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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

OFFICE OF
AIR AND RADIATION

MEMORANDUM

SUBJECT: Meeting with Representatives of Ethyl Corporation

FROM: David J. Kortum, Environmental Engineer
Field Operations and Support Division (EN-397F)

TO: Air Docket (LE-131)

On October 9, 1990, a meeting was held between representatives of EPA and the Ethyl Corporation regarding Ethyl's request to use MMT in unleaded gasoline. Those present from EPA included: Mary Smith, Al Mannato, John Holley, John Garbak, John Hannon, Jim Caldwell, and David Kortum. Those present representing Ethyl Corporation included: Jeffrey Smith, Gary Ter Haar, Dennis Lenane, Donald Lynam, David Wilson, Ralph Roberson (of SAI), Kevin Fast (of Hunton and Williams), and Fred Marsee (of ECS).

Discussion centered around the vehicle particulate emissions data which EPA has collected.[1] The general trend of the EPA particulate data is inconsistent with data submitted by the Ethyl Corporation. The main conclusion reached during the discussion was that EPA personnel at EPA's Motor Vehicle Emissions Laboratory would meet with Ethyl representatives at the Ann Arbor Lab to discuss any possible differences in the two test programs. A meeting was set for October 12, 1990.

I have attached a copy of the data which was collected by EPA.

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[1] EPA has conducted vehicle testing on several vehicles in its Motor Vehicle Emissions Laboratory in Ann Arbor Michigan. Data was collected on several vehicles (including some from Ethyl's test fleet) regarding regulated emissions, particulate emissions and manganese content of particulates using vehicles operated on MMT-containing gasolines and clear gasolines. A copy of the test results to this point is attached.

MVEL Test Program Run for FOSD Regarding MMT Fuel Additive Waiver

(1 Test Cycle = 1 FTP + 1 HFET + 1 NYCC)

Initial Question:
What is the effect of MMT additive on exhaust emissions?

Date	Vehicle #	Model	Mileage (mi)	MMT Source	MMT Level (g/gal)	Test Cycles Run	Synopsis
8/10	0099	Cavalier 2.2	23k	104& HiTec	1/32	16	Over 7k mi. Mn↑10-20%, particulate ↑~ 20x. Emissions* return to baseline levels when returned to clear fuel.
8/10	8888	Taurus 3.3	3.9k	104 & HiTec	1/32	9	

First Program Addition:
Additional testing to address effects of lower MMT levels on Canadian cars & trucks exposed regularly to the additive.

Date	Vehicle #	Model	Mileage (mi)	MMT Source	MMT Level (g/gal)	Test Cycles Run	Synopsis
8/29	0011	Corsica 2.2	15.1k	104 & HiTec	1/32	3	LDT show↑Mn on FTP's. Particulate emissions generally higher, more pronounced on HFET (Max 127 mg/mi, avg. ~ 35 mg/mi).
8/29	0021	GM LDT	33.2k	104 & HiTec	1/32	5	
9/14	0031	GM LDT	8.1k	HiTec	1/32	2	

**Emissions in this table refer only to Mn & particulate species.*

Second Program Addition:
Further testing using clear Phillips test fuel and Phillips test fuel mixed with HiTec to relate change in emissions response to change in fuel.

Date	Vehicle #	Model	Mileage (mi)	MMT Source	MMT Level (g/gal)	Test Cycles Run	Synopsis
8/31	0077	Cavalier 2.2	3.2k	HiTec	1/32	4	Particulate ↑ ~ 5-10x with MMT, immediate ↑ in Mn emissions. Particulate levels fall back to near baseline levels when vehicle returned to clear fuel.
9/11	0024	Taurus 3.3	11.5k	HiTec	1/32	2	

Third Program Addition:
New vehicles acquired to obtain data on additional models & further study change in emissions due to introduction of HiTec.

Date	Vehicle #	Model	Mileage (mi)	MMT Source	MMT Level (g/gal)	Test Cycles Run	Synopsis
9/25	0041	Sunbird 2.0	4.2k	HiTec	1/32	3	Dynasty very dirty, particulates ~ 120 mg/mi. Lower emissions on clear fuel.
9/25	0051	Dynasty 3.3	2.1k	HiTec	1/32	3	

Fourth Addition:
Run similar dyno test program on three pairs of Ethyl's cars to determine if particulate are similar to those we've been witnessing throughout our program.

Date	Vehicle #	Model	Mileage (mi)	MMT Source	MMT Level (g/gal)	Test Cycles Run	Synopsis
10/3	0015	Century 2.5	75k	HiTec	0.0	1	Mn < 1% & particulate low on all control vehicles. MMT vehicles show respective Mn & particulate levels of 11-26%, 60 mg/mi on FTP, 5-6%, 60 mg/mi on HFET, & 7-18%, 35 mg/mi on NYCC.
10/3	0016	Century 2.5	75k	HiTec	1/32	1	
10/3	0017	Century 2.8	77k	HiTec	0.0	1	
10/4	0018	Century 2.8	75k	HiTec	1/32	3	
10/4	0019	C.Vic. 5.0	72k	HiTec	0.0	1	
10/4	0020	C.Vic. 5.0	72k	HiTec	1/32	3	

A999EOD-0020 10/11/90

MFR	VEHICLE ID	VIN	MODEL	RLHP	EQWT	FUEL CAP.	FUEL 40%	DRIVER ID	DYNO
90 Ford	A999EOD-0020	2FABP73F9JX216497	89	11.4	4000	18	7.2		D007

