
771790	5-12-76	6-08	5277	1.4		2.0		2.0	22027	17216	0.1	0.19	246	1.25	36.0	318-SC-300
771791	5-12-76	6-08	5291	4.5		6.8		6.8	22027	17216	0.1	0.08	242	1.80	36.6	318-HE-200
771792	5-12-76	6-08	5302	2.0		2.9		2.9	22027	17216	0.1	0.12	249	1.28	35.6	318-SC-400

* Small Leak in Exhaust Connector

SULFATE PROJECT
VEHICLE ID : 1763062504 Rabbit

13:42:57 JUL

TEST NO.	TEST DATE	ANAL DATE	ODOM	H2SO4 MG/MI	SO2 MG/MI	% FUEL SULFUR SO4	SO2	RECOV	DRV	ANAL	EMISSIONS (G/MI.) HC	CO	CO2	NOX	MPG	COMMENTS (TEST TYPE)
771756	5-11-76	6-08	5296	0.8		0.8		0.8	22027	13933	0.5	11.50	350	0.69	24.0	504-75-100*
771757	5-11-76	6-08	5307	1.0		1.5		1.5	22027	13933	0.1	2.82	243	0.88	35.8	504-SC-100
771758	5-11-76	6-08	5320	1.1		1.6		1.6	22027	13933	0.1	1.20	241	1.41	36.5	504-HE-100
771759	5-11-76	6-08	5330	0.4		0.6		0.6	22027	13933	0.1	3.22	235	0.86	36.9	504-SC-200
771785	5-11-76	6-08	5344	0.4		0.4		0.4	13933	17216	0.4	7.69	336	0.88	25.4	504-75-200
771786	5-12-76	6-08	5355	0.5		0.7		0.7	13933	17216	0.2	2.15	237	0.97	36.9	504-SC-300
771787	5-12-76	6-08	5368	0.6		1.0		1.0	13933	17216	0.1	0.81	222	1.23	39.8	504-HE-200
771788	5-12-76	6-08	5378	0.4		0.6		0.6	13933	17216	0.1	1.45	242	0.94	36.2	504-SC-400

* One False Start on Bag 1

SULFATE PROJECT
VEHICLE ID : 5J63S127930 LTD

TEST NO.	TEST DATE	ANAL DATE	ODOM	H2SO4 MG/MI	SO2 MG/MI	% FUEL SULFUR SO4	SO2	RECOV	DRV	ANAL	EMISSIONS (G/MI.) HC	CO	CO2	NOX	MPG	COMMENTS (TEST TYPE)
772406	6-14-76	6-24	11395	6.0		2.3		2.3	11187	11003	0.6	6.13	883	1.15	9.9	930-75-100[2]
772407	6-14-76	6-24	11410	19.2		11.5		11.5	11187	11003	0.2	1.17	574	1.21	15.4	930-SC-100
772408	6-14-76	6-24	11423	36.8		22.2		22.2	11187	11187	0.2	1.05	567	1.27	15.6	930-SC-200
772409	6-14-76	6-24	11437	39.1		23.5		23.5	11003	11187	0.2	1.20	569	1.18	15.5	930-SC-300
772410	6-14-76	6-24	11448	44.5		25.8		25.8	11003	11187	0.2	1.15	590	1.21	15.0	930-SC-400
772419	6-14-76	6-24	11462	66.4		41.9		41.9	11187	11187	0.1	0.99	542	1.51	16.3	930-HE-100
772425	6-15-76	6-24	11481	5.5		2.3		2.3	11187	11003	0.7	3.45	829	1.07	10.6	930-75-200
772420	6-15-76	6-24	11492	27.4		16.4		16.4	11187	11003	0.2	1.12	573	1.22	15.4	930-SC-500
772421	6-15-76	6-24	11505	61.2		40.5		40.5	11187	11003	0.2	1.04	515	1.09	17.1	930-SC-600[2]
772422	6-15-76	6-24	11518	50.8		30.1		30.1	11187	11003	0.2	1.10	577	1.23	15.3	930-SC-700
772423	6-15-76	6-24	11531	57.8		35.1		35.1	11187	11003	0.2	1.09	563	1.22	15.7	930-SC-800
772426	6-15-76	6-24	11544	77.4		48.9		48.9	11187	11003	0.1	1.03	542	1.43	16.3	930-HE-200

