4.5 EMISSIONS TESTING RESULTS

The test results for all four test conditions are presented in this section. Mass emission results are presented for each vehicle in the as-received condition with the vacuum spark advance still connected. This is followed by the mass emission results for the test run after the vacuum spark advance disconnect (VSAD). Table 4.5-1 presents the vehicle results for each of the following tests.

1. The "Stop and Go" test involved the simulation of summer time around town driving. The driving cycle for this test is presented in Figure 4.5-1. The AESi High Ambient Temperature Simulator (HATS) was used to simulate a summer day temperature of 100°F.

2. The "50 MPH Steady State - Normal Road Load" test involved measuring the emissions of each vehicle at a steady speed of 50 mph. Each test vehicle was run on a dynamometer which loaded the vehicle engine and drive train as if it were driving at 50 mph on a level road.

3. The "50 MPH Steady State - 8% Grade" test simulated the vehicle driving up an 8% grade at 50 mph on a 100°F summer day.

4. The "Federal 1972 Hot Start" test attempts to simulate the average useage of a vehicle. Accels, decels, steady state, and idle modes are all combined in this test.

The following table defines the column headings on the computer printouts.

HEADING	DESCRIPTION
HC	Hydrocarbon calculated mass emissions as measured by the flame ionization detector.
CO	Carbon monoxide mass emissions as measured by NDIR instrumentation.
CO_2	Carbon dioxide mass emissions as measured by NDIR instrumentation.
NO	Nitrogen oxide mass emissions as measured by the chemiluminescence method.

HEADING	DESCRIPTION
NO_X	Oxides of nitrogen mass emissions as measured by chemiluminescence instrument.
NO_XC	Oxides of nitrogen mass emissions which have been corrected for humidity.
ΔNO_XC	The difference between the NO_XC measured with the vacuum advance connected and the NO_XC measured with the vacuum advance disconnected.

At the end of each printout, the results are summarized. The means and standard deviations for all effluents are presented along with the means, standard deviations and Z values of the NO_XC differences. The Z value is calculated by the following formula:

$$Z = \frac{M_D}{S_D/\sqrt{N}}$$

Where: M_D = Mean of the differences

S_D = Standard deviation of differences

N = Number of tests having both before and after VSAD data.

The Z value can be used to determine if the before and after VSAD results are significantly different. The null hypothesis, that the mean difference between the before VSAD and after VSAD test results equalled zero, was formulated. The null hypothesis should be rejected, at the 95% confidence level if the Z values are ≤ -1.96 or > 1.96.

STOP AND GO TEST RESULTS

CAR	RUN	VACUUM ADVANCE CONNECTED HC	CO	CO2	NO	NOX	NOXC	VACUUM ADVANCE DISCONNECTED HC	CO	CO2	NO	NOX	NOXC	DELTA NOXC
00001	00502	2.13	29.36	806.45	1.88	1.98	2.18	2.17	25.19	846.32	1.89	2.14	2.35	-0.17
00002	00524	3.99	22.09	800.16	4.59	5.48	5.36	2.79	25.22	922.30	2.83	3.23	3.16	2.20
00003	00529	6.66	155.08	603.20	0.72	0.74	0.75	4.19	122.66	712.42	0.65	0.67	0.68	0.07
00004	00546	4.11	56.51	619.06	3.20	3.72	3.97	3.33	50.13	626.76	2.24	2.49	2.65	1.31
00005	00551	5.95	96.25	462.05	2.05	2.26	2.29	5.54	100.71	469.39	1.25	1.30	1.32	0.98
00006	00554	4.77	15.64	696.40	4.50	5.27	5.44	6.77	17.24	779.91	3.29	3.78	3.90	1.54
00007	00555	4.52	73.05	630.88	3.27	3.52	3.83	4.24	66.07	665.96	2.57	2.80	3.05	0.79
00008	00557	3.04	68.61	777.63	2.29	2.44	2.42	3.60	115.55	763.42	1.59	1.65	1.64	0.78
00009	00559	2.82	60.12	634.31	2.68	3.10	3.12	2.70	74.90	761.47	1.52	1.62	1.63	1.48
00010	00560	4.62	88.31	624.39	2.03	2.16	2.15	3.54	85.01	678.77	1.58	1.65	1.64	0.51
00011	00564	4.43	135.56	708.15	2.82	3.15	3.55	4.88	158.92	679.33	1.70	1.75	1.97	1.58
00012	00569	4.81	189.72	612.18	0.71	0.73	0.77	4.55	171.29	637.13	0.78	0.80	0.84	-0.07
00013	00568	5.70	83.52	571.86	3.55	4.20	4.20	5.43	94.94	544.65	2.54	2.73	2.72	1.47
00014	00573	3.59	26.77	828.14	3.25	3.60	3.62	2.83	13.93	904.21	8.10	8.53	8.56	-4.94
00015	00574	18.14	374.25	597.95	0.43	0.45	0.45	19.83	414.10	652.03	0.33	0.34	0.35	0.11
00016	00584	2.64	4.90	715.14	3.83	4.27	4.36	2.10	7.93	748.15	1.86	2.03	2.07	2.29
00017	00585	2.97	12.55	571.74	2.81	3.15	3.20	2.19	15.91	608.87	1.61	1.73	1.76	1.44
00018	00602	4.27	90.14	635.64	1.79	1.95	2.13	3.66	20.84	662.28	1.85	2.06	2.24	-0.11
00019	00604	2.09	36.94	279.84	1.16	1.22	1.32	1.90	35.91	301.31	0.65	0.72	0.78	0.55
00020	00608	4.73	91.13	599.64	1.67	1.84	1.93	4.03	75.92	646.61	1.27	1.38	1.45	0.49
00021	00609	5.48	143.67	579.59	1.14	1.20	1.32	6.29	156.32	580.76	1.08	1.12	1.23	0.09
00022	00610	4.99	76.81	537.38	2.45	2.70	2.84	4.15	77.16	559.51	1.65	1.75	1.84	1.00
00023	00612	26.04	233.28	613.96	1.89	2.08	2.36	25.44	225.40	638.65	2.05	2.22	2.52	-0.16
00024	00611	3.54	54.88	633.09	1.72	1.82	1.89	3.47	38.40	699.76	1.68	1.85	1.92	-0.03
00025	00614	17.00	257.11	353.07	0.46	0.53	0.61	16.11	240.21	352.07	0.30	0.33	0.38	0.23
00026	00613	5.24	64.55	758.76	2.06	2.08	2.36	7.44	142.91	680.90	1.49	1.81	2.05	0.31
00027	00615	18.19	143.66	657.02	2.33	2.65	2.75	20.43	126.69	684.56	1.53	1.70	1.77	0.98
00028	00617	5.76	81.96	644.35	3.74	4.43	4.80	4.47	89.61	704.07	2.48	2.68	2.91	1.89
00029	00616	4.81	81.07	494.97	3.68	4.21	4.70	4.15	61.71	590.12	2.14	2.35	2.63	2.07
00030	00619	4.28	51.69	447.14	1.71	1.83	1.96	3.63	45.90	474.00	2.09	2.24	2.39	-0.43
00031	00618	9.38	135.76	616.89	1.86	2.05	2.08	8.45	142.65	677.88	0.87	0.91	0.92	1.15
00032	00620	6.25	179.50	588.93	2.52	2.73	3.13	5.59	170.77	616.35	1.54	1.71	1.96	1.17
00033	00621	2.67	45.51	505.83	3.44	3.74	3.73	2.28	37.23	584.25	2.05	2.11	2.11	1.62
00034	00622	18.77	141.33	557.55	3.28	3.54	3.74	18.94	142.73	607.44	2.05	2.14	2.26	1.48
00035	00623	5.08	158.04	632.00	2.96	3.21	3.52	5.45	159.40	715.83	2.00	2.09	2.29	1.23
00036	00624	6.98	143.50	789.31	3.33	3.56	3.64	10.84	78.27	963.72	2.17	2.32	2.37	1.27
00037	00625	4.62	11.18	366.03	2.84	3.11	3.45	4.69	11.96	384.97	1.81	1.85	2.05	1.39
00038	00626	5.55	116.78	530.55	2.90	3.09	4.10	5.17	114.43	557.36	1.65	1.73	2.30	1.80
00039	00627	4.51	44.25	666.06	2.58	2.74	2.81	3.49	60.89	506.64	1.17	1.21	1.24	1.57
00040	00628	3.14	45.70	499.00	2.84	3.05	3.20	4.39	100.69	494.94	1.26	1.37	1.44	1.77
00041	00629	4.16	41.96	687.63	3.49	3.91	4.23	4.74	38.03	726.65	2.76	3.06	3.31	0.92
00042	00630	3.24	44.21	544.79	1.35	1.44	1.48	3.24	39.76	537.31	1.48	1.75	1.81	-0.33
00043	00631	2.36	14.07	559.62	1.28	1.47	1.65	1.42	12.71	579.44	2.34	2.56	2.87	-1.22
00044	00632	4.51	119.20	607.62	2.02	2.13	2.21	3.62	105.68	595.19	1.31	1.39	1.44	0.76
00045	00634	3.31	24.27	572.08	3.00	3.25	3.58	1.84	27.86	621.58	1.67	1.71	1.89	1.69
00046	00633	3.54	4.01	829.74	3.17	3.63	3.80	2.66	4.21	880.44	2.26	2.51	2.63	1.17
00047	00639	6.96	56.18	761.54	1.52	1.67	1.73	5.65	50.05	722.19	1.37	1.41	1.47	0.26
00048	00635	5.53	90.22	568.62	2.29	2.40	2.53	5.58	94.30	547.28	2.02	2.08	2.20	0.33
00049	00637	7.49	51.63	604.86	2.46	2.63	2.84	7.19	41.16	638.40	1.64	1.73	1.87	0.98

TABLE 4.5-1

STOP AND GO TEST RESULTS

CAR	RUN	VACUUM ADVANCE CONNECTED HC	CO	CO2	NO	NOX	NOXC	VACUUM ADVANCE DISCONNECTED HC	CO	CO2	NO	NOX	NOXC	DELTA NOXC
00050	00636	5.10	75.64	672.78	4.55	5.24	5.49	5.65	102.67	692.94	2.41	2.60	2.72	2.77
00051	00638	7.37	130.74	691.60	3.37	3.64	3.89	5.75	134.81	792.67	2.72	2.93	3.13	0.76
00052	00643	2.80	38.93	987.86	3.58	3.77	3.79	6.16	84.18	639.68	3.35	3.96	3.99	-0.19
00053	00641	8.09	104.79	634.88	2.15	2.28	2.37	10.79	92.43	725.90	1.69	1.86	1.93	0.44
00054	00640	8.26	128.42	515.03	1.79	1.89	1.93	10.81	137.97	487.05	1.58	1.64	1.68	0.25
00055	00642	4.00	57.99	629.94	2.82	3.07	3.25	3.41	38.51	674.91	2.36	2.52	2.67	0.58
00056	00645	3.22	19.99	778.54	3.45	3.88	4.07	2.91	21.24	728.75	2.74	2.97	3.12	0.95
00057	00644	6.43	186.59	654.37	0.99	1.08	1.15	6.97	191.50	707.70	0.63	0.65	0.70	0.45
00058	00646	4.37	65.63	687.59	4.62	5.25	5.66	3.67	59.94	706.34	2.90	3.17	3.42	2.24
00059	00647	4.97	17.47	453.02	2.78	3.05	3.34	4.60	14.93	416.85	2.67	2.92	3.20	0.14
00060	00652	5.10	163.14	465.87	3.05	3.28	3.60	5.06	171.02	453.90	1.68	1.94	2.12	1.48
00061	00649	5.86	162.08	659.21	2.44	2.57	2.79	4.15	82.83	769.97	2.20	2.31	2.50	0.28
00062	00650	10.23	156.82	476.08	2.23	2.34	2.43	10.29	174.26	477.05	1.10	1.16	1.21	1.22
00063	00651	14.08	212.84	637.93	1.89	2.00	2.02	14.70	232.93	634.46	1.05	1.12	1.13	0.89
00064	00653	4.21	50.12	581.40	3.16	3.41	3.79	3.43	53.19	635.98	2.15	2.30	2.56	1.23
00065	00654	2.51	63.58	498.01	4.00	4.35	4.64	1.53	55.64	635.28	2.31	2.65	2.82	1.82
00066	00655	3.67	110.89	748.07	1.79	1.89	2.00	2.30	96.63	807.26	1.24	1.30	1.38	0.62
00067	00653	5.80	146.17	540.24	0.99	1.06	1.11	5.19	163.17	609.10	0.80	0.84	0.88	0.23
00068	00656	5.47	73.99	581.90	3.83	4.36	4.53	4.64	117.56	633.13	1.70	1.89	1.97	2.56
00069	00670	2.88	27.87	395.57	4.20	4.83	4.80	2.72	23.45	406.05	3.09	3.42	3.40	1.40
00070	00658	11.35	244.56	916.67	3.24	3.57	3.91	8.26	204.36	905.54	2.13	2.25	2.47	1.44
00071	00660	8.29	224.27	746.77	1.81	1.88	2.06	9.62	370.57	777.87	0.95	1.03	1.13	0.92
00072	00662	2.87	53.30	563.69	3.90	4.36	4.62	2.16	51.04	632.40	2.65	2.86	3.03	1.59
00073	00661	7.80	40.43	767.35	2.44	3.36	3.39	4.86	68.88	858.01	1.97	2.10	2.12	1.27
00074	00669	6.93	220.96	620.99	1.26	1.55	1.65	5.22	153.83	683.90	1.67	1.81	1.92	-0.27
00075	00664	5.68	103.52	566.99	2.87	3.06	3.38	5.63	115.07	555.40	1.66	1.76	1.95	1.44
00075	10665	4.33	53.77	582.91	3.06	3.35	3.76	4.01	64.46	579.05	1.62	1.68	1.88	1.88
00076	00668	2.65	48.59	454.32	4.21	4.67	4.90	1.63	17.76	557.76	2.61	2.78	2.91	1.98
00077	00667	0.67	14.24	229.61	0.73	0.75	0.80	1.32	39.00	582.81	1.47	1.55	1.65	-0.85
00077	10674	1.72	45.48	486.89	1.48	1.58	1.64	1.26	34.91	518.48	0.99	1.08	1.12	0.52
00078	00673	5.96	191.12	652.67	2.27	2.41	2.55	5.33	184.81	686.68	2.01	2.12	2.24	0.31
00079	00672	4.44	121.33	624.50	0.64	0.72	0.76	2.64	98.50	632.10	0.43	0.45	0.47	0.29
00080	00671	11.78	141.01	697.36	1.73	1.82	1.87	11.22	130.16	683.34	1.74	1.82	1.87	-0.00
00081	00676	6.05	180.36	602.72	1.31	1.38	1.43	5.25	217.17	678.06	0.85	0.91	0.94	0.49
00082	00675	21.77	277.73	541.42	0.59	0.61	0.64	17.83	260.91	601.43	0.63	0.66	0.68	-0.05
00083	00677	8.23	203.33	690.33	1.35	1.43	1.51	5.47	195.42	792.20	1.12	1.14	1.20	0.31
00083	10678	8.55	221.41	697.71	1.26	1.28	1.40	6.24	230.77	752.63	1.02	1.04	1.14	0.26
00084	00687	7.64	148.25	518.03	2.72	2.97	3.19	4.70	90.73	604.42	1.43	1.50	1.61	1.58
00085	00679	10.59	194.80	456.83	2.14	2.27	2.44	10.59	190.44	510.89	1.97	2.10	2.25	0.18
00085	10680	10.66	160.89	572.51	4.28	4.82	5.10	9.57	156.16	610.32	3.02	3.32	3.51	1.59
00086	00681	3.43	124.27	595.22	1.43	1.51	1.59	4.06	110.04	731.88	1.24	1.26	1.33	0.26
00087	00684	13.28	294.79	761.57	0.95	0.99	1.04	8.12	211.07	891.91	0.88	0.90	0.94	0.09
00088	00683	14.91	351.32	533.59	0.82	0.91	0.96	21.55	566.16	627.58	0.37	0.41	0.43	0.53
00089	00682	4.11	80.00	814.88	5.17	5.98	6.37	2.72	50.09	1040.12	3.20	3.43	3.65	2.72
00090	00685	3.31	38.40	677.20	3.35	3.81	4.05	3.14	33.22	671.01	1.83	1.94	2.06	1.99
00091	00686	6.36	83.22	616.01	3.73	4.02	4.33	7.17	147.27	692.25	2.04	2.13	2.29	2.04
00092	00689	3.92	83.83	815.00	2.49	2.60	2.80	3.87	145.25	856.76	1.27	1.35	1.46	1.34
00093	00688	3.50	27.05	659.28	4.99	5.96	6.08	3.06	24.68	655.50	3.61	4.01	4.09	1.99
00094	00690	6.74	121.50	807.18	3.96	4.35	4.53	5.38	101.98	845.56	2.58	2.71	2.82	1.71