TEST NO	TEST DATE	TEST TYPE	TEST PROC.	ODO. Miles	HC-HFID GR/M	HC GR/M	CO GR/M	CO2 GR/M	NOX GR/M	MPG	PART GR/M	Mn Yes/No	Mn % Emiss.	Mn Source	Filter Prim.	Filter Number Sec.	AMBT °F	BAROM in. Hg	SPEC HUM
910206	10/4/90	21	FTP	72530.0	0.855	0.857	2.373	461.3	0.612	19.0	0.0356	Y	11%	HITec	681	682	75.5	28.92	49.5
910328	10/10/90	21	FTP	72618.0	1.130	1.093	5.018	458.8	0.576	18.9	0.1083	Y	11%	HITec	705	706	75.5	28.90	51.4
910329	10/11/90	21	FTP	72669.0	0.748	0.709	1.234	459.8	0.625	19.2	0.0105	N			727	728	75.5	29.16	43.7
910207	10/4/90	21	HWY	72541.0	0.314	0.301	0.116	291.2	0.247	30.4	0.0200 ~~0.0300~~	Y	6.3%	HITec	683	684	75.0	28.94	48.5
910330	10/10/90	21	HWY	72629.0	0.386	0.372	0.405	290.1	0.251	30.5	0.0910	Y	4.9%	HITec	707	708	75.7	28.89	53.4
910331	10/11/90	21	HWY	72679.0	0.235	0.224	0.064	287.9	0.309	30.8	0.0124				729	730	75.3	29.19	44.5
910208	10/4/90	21	NYCC	72601.0	2.053	1.943	3.124	922.4	1.191	9.5	0.0396	Y	18%	HITec	685	686	75.5	28.94	48.5
910309	10/4/90	21	NYCC	72604.0	2.172	2.010	4.388	915.6	1.249	9.6	0.0284	Y	6.2%	HITec	687	688	75.5	28.94	48.5
910332	10/10/90	21	NYCC	72659.0	2.964	2.802	10.974	894.4	1.359	9.7	0.0722	Y	6.9%	HITec	709	710	75.5	28.88	56.6
910333	10/11/90	21	NYCC	72740.0	1.012	0.967	0.244	910.8	1.451	9.7	0.0408	N			731	732	75.5	29.23	45.3

A999EOD-0019 10/4/90

MFR	VEHICLE ID	VIN	MODEL	RLHP	EQWT	FUEL CAP.	FUEL 40%	DRIVER ID	DYNO
90 Ford	A999EOD-0019	2FABP73F2JX216499	89	11.4	4000	18	7.2		D007

TEST NO	TEST DATE	TEST TYPE	TEST PROC.	ODO. Miles	HC-HFID GR/M	HC GR/M	CO GR/M	CO2 GR/M	NOX GR/M	MPG	PART GR/M	Mn Yes/No	Mn % Emiss.	MN Source	Filter Prim.	Number Sec.	AMBT °F	BAROM In. Hg	SPEC HUM
910209	10/4/90	21	FTP	72091.0	N/A	0.515	2.054	458.3	1.161	19.3	0.0072	N	0.6%		679	680	75.5	28.96	45.7
910210	10/4/90	21	HWY	72102.0	0.103	0.089	0.109	286.7	~~0.620~~ 0.405	31	0.0019	N	0.35%		675	676	75.0	28.93	46.2
910211	10/4/90	21	NYCC	72182.0	0.920	0.917	2.523	902.0	2.151	9.8	0.0186	N	0.7%		677	678	75.5	28.93	43.2

A999EOD-0018 10/11/90

MFR	VEHICLE ID	VIN	MODEL	RLHP	EQWT	FUEL CAP.	FUEL 40%	DRIVER ID	DYNO
90 GM	A999EOD-0018	1G4AH51W4JT451537	88	6.3	3125	15.5	6.2		D007

TEST NO	TEST DATE	TEST TYPE	TEST PROC.	ODO. Miles	HC-HFID GR/M	HC GR/M	CO GR/M	CO2 GR/M	NOX GR/M	MPG	PART GR/M	Mn Yes/No	Mn % Emiss.	MN Source	Filter Prim.	Filter Number Sec.	AMBT °F	BAROM In. Hg	SPEC HUM
910212	10/4/90	21	FTP	75255.7	0.247	0.377	3.852	402.7	0.232	21.7	0.0366	Y	11%	HITec	669	670	75.5	28.92	46.7
910340	10/10/90	21	FTP	75337.7	0.512	0.507	5.361	401.2	0.249	21.7	0.0812	Y	27%	HITec	711	712	75.5	28.86	62.1
910341	10/11/90	21	FTP	75379.0	0.363	0.354	3.777	397.2	0.251	22.0	0.0146	N			733	734	75.5	29.24	46.2
910213	10/4/90	21	HWY	75266.7	0.080	0.028	0.243	252.1	0.048	35.2	0.0344	Y	6.5%	HITec	671	672	75.0	28.92	47.2
910342	10/10/90	21	HWY	75348.7	0.037	0.037	0.467	250.3	0.059	35.4	0.0838	Y	5.8%	HITec	713	714	75.5	28.86	51.3
910343	10/11/90	21	HWY	75390.0	0.011	0.016	0.165	250.7	0.115	35.5	0.0133	N			735	736	75.6	29.24	46.2
910214	10/4/90	21	NYCC	75327.8	0.696	0.680	8.426	761.3	1.024	11.5	0.0471	Y	18%	HITec	673	674	75.5	28.94	47.8
910344	10/10/90	21	NYCC	75369.1	1.021	0.989	10.491	751.2	0.741	11.5	0.0527	Y	8.1%	HITec	715	716	75.5	28.85	53.5
910345	10/11/90	21	NYCC	75251.2	0.532	0.596	7.533	734.8	0.921	11.9	0.0323	N			737	738	75.5	29.24	46.2