1 One Cooling Fan Used on FTP

2 CVS Blower OSS For 3 Min During Test Due to Power Failure.

SULFATE PROJECT
VEHICLE ID : 1R10X165159 PINTO DIESEL

TEST NO.	TEST DATE	ANAL DATE	ODOM	H2SO4 MG/MI	SO2 MG/MI	% FUEL SULFUR SO4	SO2	RECOV	DRV	ANAL	EMISSIONS (G/MI.) HC	CO	CO2	NOX	MPG	COMMENTS (TEST TYPE)
77 586	2-26-76	3-02	99850	8.5		1.5		1.5	139	111	0.20	1.14	225	0.76	44.8	159-75-100
77 587	2-26-76	3-02	99861	8.5		1.8		1.8	139	-10	0.16	0.98	201	0.67	50.2	159-SC-100
77 588	2-26-76	3-02	99874	6.4		1.5		1.5	172	111	0.11	0.85	184	0.66	54.7	159-SC-200
77 589	2-26-76	3-02	99887	7.4		1.7		1.7	172	111	0.16	0.86	188	0.68	53.6	159-HE-100
77 590	2-26-76	3-02	99897	12.5		2.5		2.5	111	172	0.30	1.77	220	0.71	45.4	159-SC-300
77 591	2-26-76	3-02	99910	10.6		2.1		2.1	111	172	0.30	1.73	217	0.70	46.1	159-SC-400
77 601	2-27-76	3-02	99931	7.6		1.4		1.4	-10	110	0.28	1.25	219	0.74	45.9	159-75-200*
																START
77 602	2-27-76	3-02	99942	6.6		1.5		1.5	-10	110	0.14	0.90	192	0.67	52.5	159-SC-500
77 603	2-27-76	3-02	99955	5.6		1.3		1.3	172	-10	0.16	0.90	189	0.65	53.2	159-SC-600
77 604	2-27-76	3-02	99968	6.7		1.6		1.6	172	-10	0.15	0.90	177	0.65	57.0	159-HE-200
77 605	2-27-76	3-02	99978	8.2		1.8		1.8	110	-10	0.19	1.21	197	0.66	51.0	159-SC-700
77 606	2-27-76	3-02	99991	10.0		2.1		2.1	110	-10	0.25	1.61	209	0.69	47.8	159-SC-800

* Sample Started 15 sec. After Engine Start

SULFATE PROJECT
VEHICLE ID : 6100957 POSTAL VAN

TEST NO.	TEST DATE	ANAL DATE	ODOM	H2SO4 MG/MI	SO2 MG/MI	% FUEL SULFUR SO4	SO2	RECOV	DRV	ANAL	EMISSIONS (G/MI.) HC	CO	CO2	NOX	MPG	COMMENTS (TEST TYPE)
77 685	3- 4-76	3-10	198	15.5		1.9		1.9	139	-10	0.12	1.33	318	1.73	31.8	957-75-100* TRAIN 16 NOX SP URN ON BAG 1
77 686	3- 4-76	3-10	209	10.8		1.7		1.7	139	139	0.14	1.05	269	2.28	37.6	957-SC-100
77 687	3- 4-76	3-10	222	10.3		1.7		1.7	-10	139	0.14	1.07	267	2.25	37.8	957-SC-200 SAMPLE RAN 25 S
77 688	3- 4-76	3-10	235	11.0		1.8		1.8	-10	172	0.16	0.97	266	1.23	38.0	957-HE-100
77 689	3- 4-76	3-10	245	10.6		1.7		1.7	100	172	0.15	1.10	271	2.41	37.2	957-SC-300 CELL OPERATOR I
77 690	3- 4-76	3-10	258	8.0		1.3		1.3	-10	172	0.16	1.12	270	2.45	37.4	957-SC-400 CELL OPERATOR I
77 702	3- 5-76	3-10	275	11.6		1.4		1.4	-10	172	0.18	1.59	350	2.55	28.9	957-75-200 CELL OPERATOR C
77 703	3- 5-76	3-10	287	10.2		1.6		1.6	-10	172	0.16	1.10	270	2.20	37.4	957-SC-500 CELL OPERATOR I
77 704	3- 5-76	3-10	301	10.9		1.8		1.8	-10	172	0.15	1.09	271	2.30	37.3	957-SC-600 CELL OPERATOR I
77 705	3- 5-76	3-10	312	11.9		2.0		2.0	-10	172	0.17	0.99	263	2.37	38.4	957-HE-200 CELL OPERATOR I
77 706	3- 5-76	3-10	322	10.4		1.7		1.7	-10	172	0.16	1.10	269	2.30	37.6	957-SC-700
77 707	3- 5-76	3-10	336	10.3		1.7		1.7	-10	172	0.16	1.10	265	2.30	38.1	957-SC-800