TABLE 4.5-1
(Continued)

50 M.P.H. STEADY STATE TEST RESULTS - NORMAL ROAD LOAD

CAR	RUN	VACUUM ADVANCE CONNECTED HC	CO	CO2	NO	NOX	NOXC	VACUUM ADVANCE DISCONNECTED HC	CO	CO2	NO	NOX	NOXC	DELTA NOXC
00001	00502	1.17	5.49	421.94	3.09	4.12	4.53	0.58	7.23	521.86	2.03	2.25	2.48	2.05
00002	00524	2.27	7.82	540.72	5.73	9.08	8.88	1.10	8.88	606.55	2.84	3.62	3.54	5.34
00003	00529	1.21	24.57	442.74	2.61	2.95	3.00	0.70	12.76	481.28	1.64	1.81	1.84	1.16
00004	00546	1.87	23.44	381.29	4.64	6.07	6.47	1.08	16.47	421.37	3.11	3.78	4.02	2.44
00005	00551	2.01	19.58	347.53	3.49	4.73	4.80	1.60	20.08	357.85	1.98	2.20	2.23	2.57
00006	00554	1.35	9.67	433.29	5.34	7.73	7.98	3.08	3.61	463.46	3.04	3.70	3.82	4.16
00007	00555	1.98	7.01	365.07	4.52	5.86	6.38	0.95	4.54	395.82	2.50	2.93	3.19	3.19
00008	00557	1.49	7.05	390.06	4.83	6.49	6.45	0.49	9.17	466.95	1.91	2.08	2.07	4.38
00009	00559	1.18	15.01	445.91	4.70	6.66	6.70	0.56	12.58	485.74	2.75	3.31	3.33	3.37
00010	00560	2.39	16.49	414.19	3.76	5.15	5.14	1.43	20.81	449.27	2.15	2.46	2.45	2.69
00011	00564	2.08	31.12	419.74	4.02	5.15	5.81	1.62	34.53	449.78	2.47	2.77	3.13	2.68
00012	00569	3.67	69.72	401.78	3.62	4.47	4.68	2.56	57.63	414.26	1.89	2.11	2.20	2.48
00013	00568	1.92	5.51	422.74	7.00	11.65	11.63	1.12	3.81	405.20	3.38	4.20	4.19	7.44
00014	00573	1.64	3.85	470.34	4.08	5.90	5.93	0.37	2.52	517.21	2.04	2.41	2.42	3.51
00015	00574	3.05	200.05	385.90	1.30	1.45	1.46	3.21	221.35	402.61	0.61	0.64	0.64	0.82
00016	00584	1.89	1.79	408.01	6.69	9.36	9.57	0.91	2.13	433.28	3.24	3.76	3.84	5.73
00017	00585	1.71	10.09	412.90	6.01	8.38	8.52	0.85	4.47	458.89	3.39	4.28	4.35	4.17
00018	00602	1.45	4.53	434.36	4.24	5.91	6.43	0.66	3.80	482.05	2.36	2.70	2.94	3.49
00019	00604	1.42	1.63	287.25	5.48	8.59	9.33	1.09	2.00	302.10	3.85	5.85	6.36	2.97
00020	00608	2.20	2.62	411.76	5.26	7.89	8.27	1.23	2.85	442.12	2.63	3.25	3.41	4.86
00021	00609	2.13	42.33	434.35	1.65	1.89	2.07	1.85	37.66	414.76	1.55	1.75	1.92	0.16
00022	00610	1.52	3.25	336.04	4.58	6.47	6.79	0.66	3.00	367.63	1.69	1.85	1.94	4.85
00023	00612	9.85	26.00	507.99	2.38	3.33	3.77	9.59	22.24	479.06	2.73	3.27	3.71	0.07
00024	00611	2.31	6.75	375.71	2.90	5.28	5.48	1.51	6.64	392.35	2.55	3.04	3.16	2.32
00025	00614	3.17	65.97	255.79	1.49	1.73	2.00	1.78	59.89	262.09	0.42	0.46	0.53	1.46
00026	00613	1.92	24.01	432.82	2.71	3.79	4.30	0.98	20.35	492.97	1.83	2.12	2.40	1.90
00027	00615	9.20	32.52	398.83	3.33	5.54	5.75	8.93	26.01	408.08	2.66	3.22	3.34	2.40
00028	00617	2.25	2.31	478.85	5.66	9.97	10.80	0.86	2.66	456.04	2.77	3.16	3.43	7.37
00029	00616	2.28	3.74	390.50	4.82	6.65	7.43	0.98	3.16	426.87	2.15	2.43	2.72	4.71
00030	00619	1.62	15.78	342.75	3.22	3.93	4.20	1.42	14.19	333.17	3.13	3.76	4.01	0.18
00031	00618	3.40	76.27	445.76	2.63	3.30	3.35	2.60	66.62	466.68	1.41	1.54	1.56	1.78
00032	00620	2.89	36.83	454.09	5.60	8.16	9.34	1.92	39.02	403.27	2.12	2.34	2.68	6.66
00033	00621	1.48	3.42	467.59	5.80	8.06	8.05	6.87	3.76	470.77	2.90	3.85	3.85	4.20
00034	00622	2.02	43.71	497.37	3.74	6.24	6.60	9.97	48.38	448.70	2.83	3.22	3.40	3.20
00035	00623	1.36	12.92	433.13	0.92	1.25	1.37	0.48	7.74	486.49	0.56	0.59	0.65	0.72
00036	00624	2.02	18.74	416.66	4.30	5.41	5.53	1.54	27.71	422.47	2.00	2.19	2.24	3.29
00037	00625	1.55	19.95	207.74	2.25	2.62	2.91	1.22	14.14	220.16	1.49	1.76	1.94	0.96
00038	00626	2.24	20.60	364.94	4.06	5.19	6.90	1.47	16.46	366.65	1.96	2.13	2.83	4.07
00039	00627	2.58	15.54	370.19	3.87	5.01	5.12	1.26	6.90	379.42	1.89	2.11	2.16	2.97
00040	00628	1.73	18.60	341.58	3.35	4.33	4.55	4.22	22.60	347.83	1.97	2.19	2.29	2.25
00041	00629	1.49	2.06	377.23	5.55	7.49	8.11	0.61	2.06	390.32	2.23	2.55	2.76	5.34
00042	00630	1.05	5.15	295.48	1.40	1.60	1.65	0.94	5.95	300.42	1.56	1.71	1.77	-0.12
00043	00631	1.32	5.38	332.77	4.79	7.69	8.65	0.50	4.42	353.48	2.39	2.83	3.18	5.47
00044	00632	1.18	31.23	419.75	3.87	5.24	5.44	0.63	19.81	479.97	2.78	3.22	3.34	2.10
00045	00634	1.26	7.35	314.69	3.35	4.23	4.66	0.44	3.69	358.72	1.75	1.97	2.17	2.49
00046	00633	0.96	2.62	479.74	5.39	7.07	7.41	0.36	2.24	555.68	2.06	2.26	2.37	5.04
00047	00639	0.90	17.61	424.47	2.05	2.40	2.50	0.87	15.10	419.86	2.01	2.38	2.48	0.02
00048	00635	1.10	11.66	479.28	2.46	2.91	3.07	1.07	11.15	474.44	2.41	2.82	2.98	0.10
00049	00637	2.13	19.36	377.20	3.30	4.01	4.33	1.49	16.32	401.06	1.97	2.19	2.37	1.97

TABLE 4.5-1
(Continued)

50 M.P.H. STEADY STATE TEST RESULTS - NORMAL ROAD LOAD

CAR	RUN	VACUUM ADVANCE CONNECTED HC	CO	CO2	NO	NOX	NOXC	VACUUM ADVANCE DISCONNECTED HC	CO	CO2	NO	NOX	NOXC	DELTA NOXC
00095	00692	**********	ABORT	**********				**********	ABORT	**********				
00096	00691	0.47	1.78	253.84	3.06	3.80	3.81	**********	ABORT	**********				
00097	00694	1.02	4.27	252.69	3.20	3.74	3.76	0.73	4.27	249.83	2.10	2.23	2.24	1.52
00098	00693	0.84	8.98	431.88	5.78	7.41	7.70	0.48	9.45	435.50	3.11	3.75	3.90	3.80
00099	00697	1.81	30.24	392.85	2.34	2.49	2.53	1.02	23.21	445.79	1.30	1.37	1.39	1.14
00100	00696	2.51	14.30	391.37	5.60	7.16	7.73	1.22	17.47	422.54	2.45	2.64	2.85	4.88
N		99	99	99	99	99	99	98	98	98	98	98	98	98
MEAN		2.01	25.91	403.73	3.85	5.16	5.46	1.54	23.96	429.45	2.17	2.52	2.66	2.81
STD DEV		1.44	36.97	78.79	1.45	2.29	2.41	1.77	33.72	79.06	0.79	1.04	1.09	1.83
N (DIFF)								98	98	98	98	98	98	
MEAN (DIFF)								0.49	2.19	-24.19	1.69	2.65	2.81	
STD DEV (DIFF)								1.20	13.45	37.29	1.06	1.73	1.83	
Z VALUE (DIFF)								4.03	1.61	-6.42	15.82	15.18	15.20	

TABLE 4.5-1
(Continued)

50 M.P.H. STEADY STATE TEST RESULTS - NORMAL ROAD LOAD

CAR	RUN	VACUUM ADVANCE CONNECTED HC	CO	CO2	NO	NOX	NOXC	VACUUM ADVANCE DISCONNECTED HC	CO	CO2	NO	NOX	NOXC	DELTA NOXC
00095	00692	ABORT						ABORT						
00096	00691	ABORT						ABORT						
00097	00694	0.47	1.78	253.84	3.06	3.80	3.81	0.73	4.27	249.83	2.10	2.23	2.24	1.52
00098	00693	1.02	4.27	252.69	3.20	3.74	3.76	0.48	9.45	435.50	3.11	3.75	3.90	3.80
00099	00697	0.84	8.98	431.88	5.78	7.41	7.70	1.02	23.21	445.79	1.30	1.37	1.39	1.14
00100	00696	1.81	30.24	392.85	2.34	2.49	2.53	1.22	17.47	422.54	2.45	2.64	2.85	4.88
		2.51	14.30	391.37	5.60	7.16	7.73							
N		99	99	99	99	99	99	98	98	98	98	98	98	98
MEAN		2.01	25.91	403.73	3.85	5.16	5.46	1.54	23.96	429.45	2.17	2.52	2.66	2.81
STD DEV		1.44	36.97	78.79	1.45	2.29	2.41	1.77	33.72	79.06	0.79	1.04	1.09	1.83
N (DIFF)								98	98	98	98	98	98	
MEAN (DIFF)								0.49	2.19	-24.19	1.69	2.65	2.81	
STD DEV (DIFF)								1.20	13.45	37.29	1.06	1.73	1.83	
Z VALUE (DIFF)								4.03	1.61	-6.42	15.82	15.18	15.20	