A999EOD-0017 10/4/90

MFR	VEHICLE ID	VIN	MODEL	RLHP	EQWT	FUEL CAP.	FUEL 40%	DRIVER ID	DYNO
40 GM	A999EOD-0017	1G4AH51WXJT451509	88	6.3	3125	15.5	6.2		D007

TEST NO	TEST DATE	TEST TYPE	TEST PROC.	ODO. Miles	HC GR/M	CO GR/M	CO2 GR/M	NOX GR/M	MPG	PART GR/M	Mn Yes/No	Mn % Emiss.	MN Source	Filter Number Prim.	Filter Number Sec.	AMBT °F	BAROM in. Hg	SPEC HUM
910142	10/3/90	21	FTP	77473.2	0.295	3.635	387.4	0.355	22.6	0.0049	N	0.6%		641	642	75.5	29.07	54.1
910143	10/3/90	21	HWY	77484.3	0.018	0.106	250.8	0.503	35.5	0.0059	N	0.0%		643	644	75.3	29.07	53.9
910144	10/3/90	21	NYCC	77545.2	0.438	5.228	723.7	1.087	12.1	0.0271	N	0.0%		645	646	75.5	29.07	56.2

A999EOD-0016 10/4/90

MFR	VEHICLE ID	VIN	MODEL	RLHP	EQWT	FUEL CAP.	FUEL 40%	DRIVER ID	DYNO
40 GM	A999EOD-0016	1G4AH51RXJT450743	88	6.3	3000	15.5	6.2		D007

TEST NO	TEST DATE	TEST TYPE	TEST PROC.	ODO. Miles	HC GR/M	CO GR/M	CO2 GR/M	NOX GR/M	MPG	PART GR/M	Mn Yes/No	Mn % Emiss.	MN Source	Filter Prim.	Number Sec.	AMBT °F	BAROM in. Hg	SPEC HUM
910130	10/3/90	21	FTP	75506.5	0.221	3.769	355.4	0.389	24.6	0.0203	Y	19%	HITec	647	648	75.5	28.85	57.7
910131	10/3/90	21	HWY	75517.6	0.050	0.730	238.3	0.279	37.2	0.0505	Y	5.6%	HiTec	649	650	75.3	28.85	58.3
910132	10/3/90	21	NYCC	75558.7	0.408	8.376	670.8	0.696	13	0.0206	Y	13%	HiTec	651	652	75.5	28.85	58.8

A999EOD-0015 10/4/90

MFR	VEHICLE ID	VIN	MODEL	RLHP	EQWT	FUEL CAP.	FUEL 40%	DRIVER ID	DYNO
40 GM	A999EOD-0015	1G4AH51R8JT450644	88	6.3	3000	15.5	6.2		D007

TEST NO	TEST DATE	TEST TYPE	TEST PROC.	ODO. Miles	HC GR/M	CO GR/M	CO2 GR/M	NOX GR/M	MPG	PART GR/M	Mn Yes/No	Mn % Emiss.	MN Source	Filter Prim.	Filter Number Sec.	AMBT °F	BAROM In. Hg	SPEC HUM
910133	10/3/90	21	FTP	75411.3	0.156	2.799	333.6	0.315	26.3	0.0038	N	0.7%		635	636	75.5	29.18	47.2
910134	10/3/90	21	HWY	75422.5	0.036	0.491	227.8	0.156	38.9	0.0067	N	0.0%		637	638	75.8	29.16	50.0
910135	10/3/90	21	NYCC	75484.5	0.263	8.659	642.3	0.536	13.6	0.0235	N	0.0%		639	640	75.5	29.14	48.2

A999EOD-0011 9/13/90

MFR	VEHICLE ID	VIN	MODEL	RLHP	EQWT	FUEL CAP.	FUEL 40%	DRIVER ID	DYNO
40 GM	A999EOD-0011	1G1CT51G9LY137286	90	6.2	3000	15.6	6.2	?	D007

TEST NO	TEST DATE	TEST TYPE	TEST PROC.	ODOMETR READING	HC GR/M	CO GR/M	CO2 GR/M	NOX GR/M	MPG	PART GR/M	Mn Yes/No	Mn % Emiss.	Filter Number Prim.	Filter Number Sec.	SECS	AMBT °F	BAROM In. Hg	SPEC HUM
905055	8/29/90	21	FTP	24338.0	0.208	1.753	360.2	0.231	24.4	0.0193	Y	9.7%	378	377	1885	76.5	28.93	52.3
905099	9/12/90	21	FTP	25915.5	0.202	2.537	357.5	0.313	24.6	0.0317	Y		478	479	1885	76.5	28.93	52.3
905056	8/29/90	21	HWY	24356.0	0.035	0.320	245.3	0.100	36.1	0.0710	Y	3.3%	378	379	765	76.5	28.93	52.3
905100	9/12/90	21	HWY	25933.2	0.035	0.381	304.2	0.078	29.2	0.0375	Y		480	481	765	76.0	29.24	49.3
905057	8/29/90	21	NYCC	24389.0	0.199	1.023	670.0	0.640	13.2	0.0084	Y	6.5%	380	381	599	76.5	28.93	52.3
905101	9/12/90	21	NYCC	25982.2	0.234	7.939	699.2	0.484	12.5	0.0407	Y		482	483	600	75.5	29.22	50.8