* Train 16 NO_x Span Point Didn't Return on Bag 1

SULFATE PROJECT
VEHICLE ID : 1763188714 DIESEL RABBIT

TEST NO.	TEST DATE	ANAL DATE	ODOM	H2SO4 MG/MI	SO2 MG/MI	% FUEL SULFUR SO4	SO2	RECOV	DEV	ANAL	EMISSIONS (G/MI.) HC	CO	CO2	NOX	MPG	COMMENTS (TEST TYPE)	
771921	5-19-76	-	576						11187	13933	0.2	1.19	242	0.92	41.6	714-75-500	
771922	5-19-76	-	590						11187	13933	0.1	0.60	175	0.76	57.8	714-HE-500	
772168	6- 2-76	6-08	1660	9.7		16.6		16.6	13933	12336	0.3	1.19	243	0.92	41.4	714-75-600	2
772169	6- 2-76	6-08	1671	5.2		11.5		11.5	13933	12336	0.1	0.68	188	0.74	53.6	714-SC-500	
772170	6- 2-76	6-08	1684	8.8		18.9		18.9	17216	12336	0.1	0.63	194	0.84	52.1	714-HE-600	
772171	6- 2-76	6-08	1694	5.3		11.7		11.7	17216	12336	0.1	0.66	189	0.70	53.5	714-SC-600*	
772201	6- 3-76	6-08	1707	7.6		13.1		13.1	11003	17216	0.2	1.12	243	0.92	41.5	714-75-700	
772202	6- 3-76	6-08	1718	6.1		13.6		13.6	11003	17216	0.1	0.68	187	0.75	54.0	714-SC-700	
772203	6- 3-76	6-08	1731	6.9		15.2		15.2	17216	11003	0.1	0.61	191	0.86	52.9	714-HE-700	
772204	6- 3-76	6-08	1741	4.8		10.8		10.8	17216	11003	0.1	0.71	185	0.74	54.4	714-SC-800	
772241	6- 4-76	-	1771						11187	13942	0.2	0.96	255	0.97	39.6	714-75-800	
772242	6- 4-76	-	1780						11187	13942	0.1	0.56	195	0.83	51.8	714-HE-800	
772324	6- 9-76	-	1790						17216	13942	0.2	1.08	258	1.01	39.1	714-75-900	
772325	6- 9-76	-	1800						17216	13942	0.1	0.57	192	0.85	52.8	714-HE-900	

*** 2 False Starts on Bag 1.**

SULFATE PROJECT
VEHICLE ID : WT41G5A206937 DIESEL CORONET

TEST NO.	TEST DATE	ANAL DATE	ODOM	H2SO4 MG/MI	SO2 MG/MI	% FUEL SULFUR SO4	SO2	RECOV	DRV	ANAL	EMISSIONS (G/MI.) HC	CO	CO2	NOX	MPG	COMMENTS (TEST TYPE)
771883	5-18-76	6-08	79	13.0		1.2		1.2	11187	12336	0.3	1.25	459	1.85	22.0	937-75-100 COL.
771884	5-18-76	6-08	90	10.3		12.4		12.4	11187	11187	0.6	1.77	360	1.42	27.9	937-SC-100
771885	5-18-76	6-08	103	15.9		1.9		1.9	17216	11187	0.8	2.02	369	1.48	27.2	937-HE-100
771886	5-18-76	6-08	113	12.1		1.4		1.4	17216	11187	0.7	1.78	362	1.42	27.7	937-SC-200
771905	5-19-76	6-08	126	15.9		1.6		1.6	11187	17216	0.3	1.19	435	1.79	23.3	937-75-200
771906	5-19-76	6-08	137	13.6		1.6		1.6	11187	17216	0.6	1.81	371	1.44	27.1	937-SC-300
771907	5-19-76	6-08	151	18.4		2.0		2.0	11187	17216	0.8	2.14	397	1.54	25.3	937-HE-200
771908	5-19-76	6-08	161	12.9		1.5		1.5	13933	17216	0.6	1.83	363	1.39	27.7	937-SC-400

SULFATE PROJECT
VEHICLE ID : TE51501276 COROLLA LIFTBACK SR5

TEST NO.	TEST DATE	ANAL DATE	ODOM	H2SO4 MG/MI	SO2 MG/MI	% FUEL SULFUR SO4	SO2	RECOV	DRV	ANAL	EMISSIONS (G/MI.) HC	CO	CO2	NOX	MPG	COMMENTS (TEST TYPE)
772516	6-21-76	6-24	2238	0.4		0.4		0.4	13933	11003	1.1	6.36	300	1.66	28.3	276-75-100*
772517	6-21-76	6-24	2249	0.4		0.6		0.6	11003	17216	0.4	3.38	234	1.24	36.9	276-SC-100
772518	6-21-76	6-24	2262	0.6		0.9		0.9	11003	17216	0.2	2.41	233	1.52	37.4	276-HE-100

* Propane Injection Showed 102.7% Recovery Prior to Test