TABLE 4.5-1
(Continued)

50 M.P.H. STEADY STATE TEST RESULTS - 8 PERCENT GRADE LOAD

CAR	RUN	VACUUM ADVANCE CONNECTED HC	CO	CO2	NO	NOX	NOXC	VACUUM ADVANCE DISCONNECTED HC	CO	CO2	NO	NOX	NOXC	DELTA NOXC
00001	C0502	1.44	10.95	876.70	7.00	10.74	11.81	1.17	7.84	88C.45	1.7C	2.76	3.04	8.77
00002	00524	3.89	20.78	848.71	9.27	16.83	16.45	3.25	24.86	980.15	9.75	14.91	14.57	1.88
00003	00529	2.89	37.83	584.78	6.30	9.94	10.09	1.44	37.50	619.20	4.50	5.63	5.72	4.37
00004	00546	ABORT						ABORT						
00005	00551	3.06	52.28	532.72	6.65	9.61	9.76	2.73	42.23	532.84	4.74	6.58	6.68	3.08
00006	00554	5.58	28.91	758.57	7.47	12.53	12.95	5.09	33.82	771.45	8.84	12.99	13.41	-0.47
00007	00555	3.16	26.36	709.10	9.09	13.67	14.89	3.54	69.99	693.71	6.62	11.35	12.36	2.53
00008	00557	2.19	27.44	479.52	6.83	9.97	9.90	1.74	34.6C	571.94	4.76	6.17	6.13	3.77
00009	00559	ABORT						1.96	64.28	786.34	6.23	12.78	12.86	
00010	00560	ABORT						ABORT						
00011	00564	3.41	95.13	748.54	7.03	10.55	11.90	2.99	66.C5	724.18	7.3C	11.5C	12.96	-1.06
00012	C0569	4.28	104.44	664.36	4.73	6.58	6.88	4.44	125.74	6C3.46	3.35	4.43	4.64	2.24
00013	00568	3.13	25.34	715.93	11.18	18.09	18.05	2.69	19.34	712.51	8.89	15.53	15.5C	2.55
00014	00573	2.56	14.83	676.35	7.32	13.17	13.23	2.12	27.64	700.26	5.93	9.57	9.61	3.62
00015	00574	4.03	355.52	479.05	1.61	1.76	1.77	4.C5	372.86	53C.19	1.C9	1.13	1.14	0.64
00016	C0584	2.22	3.38	718.46	11.21	18.39	18.79	2.C9	3.96	1C75.23	1C.92	17.78	18.17	0.62
00017	00585	2.62	8.73	697.43	10.36	18.01	18.29	1.91	28.87	719.33	8.43	12.46	12.66	5.64
00018	00602	2.72	8.38	749.76	9.71	17.85	19.44	2.76	11.13	746.32	1C.61	18.18	19.8C	-0.36
00019	00604	1.63	2.43	481.67	8.69	15.05	16.35	1.57	2.C7	448.C6	6.37	13.19	14.33	2.02
00020	00608	3.22	5.80	697.99	9.21	16.70	17.50	2.85	5.67	696.52	7.52	14.20	14.88	2.61
00021	00609	2.91	36.97	743.49	7.13	11.50	12.61	3.42	69.69	709.37	5.80	9.C0	9.87	2.74
00022	00610	2.35	6.35	615.50	8.63	15.85	16.65	2.11	9.44	628.12	7.48	11.59	12.18	4.47
00023	00612	13.20	70.35	865.34	6.92	11.59	13.15	13.C4	61.17	844.18	7.44	11.99	13.61	-0.46
00024	00611	3.68	27.62	641.69	7.42	13.04	13.54	3.45	27.02	645.46	6.34	12.84	13.33	0.21
00025	00614	4.18	81.76	487.13	4.92	6.91	7.96	3.88	68.91	502.08	5.C6	7.20	8.29	-0.33
00026	00613	2.95	16.56	681.59	9.49	16.53	18.75	2.62	37.C2	682.55	6.C8	9.20	10.44	8.32
00027	C0615	11.18	68.45	457.83	6.66	11.57	12.01	11.20	60.2C	6C3.25	5.99	9.59	9.96	2.05
00028	00617	ABORT						ABORT						
00029	00616	3.26	4.12	634.60	9.87	17.82	19.91	2.52	4.28	657.41	7.87	12.75	14.24	5.67
00030	00619	1.97	3.31	566.43	7.86	13.50	14.42	1.92	3.C5	552.73	7.51	13.27	14.17	0.25
00031	C0618	3.18	132.71	717.58	5.67	8.76	8.88	5.32	138.40	707.68	4.3C	5.30	5.38	3.50
00032	00620	3.54	18.56	754.09	9.59	18.43	21.10	2.91	15.28	757.52	8.74	15.19	17.39	3.71
00033	C0621	1.24	6.17	291.79	4.61	6.60	6.59	0.63	2.44	437.43	6.32	8.95	8.94	-2.34
00034	C0622	14.44	204.65	668.47	2.91	4.08	4.31	14.12	223.22	623.15	2.89	3.36	3.55	0.76
00035	00623	1.35	4.08	737.83	2.78	4.15	4.55	2.64	7.92	802.20	9.75	14.10	15.47	-10.92
00036	00624	3.89	96.41	506.64	5.23	7.51	7.68	ABORT						
00037	00625	2.26	20.52	394.70	5.67	7.96	8.82	2.01	6.42	379.21	5.69	7.74	8.57	0.25
00038	00626	2.64	3.62	694.13	9.82	17.63	23.42	2.C5	3.60	722.54	9.36	14.8C	19.67	3.75
00039	00627	4.61	13.98	591.38	8.65	13.52	13.84	3.51	13.55	611.75	7.02	10.48	10.72	3.11
00040	00628	3.26	27.52	643.92	7.79	12.19	12.79	8.93	104.67	629.42	4.74	6.82	7.16	5.63
00041	00629	2.32	5.87	523.60	8.89	14.42	15.61	2.10	8.24	523.63	7.C4	1C.76	11.65	3.97
00042	0063C	2.11	9.01	551.41	7.20	9.98	10.27	2.40	30.42	527.98	6.59	8.56	8.81	1.46
00043	00631	2.59	72.31	577.78	5.49	7.72	8.69	2.61	83.15	576.09	5.18	7.11	8.00	0.69
00044	00632	4.03	99.17	711.74	7.76	11.98	12.43	3.45	90.96	715.20	6.77	10.32	10.71	1.72
00045	00634	2.39	6.25	559.16	7.93	13.59	14.96	1.43	7.54	595.33	6.75	1C.53	11.59	3.37
00046	00633	1.49	5.35	890.52	11.04	17.21	18.05	1.36	5.60	927.63	9.99	16.43	17.22	0.83
00047	00639	3.44	109.73	608.82	4.51	6.08	6.32	3.01	104.73	641.72	4.54	6.C1	6.25	0.08
00048	00635	3.74	60.95	757.72	7.27	10.55	11.14	3.97	78.30	745.50	5.33	8.63	9.12	2.02
00049	00637	3.41	33.63	637.35	7.67	11.62	12.56	2.74	33.C2	649.18	6.43	1C.57	11.42	1.14

TABLE 4.5-1
(Continued)

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50 M.P.H. STEADY STATE TEST RESULTS - 8 PERCENT GRADE LOAD

CAR	RUN	VACUUM ADVANCE CONNECTED HC	CO	CO2	NO	NOX	NOXC	VACUUM ADVANCE DISCONNECTED HC	CO	CO2	NO	NOX	NOXC	DELTA NOXC
00050	00636	2.03	7.67	830.32	11.85	19.21	20.12	2.01	9.35	857.64	9.43	16.12	16.89	3.24
00051	00638	3.91	58.25	821.00	10.32	16.88	18.04	4.36	111.96	807.82	7.77	11.06	11.82	6.22
00052	00643	0.52	6.15	795.82	5.58	7.88	7.93	11.41	209.36	942.33	4.73	7.50	7.54	0.39
00053	00641	2.92	18.18	702.11	9.25	15.24	15.85	2.36	17.59	734.43	7.71	11.81	12.28	3.57
00054	00640	2.32	4.28	711.57	8.59	14.32	14.64	2.61	5.65	705.43	8.40	13.92	14.24	0.41
00055	00642	ABORT						ABORT						
00056	00645	4.75	7.44	801.95	11.91	18.40	19.33	3.24	5.82	742.45	11.19	17.33	18.20	1.13
00057	00644	4.25	165.06	592.38	3.71	4.41	4.71	3.33	157.53	680.99	2.26	2.55	2.73	1.99
00058	00646	4.00	21.30	774.95	11.94	20.13	21.72	2.31	10.65	797.93	10.68	17.34	18.71	3.01
00059	00647	1.66	11.03	491.66	8.40	12.96	14.19	1.24	30.99	477.76	6.02	9.14	10.01	4.18
00060	00652	2.47	69.32	635.01	9.42	13.92	15.25	2.37	64.87	640.45	6.43	9.50	10.41	4.84
00061	00649	4.74	140.69	727.95	6.20	7.86	8.53	ABORT						
00062	00650	3.77	59.18	713.27	8.04	11.76	12.23	3.68	90.66	714.12	6.16	7.50	7.80	4.43
00063	00651	13.44	351.78	652.48	3.32	3.68	3.72	14.38	392.87	597.75	1.84	1.91	1.93	1.79
00064	00653	2.00	5.36	669.50	9.42	16.60	18.45	1.24	6.19	734.54	8.88	11.97	13.31	5.14
00065	00654	ABORT						ABORT						
00066	00655	ABORT						ABORT						
00067	00653	3.82	61.99	643.54	9.29	6.72	7.03	3.61	100.86	657.43	4.37	5.29	5.54	1.50
00068	00656	4.15	8.15	731.63	11.77	18.48	19.20	3.44	23.37	740.04	8.45	12.93	13.43	5.77
00069	00670	1.38	2.07	458.51	8.89	14.77	14.66	1.28	1.95	449.61	8.87	14.87	14.75	-0.10
00070	00658	ABORT						ABORT						
00071	00660	9.56	144.80	756.08	6.45	8.66	9.49	10.41	187.83	756.54	4.66	5.66	6.20	3.29
00072	00662	ABORT						ABORT						
00073	00661	5.49	410.39	600.95	0.44	0.51	0.52	ABORT						
00074	00669	9.01	315.09	528.42	0.94	1.05	1.12	ABORT						
00075	00664	3.71	62.24	671.15	9.39	12.68	14.03	3.96	76.63	652.97	8.22	11.58	12.81	1.21
00075	10665	2.80	16.84	698.11	7.93	14.29	16.01	3.03	46.31	665.68	8.22	12.82	14.37	1.64
00076	00668	ABORT						ABORT						
00077	00667	2.45	75.96	372.42	3.12	3.67	3.90	ABORT						
00077	10674	1.53	4.46	534.77	8.53	13.89	14.44	1.23	4.91	499.39	6.87	12.27	12.75	1.68
00078	00673	ABORT						ABORT						
00079	00672	ABORT						ABORT						
00080	00671	ABORT						ABORT						
00081	00676	ABORT						ABORT						
00082	00675	5.74	232.15	599.57	2.25	2.64	2.74	ABORT						
00083	00677	5.66	238.39	748.82	3.44	4.28	4.52	ABORT						
00083	10678	5.46	240.25	759.64	4.13	4.91	5.36	ABORT						
00084	00687	4.34	84.83	522.41	4.73	7.17	7.70	4.34	104.52	541.27	4.01	4.69	5.03	2.67
00085	00679	ABORT						ABORT						
00085	10680	ABORT						ABORT						
00086	00681	ABORT						ABORT						
00087	00684	3.13	102.21	440.41	1.90	2.10	2.20	ABORT						
00088	00683	3.51	91.75	717.05	5.83	7.56	8.05	4.43	31.05	646.27	3.27	3.68	3.92	4.13
00089	00682	ABORT						ABORT						
00090	00685	1.97	42.96	484.82	5.12	7.82	8.32	1.20	40.09	516.35	3.75	5.53	5.88	2.44
00091	00686	4.60	112.77	717.02	8.02	10.20	10.98	4.27	135.43	705.77	4.83	5.77	6.21	4.78
00092	00689	4.03	109.02	718.30	7.23	10.77	11.60	4.27	252.41	688.35	2.95	3.32	3.58	8.02
00093	00688	3.01	11.64	739.69	9.40	18.82	19.22	2.33	12.85	711.44	11.62	17.58	17.95	1.27
00094	00690	3.42	228.51	806.71	1.91	2.07	2.16	2.14	216.50	834.06	1.45	1.52	1.58	0.58

TABLE 4.5-1
(Continued)

50 M.P.H. STEADY STATE TEST RESULTS - 8 PERCENT GRADE LOAD

CAR	RUN	VACUUM ADVANCE CONNECTED HC	CO	CO2	NO	NOX	NOXC	VACUUM ADVANCE DISCONNECTED HC	CO	CO2	NO	NOX	NOXC	DELTA NOXC
00095	00692	ABORT						ABORT						
00096	00691	ABORT						ABORT						
00097	00694	2.40	75.24	474.48	3.42	5.24	5.27	ABORT						
00098	00693	ABORT						ABORT						
00099	00697	ABORT						ABORT						
00100	00696	4.27	70.26	679.63	8.13	11.62	12.55	4.37	93.68	676.83	6.14	8.16	8.81	3.74
N		79	79	79	79	79	79	71	71	71	71	71	71	70
MEAN		3.82	69.37	648.90	7.12	11.16	11.89	3.69	65.74	678.89	6.47	9.69	10.53	2.40
STD DEV		2.60	88.27	125.28	2.79	5.15	5.58	2.98	80.77	129.11	2.47	4.42	4.75	2.76
N (DIFF)								70	70	70	70	70	70	
MEAN (DIFF)								-0.01	-11.56	-16.44	1.18	2.25	2.40	
STD DEV (DIFF)								1.62	34.36	60.80	1.69	2.54	2.76	
Z VALUE (DIFF)								-0.06	-2.82	-2.26	5.85	7.39	7.27	