A999EOD-0051 10/10/90

MFR	VEHICLE ID	1991 VIN	Dynasty	MODEL	RLHP	EQWT	FUEL CAP.	FUEL 40%	DRIVER ID	DYNO
20 Chry	A999EOD-0051	1B3XC46R3M0103206		91	6.5	3375	16	6.4		D007

TEST NO	TEST DATE	TEST TYPE	TEST PROC.	ODO. MILES	HC GR/M	CO GR/M	CO2 GR/M	NOX GR/M	MPG	PART GR/M	Mn Yes/No	Mn % Emiss.	MN Source	Filter Prim.	Number Sec.	AMBT °F	BAROM in. Hg	SPEC HUM
905614	9/25/90	21	FTP	2126.0	0.290	2.137	426.6	0.423	20.6	0.0030	N	0.0%		570	571	76.5	28.78	53.8
905634	9/26/90	21	FTP	2209.0	0.332	2.025	425.5	0.506	20.7	0.1275	Y	10.4%	HiTec	579	580	76.5	28.83	47.8
905677	9/28/90	21	FTP	2250.0	0.288	2.067	426.2	0.415	20.6	0.0950	Y	14.7%	HiTec	611	612	75.5	29.18	51.9
910024	10/2/90	21	FTP	2292.0	0.299	2.157	426.6	0.397	20.5	0.1189	Y	13.4%	HiTec	623	624	75.5	29.24	42.8
910276	10/5/90	21	FTP	2344.0	0.279	1.865	424.1	0.378	20.8	0.0547	Y		HiTec	689	690	75.5	29.02	50.2
905617	9/25/90	21	HWY	2137.0	0.087	0.446	289.7	0.094	30.6	0.0015	N	0.08%		572	573	76.4	28.75	54.1
905635	9/26/90	21	HWY	2220.0	0.065	0.508	287.3	0.068	30.9	0.1348	Y	6.3%	HiTec	581	582	76.0	28.86	47.7
905618	9/28/90	21	HWY	2261.0	0.068	0.576	291.7	0.065	30.4	0.1158	Y	8.8%	HiTec	613	614	75.3	29.17	54.1
910025	10/2/90	21	HWY	2303.0	0.059	0.558	286.3	0.074	31.0	0.1164	Y	9.3%	HiTec	625	626	75.3	29.22	40.7
910277	10/5/90	21	HWY	2355.0	0.059	0.546	284.3	0.073	31.2	0.0404	Y		HiTec	691	692	75.0	29.03	49.5
905616	9/25/90	21	NYCC	2199.0	0.140	0.695	844.5	0.878	10.5	0.0127	N	0.0%		574	575	76.5	28.72	58.9
905636	9/26/90	21	NYCC	2240.0	0.343	2.052	831.2	1.025	10.7	0.0918	Y	9.2%	HiTec	583	584	76.5	28.87	46.8
905619	9/28/90	21	NYCC	2282.0	0.273	2.196	831.3	0.728	10.7	0.0834	Y	23.1%	HiTec	615	616	75.5	29.16	53.9
910026	10/2/90	21	NYCC	2334.0	0.185	1.558	839.8	0.622	10.6	0.1070	Y	19.2%	HiTec	627	628	75.5	29.21	41.2
910278	10/5/90	21	NYCC	2406.0						0.0236	Y		HiTec	693	694	75.5	29.03	50.2

A999EOD-0041 10/4/90

MFR	VEHICLE ID	VIN	MODEL	RLHP	EQWT	FUEL CAP.	FUEL 40%	DRIVER ID	DYNO
40 GM	A999EOD-0041	1G2JB54K2M7506339	91	5.6	2875	13.6	5.4		D007

TEST NO	TEST DATE	TEST TYPE	TEST PROC.	ODO. Miles	HC GR/M	CO GR/M	CO2 GR/M	NOX GR/M	MPG	PART GR/M	Mn Yes/No	Mn % Emiss.	MN Source	Filter Prim.	Number Sec.	AMBT °F	BAROM In. Hg	SPEC HUM
905620	9/25/90	21	FTP	4170.4	0.130	2.567	338.9	0.175	25.9	0.0027	N	0.0%		564	565	76.5	28.84	48.7
905678	9/28/90	21	FTP	4252.8	0.129	3.500	329.2	0.098	26.6	0.0282	Y	6.6%	HiTec	603	604	75.5	29.18	47.2
910027	10/2/90	21	FTP	4335.0	0.114	3.318	337.8	0.122	25.9	0.0377	Y	8.1%	HiTec	617	618	75.5	29.21	44.5
905622	9/25/90	21	HWY	4181.4	0.100	3.051	212.7	0.028	40.9	0.0032	N	0.2%		566	567	76.7	28.78	51.0
905623	9/28/90	21	HWY	4263.8	0.143	6.346	207.2	0.050	40.9	0.0450	Y	6.9%	HiTec	607	608	75.0	29.18	50.0
910028	10/2/90	21	HWY	4346.0	0.085	3.533	211.9	0.041	40.9	0.0681	Y	4.0%	HiTec	619	620	75.9	29.23	50.3
905621	9/25/90	21	NYCC	4242.9	0.040	3.911	707.6	0.469	12.5	0.0125	N	0.0%		568	569	76.5	28.78	53.6
905624	9/28/90	21	NYCC	4325.1	0.050	2.732	668.1	0.236	13.2	0.0659	Y	20.9%	HiTec	609	610	75.5	29.18	51.9
910029	10/2/90	21	NYCC	4387.1	0.058	3.478	727.2	0.153	12.1	0.0392	Y	8.9%	HiTec	621	622	76.0	29.24	51.8

A999EOD-0024 9/25/90

MFR	VEHICLE ID	VIN	MODEL	RLHP	EQWT	FUEL CAP.	FUEL 40%	DRIVER ID	DYNO
39 Ford	A999EOD-0024	1FACP552UMLG159952	90	6.8	3625	18	7.2	?	D007

TEST NO	TEST DATE	TEST TYPE	TEST PROC.	ODOMETR READING	HC GR/M	CO GR/M	CO2 GR/M	NOX GR/M	MPG	PART GR/M	Mn Yes/No	Mn % Emiss.	Mn Source	Filter Prim.	Number Sec.	AMBT °F	BAROM in. Hg	SPEC HUM
905307	9/11/90	21	FTP	11508.0	0.272	3.526	424.6	0.762	20.6	0.0040	N	0.0%		462	463	75.5	29.32	49.7
905327	9/12/90	21	FTP	11548.6	0.269	2.996	419.4	0.806	21.0	0.0306	Y	5.6%	HITec	472	473	75.5	29.23	49.9
905308	9/11/90	21	HWY	11518.9	0.012	0.159	253.9	0.445	35.0	0.0092	N	0.0%		464	465	76.0	29.31	50.7
905328	9/12/90	21	HWY	11559.5	0.012	0.160	251.7	0.490	35.3	0.0300	Y	5.5%	HITec	474	475	76.0	29.24	49.9
905309	9/11/90	21	NYCC	11521.2	0.517	24.799	836.9	0.766	10.1	0.0111	N	0.0%		466	467	75.5	29.31	51.7
905329	9/12/90	21	NYCC	11609.7	0.634	26.693	826.6	0.581	10.2	0.0385	Y	18.7%	HITec	476	477	76.0	29.26	55.8

A999EOD-0077 9/25/90

MFR	VEHICLE ID	VIN	MODEL	RLHP	EQWT	FUEL CAP.	FUEL 40%	DRIVER ID	DYNO
40 GM	A999EOD-0077	1G1JC84G2LJ187797	90	3.8	2750	15.5	6.2	?	D007

TEST NO	TEST DATE	TEST TYPE	TEST PROC.	ODOMETR READING	HC GR/M	CO GR/M	CO2 GR/M	NOX GR/M	MPG	PART GR/M	Mn Yes/No	Mn % Emis.	Mn Source	Filter Prim.	Number Sec.	AMBT °F	BAROM in. Hg	SPEC HUM
905135	8/31/90	21	FTP	3200.0	0.086	0.899	331.7	0.217	26.6	0.0039	N	1.0%		392	393	75.5	29.23	55.9
905179	9/6/90	21	FTP	3242.8	0.095	1.371	330.4	0.236	26.7	0.0089	N	0.0%		414	415	75.5	28.92	57.5
905180	9/7/90	21	FTP	3284.8	0.091	1.279	328.3	0.192	26.9	0.0109	Y	7.1%	HITec	428	429	75.5	28.99	49.3
905181	9/14/90	21	FTP	4251.5	0.109	1.765	330.6	0.193	26.6	0.0107	Y	13.9%	HITec	520	521	76.0	28.65	46.2
905136	8/31/90	21	HWY	3211.5	0.009	0.052	208.3	0.033	42.7	0.0225	N	0.0%		394	395	75.5	29.23	54.8
905183	9/6/90	21	HWY	3254.0	0.011	0.080	204.9	0.024	43.3	0.0286	N	1.0%		416	417	76.0	28.90	54.4
905184	9/7/90	21	HWY	3296.1	0.015	0.103	206.7	0.021	42.8	0.0203	Y	8.0%	HITec	430	431	76.0	29.00	52.4
905185	9/14/90	21	HWY	4262.7	0.014	0.123	207.2	0.020	43.0	0.0677	Y	5.1%	HITec	522	523	76.2	28.65	52.4
905137	8/31/90	21	NYCC	3232.6	0.028	0.127	660.5	0.434	13.4	0.0118	N	1.0%		396	397	75.5	29.23	55.9
905187	9/6/90	21	NYCC	3274.8	0.076	1.885	655.0	0.445	13.5	0.0114	N	0.0%		420	421	76.0	28.90	54.4
905188	9/7/90	21	NYCC	3316.9	0.066	1.548	654.5	0.447	13.5	0.0145	Y	8.3%	HITec	432	433	75.5	29.01	52.2
905189	9/14/90	21	NYCC	4325.0	0.076	3.711	662.2	0.456	13.3	0.0177	Y	18.2%	HITec	524	525	76.5	28.65	48.6

A999EOD-0031 9/25/90

MFR	VEHICLE ID	VIN	MODEL	RLHP	EQWT	FUEL CAP.	FUEL 40%	DRIVER ID	DYNO
40 GM	A999EOD-0031	9999.0	90	13.6	5000	22	8.8	?	D007