TABLE 4.5-1
(Continued)

1972 FEDERAL PROCEDURE TEST RESULTS

CAR	RUN	VACUUM ADVANCE CONNECTED HC	CO	CO2	NO	NOX	NOXC	VACUUM ADVANCE DISCONNECTED HC	CO	CO2	NO	NOX	NOXC	DELTA NOXC
00001	00502	2.63	19.28	639.08	3.08	3.84	4.23	2.11	21.02	704.56	2.25	2.58	2.84	1.39
00002	00524	3.79	20.15	706.59	5.10	7.10	6.94	2.53	22.40	819.17	3.25	3.83	3.74	3.20
00003	00529	3.27	83.08	584.11	1.55	1.79	1.81	2.30	71.62	653.59	1.13	1.26	1.28	0.53
00004	00546	3.72	38.43	548.82	3.94	5.30	5.65	2.58	37.53	563.99	2.78	3.42	3.65	2.00
00005	00551	4.75	64.16	428.45	2.99	3.90	3.96	3.94	68.54	439.18	1.78	2.08	2.12	1.85
00006	00554	4.63	23.87	622.56	4.49	5.97	6.16	6.04	17.41	664.17	3.26	3.99	4.12	2.04
00007	00555	3.59	56.28	530.21	3.50	4.56	4.96	2.99	52.19	556.36	2.60	3.11	3.39	1.58
00008	00557	1.95	19.63	643.73	3.72	4.53	4.50	1.36	21.58	681.21	2.23	2.50	2.48	2.02
00009	00559	2.35	38.37	616.50	3.73	5.14	5.18	1.65	36.87	685.81	2.46	2.92	2.94	2.24
00010	00560	3.97	73.68	545.19	2.45	3.04	3.04	2.91	74.70	604.44	1.83	2.06	2.05	0.98
00011	00564	3.47	88.18	583.58	3.25	3.83	4.32	3.29	90.82	595.83	2.18	2.48	2.79	1.53
00012	00569	5.68	125.02	523.86	2.13	2.66	2.78	4.22	126.17	544.22	1.41	1.56	1.64	1.14
00013	00568	4.45	47.07	514.47	4.73	7.19	7.18	3.43	43.21	521.03	3.15	4.15	4.14	3.03
00014	00573	3.73	54.01	650.26	3.23	4.35	4.37	2.37	33.18	705.04	2.01	2.41	2.42	1.95
00015	00574	7.41	275.88	553.14	0.92	0.98	0.99	6.89	282.87	572.66	0.56	0.59	0.60	0.39
00016	00584	2.42	5.88	578.51	4.55	6.01	6.14	1.73	6.55	620.03	2.70	3.06	3.13	3.01
00017	00585	2.14	10.01	517.67	4.15	5.60	5.69	1.65	8.02	564.56	2.50	3.01	3.06	2.63
00018	00602	2.67	30.93	576.13	2.99	3.61	3.93	2.04	26.66	650.66	2.03	2.29	2.50	1.44
00019	00604	2.61	38.32	437.79	4.68	6.42	6.98	1.53	22.45	297.43	1.79	2.17	2.36	4.62
00020	00608	3.07	43.78	541.05	2.86	3.63	3.80	2.80	44.16	557.54	1.94	2.23	2.34	1.46
00021	00609	3.66	80.43	519.55	1.23	1.34	1.47	3.72	82.39	566.69	1.70	1.91	2.10	-0.63
00022	00610	3.37	23.96	484.09	3.91	5.07	5.33	2.39	26.92	508.68	2.07	2.34	2.46	2.87
00023	00612	20.28	138.83	655.89	2.43	3.32	3.77	19.56	134.23	625.99	2.64	3.14	3.56	0.20
00024	00611	3.62	29.03	511.58	3.02	4.53	4.70	2.77	29.67	565.15	2.30	2.69	2.79	1.91
00025	00614	11.72	173.71	320.83	1.08	1.21	1.39	10.19	178.06	343.28	0.76	0.85	0.98	0.41
00026	00613	4.19	34.91	611.11	2.93	3.53	4.01	3.46	34.13	653.64	2.06	2.31	2.62	1.39
00027	00615	3.65	91.46	620.59	3.11	4.25	4.41	4.24	94.74	653.75	2.10	2.51	2.61	1.80
00028	00617	3.79	48.88	623.94	5.11	7.52	8.15	2.76	51.90	621.77	2.99	3.57	3.87	4.29
00029	00616	3.94	41.62	503.72	4.31	5.98	6.68	3.14	37.34	518.45	2.77	3.30	3.68	3.00
00030	00619	3.62	36.26	485.24	2.86	3.48	3.71	3.62	36.53	475.19	2.71	3.36	3.59	0.12
00031	00618	7.45	108.88	565.10	2.42	2.94	2.98	6.74	114.36	591.66	1.29	1.41	1.43	1.56
00032	00620	5.11	110.79	543.32	3.93	4.89	5.59	4.16	103.28	576.47	2.45	2.85	3.26	2.33
00033	00621	3.01	29.24	670.49	5.81	8.32	8.31	1.31	19.68	432.99	1.97	2.20	2.19	6.11
00034	00622	16.37	99.19	531.97	3.91	5.08	5.37	16.29	102.82	551.62	2.49	2.87	3.04	2.33
00035	00623	3.34	84.68	585.84	3.80	4.64	5.10	2.11	70.53	703.91	2.68	3.03	3.32	1.77
00036	00624	5.26	94.74	613.81	3.40	4.37	4.47	8.17	68.39	683.10	1.91	2.10	2.14	2.32
00037	00625	2.84	29.26	306.37	2.03	2.44	2.70	2.71	19.56	309.81	1.77	1.89	2.10	0.60
00038	00626	4.33	74.65	468.70	3.60	4.43	5.88	3.65	70.64	503.30	2.35	2.61	3.47	2.41
00039	00627	4.86	46.37	584.82	3.12	3.80	3.89	3.31	33.42	637.49	1.91	2.10	2.14	1.74
00040	00628	2.70	39.59	446.22	3.41	4.13	4.34	4.41	42.51	481.53	2.08	2.28	2.39	1.95
00041	00629	3.14	7.53	570.54	4.87	6.18	6.69	2.04	10.27	577.30	2.92	3.33	3.61	3.09
00042	00630	2.33	49.28	388.69	1.04	1.16	1.19	2.37	31.54	441.62	1.82	1.96	2.02	-0.83
00043	00631	1.98	15.00	461.62	4.58	5.87	6.60	1.23	14.87	485.04	2.40	2.78	3.13	3.47
00044	00632	3.33	95.67	565.62	2.68	3.22	3.34	2.62	78.83	574.49	1.99	2.24	2.33	1.02
00045	00634	2.82	21.24	472.17	3.23	3.96	4.36	1.40	17.56	523.81	1.97	2.30	2.53	1.82
00046	00633	4.40	5.15	703.94	3.62	4.55	4.77	3.18	5.83	771.26	2.64	3.07	3.21	1.56
00047	00639	5.56	41.15	604.56	1.71	2.00	2.08	4.96	39.35	600.02	1.77	2.01	2.09	-0.00
00048	00635	3.83	44.94	556.40	2.66	3.21	3.39	3.73	45.94	557.89	2.75	3.21	3.39	0.01
00049	00637	5.27	48.44	537.07	2.31	2.63	2.84	4.99	42.77	549.48	1.84	2.03	2.19	0.65

TABLE 4.5-1
(Continued)

1972 FEDERAL PROCEDURE TEST RESULTS

		VACUUM ADVANCE CONNECTED						VACUUM ADVANCE DISCONNECTED						DELTA
CAR	RUN	HC	CO	CO2	NO	NOX	NOXC	HC	CO	CO2	NO	NOX	NOXC	NOXC
00050	C0636	4.29	45.06	604.57	5.53	7.48	7.83	3.81	49.35	651.36	3.11	3.63	3.8C	4.03
00051	00638	5.45	97.59	634.74	4.31	5.69	6.08	4.35	94.40	716.54	3.27	3.87	4.13	1.95
00052	00643	1.64	31.02	994.54	4.19	5.01	5.04	1.69	31.37	1029.48	4.42	5.47	5.5C	-0.45
00053	00641	4.04	84.34	529.91	2.88	3.48	3.62	3.72	76.73	610.69	1.99	2.26	2.35	1.27
00054	0064C	6.22	71.34	498.37	2.61	3.59	3.67	6.92	71.85	499.69	2.28	2.65	2.71	0.96
00055	00642	3.24	34.47	566.45	3.85	4.82	5.10	2.78	34.26	589.28	2.65	3.C8	3.25	1.85
00056	00645	2.82	18.30	748.75	4.80	5.68	5.96	2.33	12.71	702.78	3.85	4.65	4.88	1.08
00057	00644	3.50	107.13	602.47	1.64	1.79	1.92	2.93	101.86	635.98	C.94	C.99	1.C6	C.86
00058	00646	3.09	34.60	623.94	6.06	8.01	8.64	2.48	31.99	630.63	3.73	4.56	4.92	3.72
00059	00647	2.81	10.65	394.72	3.38	4.01	4.39	2.74	10.88	394.44	3.37	3.97	4.35	0.04
00060	00652	4.23	105.05	449.69	4.09	5.19	5.69	3.60	98.80	464.41	2.66	3.C0	3.29	2.41
00061	00649	3.80	52.56	632.80	4.51	6.44	6.99	3.65	79.85	665.17	2.38	2.61	2.84	4.15
00062	00650	7.25	94.39	492.68	3.07	3.61	3.75	6.70	108.29	514.19	1.72	1.84	1.91	1.84
00063	00651	7.42	224.04	539.22	2.22	2.41	2.44	6.49	216.05	537.17	1.30	1.39	1.4C	1.03
00064	00653	2.66	27.60	553.82	3.93	4.72	5.24	1.86	25.54	614.41	2.72	3.C3	3.37	1.87
00065	00654	2.C6	38.76	431.45	4.36	5.47	5.84	1.17	39.56	551.33	2.59	3.C1	3.21	2.63
00066	00655	2.60	67.29	623.25	2.75	3.22	3.42	1.89	76.93	663.67	1.60	1.79	1.90	1.52
00067	00653	4.48	93.92	494.15	1.75	1.90	1.99	3.40	92.68	586.62	1.27	1.30	1.36	0.64
00068	00656	3.95	44.24	514.64	5.39	6.73	6.99	2.57	46.C6	598.19	2.4C	2.78	2.89	4.10
00069	00670	2.58	16.13	344.62	3.76	4.84	4.80	1.88	13.37	362.59	2.62	3.C3	3.CC	1.80
00070	00658	8.38	136.66	805.78	3.66	4.54	4.97	6.54	122.16	8C3.35	3.63	4.35	4.76	0.20
00071	00660	6.78	134.18	596.93	2.83	3.18	3.49	5.60	149.39	649.31	1.5C	1.57	1.72	1.77
00072	00662	2.30	33.01	519.03	4.44	5.42	5.75	1.57	34.30	578.17	2.92	3.32	3.52	2.23
00073	C0661	3.72	75.36	644.33	2.36	2.73	2.76	2.69	60.40	699.80	1.79	1.94	1.95	0.80
00074	00669	3.20	67.12	618.38	2.03	2.18	2.31	3.57	76.28	614.87	1.87	2.15	2.28	0.03
00075	00664	4.35	43.42	514.78	4.12	4.87	5.39	3.51	42.34	518.40	2.22	2.45	2.71	2.68
00075	10665	4.C1	37.81	515.84	4.18	5.19	5.82	3.29	36.79	518.91	2.33	2.64	2.96	2.85
00076	00668	1.96	14.76	436.52	5.73	8.04	8.43	1.31	13.85	494.85	3.34	4.18	4.38	4.04
00077	00667	1.96	37.08	480.53	3.22	3.89	4.13	1.45	28.66	486.12	2.65	3.15	3.34	0.79
00077	10674	2.22	35.28	484.34	3.64	4.63	4.81	1.57	28.36	506.32	2.63	3.21	3.33	1.48
00078	0C673	3.62	80.42	598.15	4.04	5.06	5.35	2.71	69.C5	647.29	2.99	3.38	3.57	1.77
00079	00672	3.06	88.49	561.44	1.24	1.32	1.39	2.23	76.18	579.28	C.79	C.85	0.9C	0.49
00080	00671	7.62	70.45	550.81	2.30	3.19	3.28	5.91	66.07	587.83	2.14	2.39	2.46	0.83
00081	00676	4.45	101.86	524.65	2.34	2.58	2.68	3.93	134.C0	588.86	1.14	1.20	1.25	1.44
00082	00675	10.91	235.53	482.89	1.09	1.16	1.20	11.88	243.20	525.82	C.89	C.96	1.CC	C.21
00083	00677	5.45	175.68	722.09	1.72	1.80	1.90	7.18	155.52	621.42	2.75	3.C1	3.18	-1.29
00083	10678	6.98	163.26	592.71	1.99	2.18	2.38	5.33	172.86	695.53	1.56	1.65	1.8C	0.58
00084	00687	4.36	55.57	456.39	3.14	3.66	3.93	4.32	74.48	498.75	1.71	1.81	1.95	1.98
00085	C0679	7.81	120.34	473.78	3.06	3.64	3.91	8.49	129.C1	514.70	2.38	2.69	2.89	1.02
00085	10680	7.41	101.24	506.82	4.23	5.49	5.80	7.14	104.56	550.40	3.C5	3.82	4.04	1.76
00086	00681	5.57	96.65	539.51	2.43	2.76	2.89	3.75	92.03	617.67	1.74	1.88	1.97	0.92
00087	C0684	5.79	86.29	679.39	1.78	1.89	1.98	5.37	98.63	716.14	1.14	1.21	1.27	0.71
00088	00683	2.48	47.13	618.09	1.93	2.05	2.18	2.42	47.16	615.88	1.82	1.90	2.C2	0.16
00089	00682	3.86	16.58	706.51	5.51	7.77	8.27	2.05	18.69	8C3.07	3.06	3.51	3.74	4.53
00090	00685	2.53	31.36	504.63	3.78	4.46	4.75	1.72	31.22	563.76	1.88	2.C6	2.19	2.55
00091	C0686	5.19	51.13	525.77	3.96	4.74	5.10	4.11	65.96	585.79	2.C4	2.16	2.33	2.77
00092	00689	3.09	54.51	673.71	3.96	4.78	5.16	2.40	76.37	763.20	2.C9	2.33	2.51	2.65
00093	00688	3.43	18.20	598.10	6.03	8.29	8.46	2.91	20.26	586.38	4.17	5.62	5.73	2.72
00094	00690	3.23	79.42	646.36	3.35	3.87	4.04	2.23	63.12	676.32	1.79	1.93	2.C1	2.03