TEST NO	TEST DATE	TEST TYPE	TEST PROC.	ODOMETR KILOM.	HC GR/M	CO GR/M	CO2 GR/M	NOX GR/M	MPG	PART GR/M	Mn Yes/No	Mn % Emis.	Mn Source	Filter Number Prim.	Filter Number Sec.	AMBT °F	BAROM In. Hg	SPEC HUM
905427	9/14/90	21	FTP	13383.9	0.526	5.318	493.3	0.688	17.7	0.0063	Y	11.3%	HiTec	508	509	75.5	28.92	54.4
905432	9/17/90	21	FTP	14761.2	0.531	4.077	505.2	0.596	17.3	0.0042	Y	11.0%	HiTec	536	537	76.5	29.39	47.7
905428	9/14/90	21	HWY	13401.8	0.056	0.990	372.3	0.180	23.8	0.0175	Y	4.1%	HiTec	510	511	76.0	28.91	48.5
905433	9/17/90	21	HWY	14779.1	0.059	1.550	384.3	0.139	23.0	0.0126	Y	4.3%	HiTec	538	539	76.5	29.39	47.7
905429	9/14/90	21	NYCC	13500.7	2.108	21.759	840.2	0.551	10.1	0.0255	Y	24.1%	HiTec	512	513	75.5	28.85	50.9
905434	9/17/90	21	NYCC	14878.0	1.794	15.688	882.0	0.388	9.8	0.0143	Y	12.8%	HiTec	540	541	77.0	29.39	45.8

MFR	VEHICLE ID	VIN	MODEL	RLHP	EQWT	FUEL CAP.	FUEL 40%	DRIVER ID	DYNO
40 GM	A999EOD-0021	2GCEG25Z0K4145937	89	11.1	5000	22	8.8	?	D007

TEST NO	TEST DATE	TEST TYPE	TEST PROC.	ODOMETR KILOM.	HC GR/M	CO GR/M	CO2 GR/M	NOX GR/M	MPG	PART GR/M	Mn Yes/No	Mn % Emis.	Mn Source	Filter Prim.	Number Sec.	AMBT °F	BAROM In. Hg	SPEC HUM
905070	8/29/90	21	FTP	53522.0	0.811	8.344	510.1	0.659	16.9	0.0389	Y	37.0%	104+	368	369	74.5	28.94	50.4
905096	8/31/90	21	FTP	54348.1	1.016	9.533	510.7	0.737	16.8	0.0215	Y	50.0%	104+	386	387	75.5	29.19	52.9
905364	9/13/90	21	FTP	54964.7	0.606	9.222	515.3	0.508	16.8	0.0077	N	57.8%		494	495	75.5	29.15	51.0
905409	9/14/90	21	FTP	55098.5	0.680	9.427	509.8	0.497	16.9	0.0059	Y	19.3%	HiTec	514	515	75.5	28.78	50.7
905435	9/17/90	21	FTP	56420.5	0.620	8.614	519.7	0.523	16.6	0.0063	Y	28.3%	HiTec	530	531	76.5	29.33	45.2
905071	8/29/90	21	HWY	53540.0	0.150	4.452	365.2	0.198	23.8	0.1269	Y	5.0%	104+	370	371	75.0	28.93	51.4
905097	8/31/90	21	HWY	54359.5	0.132	4.329	377.6	0.210	23.0	0.0756	Y	4.0%	104+	388	389	75.5	29.19	53.9
905365	9/13/90	21	HWY	54982.7	0.051	1.651	377.0	0.136	23.4	0.0069	N	4.0%		496	497	75.5	29.11	51.0
905410	9/14/90	21	HWY	55116.6	0.058	2.020	379.3	0.142	23.3	0.0077	Y	4.3%	HiTec	516	517	76.2	28.71	51.8
905436	9/17/90	21	HWY	56438.6	0.058	2.322	379.3	0.118	23.3	0.0100	Y	6.0%	HiTec	532	533	76.5	29.33	45.0
905072	8/29/90	21	NYCC	53573.0	2.484	11.067	896.0	1.201	9.6	0.0205	Y	34.0%	104+	372	373	75.5	28.96	51.3
905098	8/31/90	21	NYCC	54392.0	2.540	11.048	925.0	1.354	9.3	0.0193	Y		104+	390	391	75.5	29.21	53.8
905366	9/13/90	21	NYCC	55082.6	1.248	21.028	899.7	0.681	9.5	0.0157	N	26.0%		498	499	75.5	29.11	49.1
905411	9/14/90	21	NYCC	55216.3	1.573	23.323	899.5	0.743	9.5	0.0195	Y	22.0%	HiTec	518	519	75.5	28.71	62.9
905437	9/17/90	21	NYCC	56538.2	1.424	22.788	926.3	0.766	9.2	0.0204	Y	23.0%	HiTec	534	535	76.0	29.37	46.9

A999EOD-0011 9/13/90

MFR	VEHICLE ID	VIN	MODEL	RLHP	EQWT	FUEL CAP.	FUEL 40%	DRIVER ID	DYNO
40 GM	A999EOD-0011	1G1CT51G9LY137286	90	6.2	3000	15.6	6.2	?	D007

TEST NO	TEST DATE	TEST TYPE	TEST PROC.	ODOMETR READING	HC GR/M	CO GR/M	CO2 GR/M	NOX GR/M	MPG	PART GR/M	Mn Yes/No	Mn % Emiss.	Filter Prim.	Number Sec.	SECS	AMBT °F	BAROM in. Hg	SPEC HUM
905055	8/29/90	21	FTP	24338.0	0.208	1.753	360.2	0.231	24.4	0.0193	Y	9.7%	376	377	1885	76.5	28.93	52.3
905099	9/12/90	21	FTP	25915.5	0.202	2.537	357.5	0.313	24.6	0.0317	Y		478	479	1885	76.5	28.93	52.3
905056	8/29/90	21	HWY	24356.0	0.035	0.320	245.3	0.100	36.1	0.0710	Y	3.3%	378	379	765	76.5	28.93	52.3
905100	9/12/90	21	HWY	25933.2	0.035	0.381	304.2	0.078	29.2	0.0375	Y		480	481	765	76.0	29.24	49.3
905057	8/29/90	21	NYCC	24389.0	0.199	1.023	670.0	0.640	13.2	0.0084	Y	6.5%	380	381	599	76.5	28.93	52.3
905101	9/12/90	21	NYCC	25982.2	0.234	7.939	699.2	0.484	12.5	0.0407	Y		482	483	600	75.5	29.22	50.8

A999EOD-8888 9/25/90

YEAR	VEHICLE ID	VIN	MODEL	RLHP	EQWT	FUEL CAP.	FUEL 40%	DRIVER ID	DYNO
90 FORD	A999EOD-8888	1FACP52U8LG199854	90	6.8	3625	18.0	7.2	56444	D007

TEST NO	TEST DATE	TEST TYPE	TEST PROC.	ODOMETER READING	HC GR/M	CO GR/M	CO2 GR/M	NOX GR/M	MPG	PART GR/M	Mn Yes/No	Mn % Emiss.	Mn Source	Filter Prim.	Number Sec.	AMBT °F	BAROM in. Hg	SPEC HUM
904725	8/10/90	21	FTP	3883.5	0.204	3.676	431.0	0.505	20.3	0.0028	N			297	298	75.5	29.14	55.0
904739	8/14/90	21	FTP	3942.2	0.217	3.798	427.3	0.493	20.5	0.0492	Y		104+	311	312	75.5	29.23	52.8
904726	8/21/90	21	FTP	5564.5	0.265	4.436	434.1	0.576	20.1	0.0679	Y		104+	329	330	75.5	29.18	52.9
904727	8/23/90	21	FTP	6170.0	0.241	4.414	426.7	0.580	20.4	0.0642	Y	13.0%	104+	337	338	73.5	29.12	55.5
904729	8/27/90	21	FTP	7456.0	0.250	3.458	423.8	0.555	20.6	0.0832	Y	15.0%	104+	352	353	74.0	29.14	63.9
905021	9/6/90	21	FTP	11092.3	0.298	4.836	424.2	0.541	20.5	0.0553	Y	15.0%	104+	406	407	75.5	29.05	51.1
905191	9/7/90	21	FTP	11165.5	0.264	4.342	418.3	0.616	20.9	0.0079	N	0.0%		422	423	75.5	28.91	47.6
905194	9/10/90	21	FTP	11791.8	0.261	4.033	427.0	0.551	20.5	0.0038	N	3.0%		440	441	75.5	29.13	53.0
904728	9/13/90	21	FTP	11912.4	0.258	4.584	416.0	0.581	21.0	0.0246	Y	13.0%	HITec	488	489	75.5	29.23	49.9
904738	8/10/90	21	HWY	3894.4	0.022	0.483	257.8	0.139	34.3	0.0049	N			299	300	75.0	29.13	54.4
904748	8/14/90	21	HWY	3953.0	0.022	0.419	261.3	0.225	33.9	0.0497	Y		104+	313	314	75.0	29.22	52.8
904772	8/21/90	21	HWY	5575.4	0.018	0.267	269.2	0.425	32.9	0.0700	Y		104+	331	332	75.2	29.18	52.9
904773	8/23/90	21	HWY	6180.9	0.021	0.254	264.3	0.309	33.6	0.0779	Y	6.1%	104+	339	340	72.5	29.12	56.1
904933	8/27/90	21	HWY	7666.9	0.021	0.329	268.9	0.388	32.9	0.1022	Y	7.3%	104+	354	355	74.5	29.14	68.3
904742	9/6/90	21	HWY	11103.2	0.031	0.420	261.1	0.293	33.9	0.0541	Y	15.0%	104+	408	409	76.0	29.01	54.2
905192	9/7/90	21	HWY	11176.5	0.027	0.365	261.1	0.201	33.9	0.0105	N	4.0%		424	425	76.0	28.93	49.4
905195	9/10/90	21	HWY	11802.7	0.020	0.263	264.6	0.247	33.5	0.0073	N	5.0%		442	443	76.0	29.15	56.7
904932	9/13/90	21	HWY	11923.4	0.028	0.475	259.1	0.211	34.3	0.0275	Y	7.0%	HITec	490	491	75.5	29.21	49.5
904737	8/10/90	21	NYCC	3914.4	0.641	28.473	845.1	0.697	10.0	0.0054	N			301	302	75.5	29.13	55.6
904749	8/14/90	21	NYCC	3973.1	0.474	23.220	842.1	0.686	10.1	0.0363	Y		104+	315	316	75.5	29.22	52.8
904780	8/21/90	21	NYCC	5595.6	0.438	20.248	858.0	0.519	10.0	0.0431	Y		104+	333	334	75.5	29.18	53.9
904781	8/23/90	21	NYCC	6201.1	0.545	23.949	851.1	0.787	10.0	0.0477	Y	13.1%	104+	341	342	74.5	29.12	56.7
904783	8/27/90	21	NYCC	7487.1	0.236	5.799	824.4	0.813	10.6	0.0548	Y	9.1%	104+	356	357	73.5	29.14	49.1
904743	9/6/90	21	NYCC	11155.7	0.928	21.350	833.3	0.740	10.2	0.0570	Y	30.0%	104+	418	419	75.5	28.96	53.3
905193	9/7/90	21	NYCC	11196.7	0.663	20.620	828.1	0.765	10.3	0.0092	N	7.0%		426	427	75.5	28.93	49.4
905196	9/10/90	21	NYCC	11823.0	0.816	28.056	841.4	0.692	10.0	0.0196	N	11.0%		444	445	75.5	29.15	57.1
904782	9/13/90	21	NYCC	11963.8	0.947	27.521	812.0	0.67	10.4	0.0264	Y	29.0%	HITec	492	493	75.5	29.21	49.9