TABLE 4.5-1
(Continued)

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FIGURE 4.5-1

STOP AND GO
DRIVING SCHEDULE

Idle	Accel, mph	Decel, mph	Cruise, mph	Avg. Speed, mph	Time in Seconds
Start 0				0.00	25.00
	0-25			12.50	12.00
			26	26.00	20.00
		26 - 12.5		19.25	7.50
			13	13.00	5.00
		13 - 0		6.50	5.00
0				0.00	20.00
	0-21			10.50	12.00
	21-25			23.00	10.00
			25	25.00	10.00
		25 - 0		12.50	15.00
0				0.00	67.00
	0-26			12.50	13.00
			26	26.00	14.00
		26 - 15		20.50	9.00
			15	15.00	4.00
		15 - 0		7.50	6.50
0				0.00	28.00
	0-20			10.00	12.00
			20	19.50	13.00
		20 - 6.5		13.00	8.00
			6.5	6.50	2.00
		6.5 - 0		3.25	4.00
0				0.00	1.00
	0-25			12.50	16.00
			25	24.50	12.00
		24 - 14.5		19.25	9.00
		14.5 - 13.5		14.00	5.00
		13.5 - 0		6.75	10.00
0				0.00	6.00
	0-8			4.00	2.50
			8	8.50	7.50
	9-20			14.50	7.00
	20-24.5			23.00	5.00
			24.5	24.50	6.00
		24.5 - 14.5		19.50	5.00
	14.5-18.5			16.50	8.00
	18.5-20.5			19.50	4.00
		20.5 - 0		10.25	9.00
0				0.00	20.00
	0-25			12.50	13.00
			25	25.00	7.00
		25 - 16		20.50	8.00

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FIGURE 4.5-1 (Continued)

STOP AND GO
DRIVING SCHEDULE

Idle	Accel, mph	Decel, mph	Cruise, mph	Avg. Speed, mph	Time in Seconds
		16 - 14.5		15.25	4.00
		14.5 - 9.5		12.00	9.00
		9.5 - 0		4.75	6.00
0				0.00	10.00
	0-25			12.50	14.00
			25	25.00	6.00
		25 - 20		22.00	11.00
		20 - 6.5		13.50	9.00
			6.5	6.50	2.00
		6.5 - 5.0		5.75	1.00
			5.0	5.00	2.00
		5 - 0		2.50	2.00
0				0.00	2.00
	0-17.5			8.75	7.00
	17.5-19			18.25	4.00
		19 - 0		9.50	9.00
End 0				0.00	20.00

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HEADING	DESCRIPTION
NO_x	Oxides of nitrogen mass emissions as measured by chemiluminescence instrument.
NO_xC	Oxides of nitrogen mass emissions which have been corrected for humidity.
$\triangle NO_xC$	The difference between the NO_xC measured with the vacuum advance connected and the NO_xC measured with the vacuum advance disconnected.

At the end of each printout, the results are summarized. The means and standard deviations for all effluents are presented along with the means, standard deviations and Z values of the NO_xC differences. The Z value is calculated by the following formula:

$$Z = \frac{M_D}{S_D/\sqrt{N}}$$

Where: M_D = Mean of the differences

S_D = Standard deviation of differences

N = Number of tests having both before and after VSAD data.

The Z value can be used to determine if the before and after VSAD results are significantly different. The null hypothesis, that the mean difference between the before VSAD and after VSAD test results equalled zero, was formulated. The null hypothesis should be rejected, at the 95% confidence level if the Z values are ≤ -1.96 or > 1.96.

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4.6 TEMPERATURE RESULTS

Temperature data was recorded when vehicles were being tested under the severe operating conditions. Both the exhaust outlet temperature and the incoming air temperature (at the grill) were measured in degrees Fahrenheit. The "grapevine" (8% grade) test and the "stop and go" test placed the greatest strain on the vehicle. This strain was intensified by the simulated 100°F ambient temperatures.

Table 4.6-1 presents a summary of the exhaust outlet temperatures. The data is presented in the following format:

HEADING	DESCRIPTION
CAR #	The vehicle identification number in the cases where replicate tests were run, the car number followed by "(Orig)" signifies the original test and "(Repl)" signifies the replicate test.
LOCATION OF TEMPERATURE CHECK	The location of the temperature probe.
GRAPEVINE (°F)	The exhaust outlet temperature measured on the "Grapevine" (50 mph steady state - 8% grade load) test.
STOP & GO (°F)	The exhaust outlet temperature measured on the "Stop and Go" test.
ΔT GRAPEVINE	The change in temperature between the pre-VSAD and the post-VSAD tests under the "Grapevine" condition.
ΔT Stop & Go	The change in temperature between the pre-VSAD and the post-VSAD tests under the "Stop and Go" condition.

Table 4.6-2 presents the effect of vacuum advance disconnect on temperature measured at the grill and at the engine outlet. The format is the same as Table 4.6-1. The ΔT's have been presented for only the change in engine outlet temperatures. The average increase in engine outlet temperatures is only 1.1°F. Table 4.6-3 presents the effect of VSAD on air cleaner inlet temperature. The results are presented in the same format as Table 4.6-1. The average increase is only 3.0°F.

AESi
AUTOMOTIVE ENVIRONMENTAL SYSTEMS, INC.

EXHAUST OUTLET TEMPERATURE SUMMARY

CAR NO.	LOCATION OF TEMP. CHECK	DIST. VACUUM CONNECTED GRAPEVINE (°F)	DIST. VACUUM CONNECTED STOP & GO (°F)	DIST. VACUUM DISCONNECTED GRAPEVINE (°F)	DIST. VACUUM DISCONNECTED STOP & GO (°F)	ΔT GRAPEVINE (°F)	ΔT STOP & GO (°F)
00001	Exhaust Outlet	-	-	-	-	-	-
00002	" "	-	-	-	-	-	-
00003	" "	615	370	739	410	+124	+ 40
00004	" "	-	-	-	-	-	-
00005	" "	830	345	885	360	+ 55	+ 15
00006	" "	830	410	852	450	+ 12	+ 40
00007	" "	820	380	825	420	+ 5	+ 40
00008	" "	635	378	705	395	+ 70	+ 17
00009	" "	Abort	410	845	430	+165	+ 20
00010	" "	Abort	522	Abort	545	-	- 23
00011	" "	880	400	908	425	+ 28	+ 25
00012	" "	812	420	820	410	+ 8	- 10
00013	" "	838	320	780	430	- 58	+110
00014	" "	705	410	762	440	+ 57	+ 30
00015	" "	670	340	660	425	- 10	+ 85
00016	" "	860	430	715	435	-145	+ 5
00017	" "	800	390	880	425	+ 80	+ 35
00018	" "	795	480	818	433	+ 23	- 47
00019	" "	819	338	775	310	- 44	- 28
00020	" "	885	455	920	440	+ 35	- 15
00021	" "	827	425	830	410	+ 3	- 15
00022	" "	748	420	790	440	+ 42	+ 20
00023	" "	718	495	883	455	+165	- 40
00024	" "	815	440	890	425	+ 75	- 15
00025	" "	775	392	758	380	- 15	- 12
00026	" "	732	445	830	425	+ 98	- 20
00027	" "	610	340	645	352	+ 35	+ 12
00028	" "	Abort	410	Abort	440	-	+ 30
00029	" "	825	435	707	390	-118	- 45
00030	" "	812	438	805	460	- 7	+ 22
00031	" "	560	330	623	352	+ 63	+ 22
00032	" "	837	455	845	455	+ 8	0
00033	" "	585	387	835	420	+251	+ 33
00034	" "	848	367	826	530	- 22	+163
00035	" "	840	480	925	547	+ 85	+ 67
00036	" "	610	330	Abort	355	-	+ 25
00037	" "	665	310	638	300	- 27	- 10
00038	" "	792	400	880	428	+ 88	+ 28
00039	" "	745	520	798	530	+ 53	+ 10
00040	" "	975	485	1045	545	+ 70	+ 60

TABLE 4.6-1

AESi
AUTOMOTIVE ENVIRONMENTAL SYSTEMS, INC.

CAR NO.	LOCATION OF TEMP. CHECK	DIST. VACUUM CONNECTED GRAPEVINE (°F)	DIST. VACUUM CONNECTED STOP & GO (°F)	DIST. VACUUM DISCONNECTED GRAPEVINE (°F)	DIST. VACUUM DISCONNECTED STOP & GO (°F)	△T GRAPEVINE (°F)	△T STOP & GO (°F)
00041	Exhaust Outlet	600	365	658	360	+ 58	- 5
00042	" "	738	300	685	305	- 53	+ 5
00043	" "	872	480	890	500	+ 18	+ 20
00044	" "	765	370	775	415	+ 10	+ 45
00045	" "	705	368	755	410	+ 50	+ 42
00046	" "	882	485	925	523	+ 43	+ 38
00047	" "	708	400	738	435	+ 30	+ 35
00048	" "	883	395	890	395	+ 7	0
00049	" "	955	455	915	465	- 40	+ 10
00050	" "	882	359	930	440	+ 48	+ 81
00051	" "	850	462	905	530	+ 55	+ 70
00052	" "	722	495	818	500	+ 96	+ 5
00053	" "	850	485	885	538	+ 35	+ 53
00054	" "	863	420	845	420	-	0
00055	" "	Abort	380	Abort	365	-	- 15
00056	" "	1105	659	1080	638	- 25	- 21
00057	" "	779	560	963	598	+184	+ 38
00058	" "	680	405	740	420	+ 60	+ 15
00059	" "	900	478	897	466	- 3	- 12
00060	" "	862	375	922	435	+ 60	+ 60
00061	" "	790	380	Abort	440	-	+ 60
00062	" "	890	415	935	440	+ 45	+ 25
00063	" "	930	450	925	500	- 5	+ 50
00064	" "	865	480	1000	520	+135	+ 40
00065	" "	Abort	470	Abort	590	-	+120
00066	" "	Abort	495	Abort	515	-	+ 20
00067	" "	875	480	950	550	+ 75	+ 70
00068	" "	920	440	975	545	+ 55	+105
00069	" "	800	410	795	430	- 5	+ 20
00070	" "	Abort	620	Abort	678	-	+ 58
00071	" "	920	455	980	540	+ 60	+ 85
00072	" "	Abort	420	Abort	440	-	+ 20
00073	" "	965	460	965	465	0	+ 5
00074	" "	680	380	Abort	365	-	- 15
00075(Orig)	" "	740	525	740	360	0	-165
00075(Repl)	" "	790	355	800	365	+ 10	+ 10
00076	" "	Abort	460	Abort	483	-	+ 23
00077(Orig)	" "	715	560	Abort	565	-	+ 5
00077(Repl)	" "	925	592	995	545	+ 70	- 47
00078	" "	Abort	410	Abort	395	-	- 15

TABLE 4.6-1
(Continued)

AESi
AUTOMOTIVE ENVIRONMENTAL SYSTEMS, INC.

CAR NO.	LOCATION OF TEMP. CHECK	DIST. VACUUM CONNECTED GRAPEVINE (°F)	DIST. VACUUM CONNECTED STOP & GO (°F)	DIST. VACUUM DISCONNECTED GRAPEVINE (°F)	DIST. VACUUM DISCONNECTED STOP & GO (°F)	△T GRAPEVINE (°F)	△T STOP & GO (°F)
00079	Exhaust Outlet	Abort	510	Abort	490	-	- 20
00080	" "	Abort	330	Abort	315	-	- 15
00081	" "	Abort	385	Abort	460	-	+ 75
00082	" "	Abort	590	Abort	405	-	-185
00083(Orig)	" "	895	455	Abort	497	-	+ 42
00083(Repl)	" "	895	425	Abort	490	-	+ 65
00084	" "	785	375	830	410	+45	+ 35
00085(Orig)	" "	Abort	393	Abort	390	-	- 3
00085 (Repl)	" "	Abort	400	Abort	380	-	- 20
00086	" "	Abort	385	Abort	420	-	+ 35
00087	" "	682	350	Abort	358	-	+ 8
00088	" "	895	440	870	545	-25	+105
00089	" "	Abort	510	Abort	540	-	+ 30
00090	" "	705	375	768	385	+63	+ 10
00091	" "	920	347	980	445	+60	+ 98
00092	" "	935	477	938	510	+ 3	+ 33
00093	" "	825	415	840	422	+15	+ 7
00094	" "	1092	445	1045	475	-47	+ 30
00095	" "	Abort	Abort	Abort	Abort	-	---
00096	" "	Abort	Abort	Abort	Abort	-	---
00097	" "	960	360	Abort	370	-	+ 10
00098	" "	Abort	445	Abort	430	-	- 15
00099	" "	Abort	450	Abort	480	-	+ 30
00100	" "	845	400	880	440	+35	+ 40

TABLE 4.6-1
(Continued)

AESi
AUTOMOTIVE ENVIRONMENTAL SYSTEMS, INC.