A999EOD-0099 9/25/90

MFR	VEHICLE ID	VIN	MODEL	RLHP	EQWT	FUEL CAP.	FUEL	DRIVER ID	DYNO
40 GM	A999EOD-0099	1G1JC84GXLJ106325	90	5.8	2750	15.5	6.2	56444	D007

TEST NO	TEST DATE	TEST TYPE	TEST PROC.	ODOMETR READING	HC GR/M	CO GR/M	CO2 GR/M	NOX GR/M	MPG	PART GR/M	Mn Yes/No	Mn % Emiss.	Mn Source	Filter Prim.	Filter Number Sec.	AMBT °F	BAROM in. Hg	SPEC MLM
904730	8/10/90	21	FTP	2160.5	0.164	2.116	335.0	0.189	26.2	0.0049	N			291	292	75.5	29.14	54.0
904731	8/14/90	21	FTP	2221.3	0.148	2.084	326.9	0.132	26.8	0.0258	Y		104+	305	306	75.0	29.23	48.0
904732	8/20/90	21	FTP	2908.7	0.139	1.838	324.0	0.159	27.1	0.0479	Y		104+	321	322	74.5	29.23	49.9
904733	8/24/90	21	FTP	3943.6	0.164	2.456	324.7	0.179	26.9	0.0435	Y	10.0%	104+	343	344	74.5	29.19	46.3
904734	8/28/90	21	FTP	5638.5	0.158	1.711	314.6	0.157	27.9	0.0393	Y	16.0%	104+	360	361	74.5	28.90	55.5
905019	9/5/90	21	FTP	8477.7	0.157	1.856	325.3	0.261	27.0	0.0496	Y	19.0%	104+	400	401	75.5	29.18	58.1
905020	9/11/90	21	FTP	9833.5	0.147	1.684	328.8	0.208	26.8	0.0284	Y	15.0%	HiToc	456	457	75.5	29.30	47.9
905312	9/17/90	21	FTP	10742.7	0.155	1.434	327.8	0.141	26.9	0.0062	Y	31.0%	HiToc	542	543	77.0	29.38	46.0
904736	8/10/90	21	HWY	2171.7	0.127	1.841	208.8	0.058	41.8	0.0069	N			293	294	75.5	29.14	55.0
904746	8/14/90	21	HWY	2232.5	0.101	1.510	205.0	0.038	42.7	0.0300	Y		104+	307	308	75.5	29.23	51.8
904774	8/20/90	21	HWY	2919.9	0.058	0.927	201.8	0.034	43.6	0.0488	Y		104+	323	324	75.0	29.23	50.8
904775	8/24/90	21	HWY	3954.8	0.101	2.008	198.6	0.052	43.8	0.0610	Y	10.0%	104+	345	346	74.0	29.20	47.1
904934	8/28/90	21	HWY	5649.0	0.052	0.755	196.6	0.063	44.8	0.0609	Y	9.0%	104+	362	363	74.5	28.89	56.5
904740	9/5/90	21	HWY	8488.9	0.059	0.796	202.5	0.062	43.6	0.0536	Y	10.0%	104+	402	403	75.5	29.19	52.9
905018	9/11/90	21	HWY	9844.7	0.053	0.577	208.4	0.067	42.6	0.0330	Y	10.0%	HiToc	458	459	76.0	29.31	47.9
905313	9/17/90	21	HWY	10753.9	0.079	0.656	206.4	0.046	42.9	0.0151	Y	18.0%	HiToc	544	545	77.3	29.38	44.2
904735	8/10/90	21	NYCC	2192.5	0.159	3.448	682.7	0.437	12.9	0.0062	N			295	296	75.5	29.14	54.0
904747	8/14/90	21	NYCC	2253.2	0.090	2.950	655.4	0.400	13.4	0.0374	Y		104+	309	310	75.5	29.23	53.8
904776	8/20/90	21	NYCC	2940.6	0.125	3.334	660.9	0.431	13.3	0.0464	Y		104+	327	328	75.5	29.23	50.8
904777	8/24/90	21	NYCC	3975.5	0.140	3.074	670.5	0.431	13.1	0.0454	Y	6.0%	104+	347	348	73.5	29.20	47.1
904778	8/28/90	21	NYCC	5670.0	0.089	0.874	651.9	0.443	13.6	0.0340	Y	7.0%	104+	364	365	74.5	28.88	55.5
904741	9/5/90	21	NYCC	8509.7	0.179	3.041	619.0	0.497	14.2	0.0436	Y	14.0%	104+	404	405	75.5	29.19	52.9
904779	9/11/90	21	NYCC	9886.2	0.133	2.797	662.2	0.884	13.3	0.0423	Y	44.0%	HiToc	480	481	75.5	29.31	48.8
905314	9/17/90	21	NYCC	10816.2	0.182	8.494	651.3	0.178	13.4	0.0196	Y	66.0%	HiToc	546	547	77.0	29.38	44.2
90PartOnly	9/13/90	21	LA4's	???						0.0280	Y		HiToc	504	505		29.21	

* After 700 miles @ 1 gr/gal Mn and 300 miles @ 1/32 gr/gal, all Hitec 3000