EFFECT OF VACUUM ADVANCE ON TEMPERATURE

CAR NO.	LOCATION OF TEMP. CHECK	DIST. VACUUM CONNECTED GRAPEVINE (°F)	DIST. VACUUM CONNECTED STOP & GO (°F)	DIST. VACUUM DISCONNECTED GRAPEVINE (°F)	DIST. VACUUM DISCONNECTED STOP & GO (°F)	△T GRAPEVINE (°F)	△T STOP & GO (°F)
00001	Grill	100	97	97	95		
	Eng. Outlet	235	230	235	225	0	- 5
00002	Grill	97	90	92	95		
	Eng. Outlet	240	230	255	242	+15	+12
00003	Grill	95	98	98	95		
	Eng. Outlet	230	218	240	220	+10	+ 2
00004	Grill	Abort	98	Abort	105		
	Eng. Outlet	Abort	235	Abort	240	--	+ 5
00005	Grill	95	95	95	95		
	Eng. Outlet	210	210	220	220	+10	+10
00006	Grill	100	95	98	97		
	Eng. Outlet	281	225	272	240	- 9	+15
00007	Grill	103	95	95	98		
	Eng. Outlet	270	225	260	238	-10	+13
00008	Grill	95	97	100	95		
	Eng. Outlet	230	230	233	225	+ 3	- 5
00009	Grill	Abort	95	98	95		
	Eng. Outlet	Abort	190	240	195	--	+ 5
00010	Grill	Abort	98	Abort	98		
	Eng. Outlet	Abort	218	Abort	222	--	+ 4
00011	Grill	105	100	100	105		
	Eng. Outlet	255	195	220	198	-35	+ 3
00012	Grill	101	100	100	98		
	Eng. Outlet	225	210	233	202	+ 8	- 8
00013	Grill	99	100	100	95		
	Eng. Outlet	240	205	235	205	- 5	0
00014	Grill	100	102	100	100		
	Eng. Outlet	233	200	238	210	+ 5	+10

TABLE 4.6-2

AESi
AUTOMOTIVE ENVIRONMENTAL SYSTEMS, INC.

CAR NO.	LOCATION OF TEMP. CHECK	DIST. VACUUM CONNECTED GRAPEVINE (°F)	DIST. VACUUM CONNECTED STOP & GO (°F)	DIST. VACUUM DISCONNECTED GRAPEVINE (°F)	DIST. VACUUM DISCONNECTED STOP & GO (°F)	ΔT GRAPEVINE (°F)	ΔT STOP & GO (°F)
00015	Grill	102	100	100	99		
	Eng. Outlet	217	200	200	198	-17	- 2
00016	Grill	101	100	100	95		
	Eng. Outlet	225	205	222	203	- 3	- 2
00017	Grill	103	98	101	100		
	Eng. Outlet	217	198	224	201	+ 7	+ 3
00018	Grill	110	100	100	99		
	Eng. Outlet	220	200	218	201	- 2	+ 1
00019	Grill	100	100	100	93		
	Eng. Outlet	218	183	208	185	-10	+ 2
00020	Grill	100	98	98	99		
	Eng. Outlet	224	215	235	205	+11	-10
00021	Grill	101	98	100	98		
	Eng. Outlet	221	195	222	196	+ 1	+ 1
00022	Grill	102	98	101	100		
	Eng. Outlet	227	210	225	212	- 2	+ 2
00023	Grill	100	100	102	100		
	Eng. Outlet	210	200	210	200	0	0
00024	Grill	100	97	100	97		
	Eng. Outlet	240	220	260	220	+20	0
00025	Grill	101	102	103	100		
	Eng. Outlet	230	202	223	200	- 7	- 2
00026	Grill	99	95	101	100		
	Eng. Outlet	220	209	235	218	+15	+ 9
00027	Grill	110	100	100	100		
	Eng. Outlet	222	200	221	200	- 1	0
00028	Grill	Abort	100	Abort	99		
	Eng. Outlet	Abort	225	Abort	230	--	+ 5

TABLE 4.6-2
(Continued)

AESi
AUTOMOTIVE ENVIRONMENTAL SYSTEMS, INC.

CAR NO.	LOCATION OF TEMP. CHECK	DIST. VACUUM CONNECTED GRAPEVINE (°F)	DIST. VACUUM CONNECTED STOP & GO (°F)	DIST. VACUUM DISCONNECTED GRAPEVINE (°F)	DIST. VACUUM DISCONNECTED STOP & GO (°F)	ΔT GRAPEVINE (°F)	ΔT STOP & GO (°F)
00029	Grill	105	101	100	102		
	Eng. Outlet	210	200	217	195	+ 7	- 5
00030	Grill	104	100	101	103		
	Eng. Outlet	190	169	192	175	+ 2	+ 6
00031	Grill	100	100	100	100		
	Eng. Outlet	218	210	218	220	0	+10
00032	Grill	104	104	100	100		
	Eng. Outlet	226	204	227	205	+ 1	+ 1
00033	Grill	101	100	102	101		
	Eng. Outlet	218	200	227	204	+ 9	+ 4
00034	Grill	100	99	102	102		
	Eng. Outlet	239	218	243	218	+ 5	0
00035	Grill	102	100	101	100		
	Eng. Outlet	230	202	230	208	0	+ 6
00036	Grill	Abort	100	Abort	99		
	Eng. Outlet	Abort	203	Abort	204	--	+ 1
00037	Grill	100	97	97	96		
	Eng. Outlet	218	200	205	193	-13	- 7
00038	Grill	100	100	102	97		
	Eng. Outlet	218	205	220	200	+ 2	- 5
00039	Grill	103	100	100	104		
	Eng. Outlet	219	200	217	195	- 2	- 5
00040	Grill	102	103	102	102		
	Eng. Outlet	221	205	228	220	+ 7	+15
00041	Grill	100	98	103	98		
	Eng. Outlet	227	215	230	210	+ 3	- 5

TABLE 4.6-2
(Continued)

AESi
AUTOMOTIVE ENVIRONMENTAL SYSTEMS, INC.

CAR NO.	LOCATION OF TEMP. CHECK	DIST. VACUUM CONNECTED GRAPEVINE (°F)	DIST. VACUUM CONNECTED STOP & GO (°F)	DIST. VACUUM DISCONNECTED GRAPEVINE (°F)	DIST. VACUUM DISCONNECTED STOP & GO (°F)	Δ T GRAPEVINE (°F)	Δ T STOP & GO (°F)
00042	Grill	100	100	97	98		
	Eng. Outlet	218	204	220	210	+ 2	+ 6
00043	Grill	100	100	103	100		
	Eng. Outlet	225	200	240	200	+15	0
00044	Grill	100	100	100	100		
	Eng. Outlet	254	220	245	225	- 9	+ 5
00045	Grill	100	98	100	100		
	Eng. Outlet	230	213	240	220	+10	+ 7
00046	Grill	100	98	100	100		
	Eng. Outlet	230	205	232	215	+ 2	+10
00047	Grill	100	105	110	110		
	Eng. Outlet	220	190	220	205	0	+15
00048	Grill	100	100	102	100		
	Eng. Outlet	213	190	215	192	+ 2	+ 2
00049	Grill	100	98	100	100		
	Eng. Outlet	230	215	255	217	+25	+ 2
00050	Grill	100	100	100	100		
	Eng. Outlet	217	200	220	202	+ 3	+ 2
00051	Grill	105	98	100	100		
	Eng. Outlet	220	200	220	215	0	+15
00052	Grill	110	110	102	105		
	Eng. Outlet	220	210	225	215	+ 5	+ 5
00053	Grill	100	100	102	100		
	Eng. Outlet	215	200	215	210	0	+10
00054	Grill	105	105	105	100		
	Eng. Outlet	230	200	230	200	0	0

TABLE 4.6-2
(Continued)

AESi
AUTOMOTIVE ENVIRONMENTAL SYSTEMS, INC.

CAR NO.	LOCATION OF TEMP. CHECK	DIST. VACUUM CONNECTED GRAPEVINE (°F)	DIST. VACUUM CONNECTED STOP & GO (°F)	DIST. VACUUM DISCONNECTED GRAPEVINE (°F)	DIST. VACUUM DISCONNECTED STOP & GO (°F)	ΔT GRAPEVINE (°F)	ΔT STOP & GO (°F)
00055	Grill	Abort	105	Abort	100		
	Eng. Outlet	Abort	225	Abort	225	--	0
00056	Grill	115	100	108	100		
	Eng. Outlet	230	220	230	220	0	0
00057	Grill	110	100	103	100		
	Eng. Outlet	217	200	210	203	- 7	+ 3
00058	Grill	105	104	108	105		
	Eng. Outlet	230	200	228	200	- 2	0
00059	Grill	100	99	105	100		
	Eng. Outlet	220	180	220	185	0	+ 5
00060	Grill	102	98	100	100		
	Eng. Outlet	238	200	238	210	0	+10
00061	Grill	100	100	Abort	100		
	Eng. Outlet	230	202	Abort	200	+ 5	- 2
00062	Grill	102	98	100	98		
	Eng. Outlet	200	190	205	195	+ 5	+ 5
00063	Grill	100	100	102	100		
	Eng. Outlet	242	195	230	195	-12	0
00064	Grill	102	100	100	97		
	Eng. Outlet	235	215	245	220	+10	+ 5
00065	Grill	Abort	100	Abort	102		
	Eng. Outlet	Abort	228	Abort	238	--	+10
00066	Grill	Abort	100	Abort	100		
	Eng. Outlet	Abort	205	Abort	205	--	0
00067	Grill	100	100	100	100		
	Eng. Outlet	222	200	240	210	-18	+10
00068	Grill	100	95	100	100		
	Eng. Outlet	223	190	230	210	+ 7	+20

TABLE 4.6-2
(Continued)

AESi
AUTOMOTIVE ENVIRONMENTAL SYSTEMS, INC.

CAR NO.	LOCATION OF TEMP. CHECK	DIST. VACUUM CONNECTED GRAPEVINE (°F)	DIST. VACUUM CONNECTED STOP & GO (°F)	DIST. VACUUM DISCONNECTED GRAPEVINE (°F)	DIST. VACUUM DISCONNECTED STOP & GO (°F)	△T GRAPEVINE (°F)	△T STOP & GO (°F)
00069	Grill	97	100	100	100		
	Eng. Outlet	220	194	220	200	0	+ 6
00070	Grill	Abort	100	Abort	100		
	Eng. Outlet	Abort	218	Abort	232	--	-14
00071	Grill	100	103	105	100		
	Eng. Outlet	240	222	262	240	+22	+18
00072	Grill	Abort	102	Abort	100		
	Eng. Outlet	Abort	215	Abort	218	--	+ 3
00073	Grill	100	100	100	100		
	Eng. Outlet	218	220	220	205	+ 2	-15
00074	Grill	100	104	Abort	100		
	Eng. Outlet	230	238	Abort	237	--	- 1
00075	Grill	100	105	100	105		
(Orig.)	Eng. Outlet	240	220	250	225	+10	+ 5
00075	Grill	100	103	100	105		
(Repl.)	Eng. Outlet	238	220	242	218	+ 4	- 2
00076	Grill	Abort	100	Abort	100		
	Eng. Outlet	Abort	215	Abort	205	--	-10
00077	Grill	100	105	Abort	105		
(Orig.)	Eng. Outlet	220	195	Abort	190	--	- 5
00077	Grill	98	100	97	100		
(Repl.)	Eng. Outlet	235	217	245	215	+10	- 2
00078	Grill	Abort	100	Abort	100		
	Eng. Outlet	Abort	217	Abort	215	--	- 2
00079	Grill	Abort	100	Abort	105		
	Eng. Outlet	Abort	215	Abort	210	--	- 5
00080	Grill	Abort	104	Abort	105		
	Eng. Outlet	Abort	213	Abort	210	--	- 3

TABLE 4.6-2
(Continued)

AESi
AUTOMOTIVE ENVIRONMENTAL SYSTEMS, INC.

CAR NO.	LOCATION OF TEMP. CHECK	DIST. VACUUM CONNECTED GRAPEVINE (°F)	DIST. VACUUM CONNECTED STOP & GO (°F)	DIST. VACUUM DISCONNECTED GRAPEVINE (°F)	DIST. VACUUM DISCONNECTED STOP & GO (°F)	ΔT GRAPEVINE (°F)	ΔT STOP & GO (°F)
00081	Grill	Abort	100	Abort	100		
	Eng. Outlet	Abort	160	Abort	160	--	0
00082	Grill	Abort	100	Abort	100		
	Eng. Outlet	Abort	190	Abort	190	--	0
00083	Grill	97	97	Abort	100		
(Orig.)	Eng. Outlet	237	200	Abort	220	--	+20
00083	Grill	100	100	Abort	100		
(Repl.)	Eng. Outlet	240	218	Abort	220	--	+ 2
00084	Grill	105	100	100	100		
	Eng. Outlet	245	215	215	218	-30	+ 3
00085	Grill	Abort	100	Abort	100		
(Orig.)	Eng. Outlet	Abort	200	Abort	200	--	0
00085	Grill	Abort	98	Abort	100		
(Repl.)	Eng. Outlet	Abort	200	Abort	200	--	0
00086	Grill	Abort	100	Abort	100		
	Eng. Outlet	Abort	220	Abort	220	--	0
00087	Grill	100	100	Abort	100		
	Eng. Outlet	225	200	Abort	208	--	+ 8
00088	Grill	100	100	100	100		
	Eng. Outlet	225	215	207	230	-18	+15
00089	Grill	Abort	100	Abort	100		
	Eng. Outlet	Abort	215	Abort	210	--	- 5
00090	Grill	105	100	98	100		
	Eng. Outlet	225	200	225	200	0	0
00091	Grill	100	100	105	102		
	Eng. Outlet	230	195	232	230	+ 2	+35
00092	Grill	100	100	100	100		
	Eng. Outlet	210	208	217	218	+ 7	+10
00093	Grill	100	95	100	100		
	Eng. Outlet	218	195	205	195	-13	0

TABLE 4.6-2
(Continued)

AESi
AUTOMOTIVE ENVIRONMENTAL SYSTEMS, INC.

CAR NO.	LOCATION OF TEMP. CHECK	DIST. VACUUM CONNECTED GRAPEVINE (°F)	DIST. VACUUM CONNECTED STOP & GO (°F)	DIST. VACUUM DISCONNECTED GRAPEVINE (°F)	DIST. VACUUM DISCONNECTED STOP & GO (°F)	ΔT GRAPEVINE (°F)	ΔT STOP & GO (°F)
00094	Grill	100	100	95	100		
	Eng. Outlet	240	225	245	230	+ 5	+ 5
00095	Grill	Abort	Abort	Abort	Abort		
	Eng. Outlet	Abort	Abort	Abort	Abort	--	--
00096	Grill	Abort	Abort	Abort	Abort		
	Eng. Outlet	Abort	Abort	Abort	Abort	--	--
00097	Grill	100	100	Abort	100		
	Eng. Outlet	235	200	Abort	200	--	0
00098	Grill	Abort	100	Abort	100		
	Eng. Outlet	Abort	225	Abort	218	--	- 7
00099	Grill	Abort	100	Abort	100		
	Eng. Outlet	Abort	235	Abort	240	--	+ 5
00100	Grill	100	100	100	100		
	Eng. Outlet	225	208	242	220	+17	+12

TABLE 4.6-2
(Continued)

AESi
AUTOMOTIVE ENVIRONMENTAL SYSTEMS, INC.

AIR CLEANER INLET TEMPERATURE

CAR NO.	LOCATION OF TEMP. CHECK	DIST. VACUUM CONNECTED GRAPEVINE (°F)	DIST. VACUUM CONNECTED STOP & GO (°F)	DIST. VACUUM DISCONNECTED GRAPEVINE (°F)	DIST. VACUUM DISCONNECTED STOP & GO (°F)	△T GRAPEVINE (°F)	△T STOP & GO (°F)
00001	Air Cleaner	155	140	145	140	-10	0
00002	" "	125	115	140	120	+15	+ 5
00003	" "	125	110	130	105	+ 5	- 5
00004	" "	Abort	120	Abort	132	--	+12
00005	" "	153	138	152	135	- 1	- 3
00006	" "	150	130	155	135	+ 5	+ 5
00007	" "	155	130	145	137	-10	+ 7
00008	" "	145	155	160	145	+15	-10
00009	" "	Abort	145	170	145	--	0
00010	" "	Abort	115	Abort	117	--	+ 2
00011	" "	190	140	170	147	-20	+ 7
00012	" "	137	135	140	137	+ 3	+ 2
00013	" "	125	115	125	110	0	- 5
00014	" "	160	140	160	167	0	+27
00015	" "	165	155	156	115	- 9	-40
00016	" "	125	115	125	100	0	-15
00017	" "	175	122	180	130	+ 5	+ 8
00018	" "	140	125	140	125	0	0
00019	" "	115	105	110	100	- 5	- 5
00020	" "	130	120	135	120	+ 5	0
00021	" "	140	140	150	140	+10	0
00022	" "	120	100	120	105	0	+ 5
00023	" "	124	115	119	116	- 5	+ 1
00024	" "	160	139	160	135	0	- 4
00025	" "	133	123	135	122	+ 2	- 1
00026	" "	100	96	100	100	0	+ 4
00027	" "	130	120	130	120	0	0
00028	" "	Abort	125	Abort	130	--	+ 5
00029	" "	130	127	135	120	+ 5	- 7
00030	" "	100	95	100	100	0	+ 5
00031	" "	145	135	152	126	+ 7	- 9
00032	" "	125	117	115	116	-10	- 1
00033	" "	140	135	150	136	+10	+ 1
00034	" "	115	100	118	105	+ 3	+ 5
00035	" "	120	110	125	110	+ 5	0
00036	" "	120	132	Abort	110	--	-22
00037	" "	115	125	115	124	0	- 1
00038	" "	114	120	124	115	+10	- 5
00039	" "	118	115	118	119	0	+ 4
00040	" "	145	118	155	125	+10	+ 7
00041	" "	113	100	115	110	+ 2	+10

TABLE 4.6-3

AESi
AUTOMOTIVE ENVIRONMENTAL SYSTEMS, INC.

AIR CLEANER INLET TEMPERATURE

CAR NO.	LOCATION OF TEMP. CHECK	DIST. VACUUM CONNECTED GRAPEVINE (°F)	DIST. VACUUM CONNECTED STOP & GO (°F)	DIST. VACUUM DISCONNECTED GRAPEVINE (°F)	DIST. VACUUM DISCONNECTED STOP & GO (°F)	△T GRAPEVINE (°F)	△T STOP & GO (°F)
00042	Air Cleaner	130	129	133	125	+ 3	- 4
00043	" "	130	138	139	132	+ 9	- 6
00044	" "	140	119	140	113	0	- 6
00045	" "	139	124	137	138	- 2	+14
00046	" "	160	134	160	140	0	+ 6
00047	" "	160	145	165	160	+ 5	+15
00048	" "	138	115	140	120	+ 2	+ 5
00049	" "	125	120	140	125	+15	+ 5
00050	" "	145	115	145	115	0	0
00051	" "	160	150	160	158	0	+ 8
00052	" "	140	126	143	136	+ 3	+10
00053	" "	125	110	130	110	+ 5	0
00054	" "	143	135	140	130	- 3	- 5
00055	" "	Abort	138	Abort	155	--	+17
00056	" "	105	105	120	105	+15	0
00057	" "	142	124	140	122	- 2	- 2
00058	" "	150	130	149	130	- 1	0
00059	" "	100	99	105	100	+ 5	+ 1
00060	" "	142	122	140	125	- 2	+ 3
00061	" "	130	110	Abort	110	--	0
00062	" "	130	110	130	105	0	- 5
00063	" "	138	120	150	125	+12	+ 5
00064	" "	145	120	150	120	+ 5	0
00065	" "	Abort	110	Abort	115	--	+ 5
00066	" "	Abort	130	Abort	130	--	0
00067	" "	122	115	125	110	+ 3	- 5
00068	" "	139	120	150	130	+11	+10
00069	" "	100	100	100	100	0	0
00070	" "	Abort	122	Abort	130	--	+ 8
00071	" "	190	180	200	200	+10	+20
00072	" "	Abort	118	Abort	110	--	- 8
00073	" "	170	160	175	162	+ 5	+ 2
00074	" "	145	140	Abort	140	--	0
00075	Orig" "	145	150	155	155	+10	+ 5
00075	Repl" "	140	132	146	132	+ 6	0
00076	" "	Abort	115	Abort	125	--	+10
00077	Orig" "	135	125	Abort	125	--	0
00077	Repl" "	127	120	130	115	+ 3	- 5
00078	" "	Abort	115	Abort	110	--	- 5

TABLE 4.6-3
(Continued)

AESi
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AIR CLEANER INLET TEMPERATURE

CAR NO.	LOCATION OF TEMP. CHECK	DIST. VACUUM CONNECTED GRAPEVINE (°F)	DIST. VACUUM CONNECTED STOP & GO (°F)	DIST. VACUUM DISCONNECTED GRAPEVINE (°F)	DIST. VACUUM DISCONNECTED STOP & GO (°F)	ΔT GRAPEVINE (°F)	ΔT STOP & GO (°F)
00079	Air Cleaner	Abort	124	Abort	130	--	+ 6
00080	" "	Abort	119	Abort	120	--	+ 1
00081	" "	Abort	140	Abort	140	--	0
00082	" "	Abort	115	Abort	115	--	0
00083Orig	" "	160	135	Abort	147	--	+12
00083Repl	" "	165	140	Abort	150	--	+10
00084	" "	130	115	112	130	-18	+15
00085Orig	" "	Abort	110	Abort	106	--	- 4
00085Repl	" "	Abort	100	Abort	100	--	0
00086	" "	Abort	135	Abort	135	--	0
00087	" "	145	120	Abort	120	--	0
00088	" "	150	125	150	145	0	+20
00089	" "	Abort	140	Abort	140	--	0
00090	" "	155	145	158	150	+ 3	+ 5
00091	" "	145	118	145	120	0	+ 2
00092	" "	130	118	138	115	+ 8	- 3
00093	" "	148	120	145	118	- 3	- 2
00094	" "	150	140	155	145	+ 5	+ 5
00095	" "	Abort	Abort	Abort	Abort	--	--
00096	" "	Abort	Abort	Abort	Abort	--	--
00097	" "	108	100	Abort	100	--	0
00098	" "	Abort	140	Abort	135	--	- 5
00099	" "	Abort	118	Abort	118	--	0
00100	" "	145	140	150	140	+ 5	0

TABLE 4.6-3
(Continued)

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4.7 DRIVEABILITY TEST RESULTS

Driveability evaluation is highly subjective in nature. To attempt to quantify this characteristic, a demerit system was developed whereby from 0 to 5 demerits were assigned for each of the major sections of the driveability tests, with the criteria being as follows:

For satisfactory performance	0 points
For trace of malfunction	1 point
For moderate malfunction	2 points
For severe malfunction	3 points
For stall or backfire	5 points

The driveability test procedure, instructions and forms are presented in Figure 4.7-1.

Driveability was also evaluated on the basis of the number of attempts made to start the car, the total starting time, the elapsed time from 0 to 70 mph, and the customer's opinion of the vehicle. Each vehicle owner was asked to complete a questionnaire (Figure 4.7-2) after driving the car for one week with the vacuum spark advance disconnected. Regarding the customer's opinion, AESi categorized the response into three areas: no noticeable difference; improvement; deterioration; as a result of VSAD. The table below summarizes the results of the driveability evaluation.

Item		Before VSAD	After VSAD
Total demerit points, all vehicles		1512	1595
Total start attempts, all vehicles		118	117
Total start time, all vehicles		165.4	217.6
Customer Opinion:	No difference	-	73
	Improvement	-	1
	Deterioration	-	26

Table 4.7-1 presents the driveability results for each vehicle. As may be seen from the quantifiable aspects of the driveability evaluation, the total demerit points and the customer opinion indicators suggest that VSAD results in a slight deterioration in driveability.

Replicate tests on four vehicles were performed to determine overall test repeatability. These tests show that a high level of overall repeatability was being attained.

Two Volkswagen vehicles were tested, one a 1500 CC Fastback Car Number 95, and one a normal "Beetle" Car Number 96. Both vehicles had only vacuum controlled spark advance mechanisms (no centrifugal advance system), and were highly dependent on vacuum to operate satisfactorily. Both tests were aborted early in the schedule when it became obvious that the cars would not perform well enough to accomplish the driving cycles and that a severe over-temperature condition existed with vacuum spark advance disconnected.

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DRIVEABILITY TEST PROCEDURE

Introduction

The subject of vehicle drive quality is likely the most subjective test procedure applied to vehicles. The judgement of acceptability varies from one vehicle type to another and from one model class or even model year to another. The underlying attempt in a driveability quality test is to examine all of the conditions that all of the potential consumers of the specific model might be expected to encounter. The term conditions refer to ambient, weather and operating conditions.

There is not a "go-no-go" type of test for driveability quality. In fact, the driver is the true measure of acceptability. A variety of tests constitute the final judgement of drive quality.

1. Engine start quality
   a. At all temperatures
2. Hot fuel handling characteristics or high ambient temperatures
   a. Vapor lock
   b. Percolation
   c. Accelerator pump slugging
   d. Accelerator pump "dry-out"
3. Choke performance
   a. Low ambient temperature start quality
   b. High ambient temperature start quality
   c. Loading tendency
   d. Restart quality -- following soak
4. Idle quality under all conditions
5. Warmed-up drive quality
   a. Road load surge evaluation
   b. "Crowd" evaluation
   c. Wide open throttle response
   d. Part throttle and wide open throttle "tip-in" quality

FIGURE 4.7-1

DRIVEABILITY EVALUATION

Test Procedure

I. Vehicle Preparation

A. Check coolant, oil, fuel levels, top off if necessary.
B. Park vehicle in position for drive-away.

II. Cold start and drive-away procedure

A. Prepare test data per attached sample.
B. Start engine per manufacturer's instructions in owners manual.
C. Record fast idle quality and number of stalls, if any.
D. Accelerate engine briefly and release throttle. Record idle quality and number of stalls, if any.
E. On automatic transmission vehicles, place selector in drive range. Record idle quality and number of stalls, if any.
F. Perform a normal acceleration to 25 mph, for manual transmissions, shift through a normal pattern to a high gear cruising speed of 25 mph. Accelerate at WOT from 25 mph to 35 mph, decelerate from 35 to 25 mph, accelerate 25 to 30 mph at 1/2 to 3/4 throttle, then repeat the last two sequences.
G. Note and record any unusual performance characteristics or malfunctions such as: stalls, backfires, hesitations, stumbles.
H. At 0.5 miles from the start, brake moderately to a stop. Idle for 30 seconds in drive (AT) range or with clutch disengaged (MT). Observe and record idle quality.
I. Repeat steps F, G and H through 5.0 miles from the start.

III. Safety considerations

A. In the interest of safety, all driveability studies must be conducted in accordance with applicable laws and ordinances if performed on public roads, and with regard to normal safe rules of vehicle operation at all times.
B. If major malfunctions such as loss of coolant, or loss of control systems occur, abort the test at once and take corrective action.
C. Record all deviations from established procedures with appropriate explanation.

IV. Warm vehicle driveability procedure

A. Warm up - Warm up vehicle for approximately 10 miles at freeway speeds or during cold start testing.
B. Road load operations - Operate vehicle at cruise conditions from 20 through 70 mph. Record drive quality and speed at 10 mph intervals.
C. Wide open throttle (WOT) accelerations - With automatic transmission vehicles, make the slow, moderate, and sudden WOT accelerations from 0 through 30 mph. With manual transmission vehicles, accelerate in high gear from 20 through 30 mph at WOT for indicated throttle openings. Record drive mode quality.

FIGURE 4.7-1 (Continued)

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D. Partial throttle (PT) accelerations - With automatic transmission vehicle, make the indicated accelerations from 0 through 30 mph at various constant throttle positions from very light to nearly WOT. With manual transmission vehicle these PT accelerations are to be made from 20 through 30 mph. Record drive mode quality.

E. Partial throttle crowd - "Crowds" are evaluated in high gear from 20 mph through 70 mph by accelerating at a continually increasing throttle opening. Several runs should be made varying the rate of throttle opening. Record drive mode quality.

F. Partial throttle tip-in - Evaluate "tip-in" characteristics by making several PT accelerations from 20 and 30 mph. Do not accelerate at a load which will cause the automatic transmission to down-shift. Record drive mode quality.

G. Acceleration time - Run WOT acceleration 0 to 70 mph and record time of acceleration.

H. Deceleration time - Engine coast conditions are evaluated from 70 to 30 mph at closed throttle (record time). If necessary, run in opposite directions to cancel effect of wind.

I. Soak - After the above tests have been completed. Perform three consecutive WOT accelerations from 0 through 70 mph - idle for 30 seconds. Shut off engine and soak for 15 minutes. Restart at 1/2 throttle (record time) and hold at high idle RPM for three seconds, return to idle, maintain idle for 10 seconds in neutral and, for AT, 10 seconds in drive.

Definitions of Terms Applicable to Attached Driveability Procedures

1. Road Load - A fixed throttle position which maintains a constant vehicle speed on a level road.

2. Coast - Deceleration at closed (curb idle) throttle.

3. Wide Open Throttle (WOT) Acceleration - An acceleration made entirely at wide open throttle (from any speed).

4. Part Throttle (PT) Acceleration - An acceleration made at any fixed throttle opening of the throttle.

5. Tip-In - Vehicle response (up to two seconds in duration) to the initial opening of the throttle.

6. Crowd - An acceleration made at a continually increasing throttle opening.

7. Idle Quality - An evaluation of vehicle smoothness, with the engine at curb idle in drive, as judged from the driver's seat.

8. Backfire - An explosion in the induction or exhaust system.

FIGURE 4.7-1 (Continued)

9. Hesitation - A temporary lack of initial response in acceleration rate.

10. Stumble - A short, sharp reduction in acceleration rate.

11. Lean Operation - This condition, depending on its severity, can manifest itself as outlined in the following categories:

    A. Stretchiness - A lack of anticipated response to throttle movement. This may occur on slight throttle movement from road load or during light to moderate accelerations.

    B. Surging - A condition of leanness, resulting in short, sharp fluctuations. These may be cyclic or random and can occur at any speed and/or load.

FIGURE 4.7-1 (Continued)

COLD START AND DRIVEABILITY EVALUATION DATA SHEET

Vehicle No. _____ License No. _____ Test No. _____

ate: _____ Time: Start_____ Finish_____ Odo.: Start_____ Fin_____

Vehicle	Engine	Weather	Crew
Make _____	Disp._____ Type_____	Temp: Start °F_____	Driver _____
Model _____	Nom. C.R. _____	End °F _____	Recorder _____
Year _____ _____	Carb. Mfg._____	Road Conditions:	Observer _____
Trans _____ A/C_____	Model _____	Wet _____ Dry _____	_____ _____
P/B_____ P/S_____	Choke _____	Soak Time(hrs)	

Remarks: _____

Start Time (acc.): Attempts:

Miles	Mode	Idle Satis.	Idle Rough*	Idle Stall	Accel. Satis.	Accel. Hesit.*	Accel. Stumble*	Accel. Stall	Backfire	Miles	Mode	Idle Satis.	Idle Rough*	Idle Stall	Accel. Satis.	Accel. Hesit.*	Accel. Stumble*	Accel. Stall	Accel. Lean	Backfire
Start	Hi-Cam									2.5	Idle (30 sec.)									
	Tap N										PT D/A (0-25)									
	Throttle Dr									2.6	WOT Accel (25-35)									
0	PT D/A 0-25									2.7	PT Accel (25-30)									
.2	WOT Accel(25-35)									2.8	PT Accel (25-30)									
.3	PT Accel (25-30)									2.9	PT Accel (25-30)									
.4	PT Accel (25-30)									3.0	Idle (30 sec.)									
.5	Idle (30 sec.)										PT D/ A (0-25)									
	PT D/A (0-25)									3.1	WOT Accel (25-35)									
.6	WOT Accel(25-35)									3.2	PT Accel (25-30)									
.7	PT Accel (25-30)									3.3	PT Accel (25-30)									
.8	PT Accel (25-30)									3.4	PT Accel (25-30)									
.9	PT Accel (25-30)									3.5	Idle (30 sec.)									
1.0	Idle (30 sec.)										PT D/ A 0-25									
	WOT D/A (0-25)									3.6	WOT Accel (25-35)									
1.1	WOT Accel (25-35)									3.7	PT Accel (25-30)									
1.2	PT Accel (25-30)									3.8	PT Accel (25-30)									
1.3	PT Accel (25-30)									3.9	PT Accel (25-30)									
1.4	PT Accel (25-30)									4.0	Idle(30 sec.)									
1.5	Idle (30 sec.)										PT D/A (0-25)									
	PT D/A (0-25)									4.1	WOT Accel (25-35)									
1.6	WOT Accel (25-35)									4.2	PT Accel (25-30)									
1.7	PT Accel (25-30)									4.3	PT Accel (25-30)									
1.8	PT Accel (25-30)									4.4	PT Accel (25-30)									
1.9	PT Accel (25-30)									4.5	Idle (30 sec.)									
2.0	Idle (30 sec.)										PT D/A (0-25)									
	PT D/A (0-25)									4.6	WOT Accel (25-35)									
2.1	WOT Accel 25-35)									4.7	PT Accel (25-30)									
.2	PT Accel (25-30)									4.8	PT Accel (25-30)									
.3	PT Accel (25-30)									4.9	PT Accel (25-30)									
2.4	PT Accel (25-30)									5.0	Idle (30 sec.)									

* T-Trace; M-Moderate; H-Heavy

FIGURE 4.7-1 (Continued)

WARM VEHICLE DRIVEABILITY

DATA SHEET

Vehicle No. _____

Test No. _____

		Idle			Drive Mode					
		Satisfactory	Rough	Stall	Satisfactory	Detonation	Hesitation	Stumble	Stretchiness	Backfire
Idle	N									
	D									
Road Load	20 MPH									
	30									
	40									
	50									
	60									
	70									
WOT Acc	20-30 Manual Trans 0-30 Auto Trans Sudden Throttle Opening									
	Moderate Throttle Opening									
	Slow Throttle Opening									
PT Acc	20-30 Manual Trans 0-30 Auto Trans 1/4 Throttle									
	1/2 Throttle									
	3/4 Throttle									
PT Crowd	20-70 1/4 Throttle									
	1/2 Throttle									
	3/4 Throttle									
PT Tip-In From 20 MPH	1									
	2									
From 30 MPH	1									
	2									

Acc. Time 0-70 mph (sec.) _____ SOAK (min.) _____

FIGURE 4.7-1 (Continued)

AESi
AUTOMOTIVE ENVIRONMENTAL SYSTEMS, INC.

Reply To:
14239 Hindry Avenue
Hawthorne, Calif. 90250
213 679-0123

Dear Volunteer:

Your car has been tested in a program sponsored by the California Air Resources Board. AESi has disconnected the vacuum spark advance mechanism to determine the effect on emissions of oxides of nitrogen, a harmful component of smog.

Your car may operate differently than it did before and we ask that you participate in our test by filling out a "Driveability Questionaire". You are the best judge of your own car's performance. At the end of one week, please come to the laboratory and let us reconnect the advance mechanism, (it will take only five minutes of your time) and fill out the simple questionaire.

Thank you for your co-operation and for your active participation in the fight against air pollution.

H. James Law, Jr.

H. James Law, Jr.
Project Manager
AESi

FIGURE 4.7-2

AESi
AUTOMOTIVE ENVIRONMENTAL SYSTEMS, INC.

DRIVEABILITY QUESTIONAIRE

How did your car behave?
Please compare it to the way it operated before AESi disconnected the vacuum spark advance.

Operation:	Check a Box:			
1. Cold Starting	Good☐	Fair☐	Hard☐	
2. Warmed up Starting	Good☐	Fair☐	Hard☐	
3. City Traffic				
a. Idle	Good☐	Stalls☐	Too Fast☐	Too Slow☐
b. Stop-start	Good☐	Stalls☐	Hesitates☐	
c. Cruise 20-30 MPH	Good☐	Surges☐	Sluggish☐	
4. Freeway Driving				
a. Stop-go Traffic	Good☐	Surges☐	Sluggish☐	
b. Normal 60-65 MPH	Good☐	Surges☐	No Speed☐	
5. Engine Indicators				
a. Does the hot light come on?	Yes☐	No☐		
b. Does the oil light come on?	Yes☐	No☐		

Tell us anything else you noticed.

_____

_____

_____

_____

_____

_____

Thank you on behalf of AESi and the State of California for your participation in this very important anti-smog testing program.

FIGURE 4.7-2 (Continued)

DRIVEABILITY

VEHICLE NO.	VACUUM ADVANCE CONNECTED				VACUUM ADVANCE DISCONNECTED				CUSTOMER OPINION
	DEMERIT POINTS	START ATTEMPTS	TOTAL START TIME	ELAPSED TIME 0-70 MPH	DEMERIT POINTS	START ATTEMPTS	START TIME	ELAPSED TIME 0-70 MPH	
1	15	1	2.2	14.5	11	1	1.0	13.0	No Difference
2	32	1	1.0	13.3	54	1	0.8	14.5	Good
3	88	4	14.0	14.4	46	2	8.0	14.5	No Difference
4	54	1	1.0	23.5	39	2	5.0	23.5	Slow Response
5	39	1	1.0	15.0	27	1	1.0	15.0	Vibrates
6	63	1	1.0	17.0	121	1	1.0	15.2	No Difference
7	26	1	1.0	16.2	18	1	1.2	16.0	No Difference
8	20	2	8.0	11.0	50	4	60.0	10.4	No Difference
9	54	2	1.5	15.0	70	5	6.0	15.0	Fair
10	20	2	1.5	20.5	20	1	1.0	16.7	No Difference
11	10	1	1.5	15.2	6	1	1.0	16.0	Improvement
12	20	1	1.0	14.0	29	1	1.0	14.2	Rough Idle
13	10	1	1.0	15.5	18	1	1.0	16.0	No Difference
14	36	1	1.5	11.5	17	1	3.0	10.5	No Difference
15	53	1	1.7	9.7	43	1	0.5	9.3	No Difference
16	15	1	1.2	15.2	13	1	0.9	15.5	Bad Surge
17	46	2	3.5	21.1	49	1	1.2	18.1	No Difference
18	8	3	7.0	12.6	4	4	12.0	12.3	Hard Start
19	3	1	2.0	24.5	2	1	2.0	24.0	No Difference
20	1	2	5.0	14.7	3	1	3.0	14.1	Sluggish
21	3	1	1.0	15.2	4	1	4.0	16.4	Bad Mileage

TABLE 4.7-1

DRIVEABILITY

VEHICLE NO.	VACUUM ADVANCE CONNECTED				VACUUM ADVANCE DISCONNECTED				CUSTOMER OPINION
	DEMERIT POINTS	START ATTEMPTS	TOTAL START TIME	ELAPSED TIME 0-70 MPH	DEMERIT POINTS	START ATTEMPTS	START TIME	ELAPSED TIME 0-70 MPH	
22	4	1	1.0	13.8	0	1	1.0	13.5	No Difference
23	82	2	3.0	18.7	31	2	4.0	18.3	No Difference
24	4	1	1.0	14.0	5	1	1.0	14.2	No Difference
25	26	1	1.8	13.2	16	1	1.3	14.0	No Difference
26	0	1	1.0	14.5	0	1	1.0	13.9	No Difference
27	52	1	1.0	16.3	50	1	1.0	16.0	No Difference
28	2	1	2.0	14.9	0	1	2.0	14.8	Hard Start
29	0	1	1.0	12.8	0	1	1.0	13.8	No Difference
30	0	1	1.0	17.0	0	1	1.0	17.0	No Difference
31	0	1	1.0	11.6	12	2	2.2	10.8	No Difference
32	0	1	1.0	14.0	0	1	1.0	14.0	No Difference
33	7	1	1.0	10.8	4	1	1.0	16.6	No Difference
34	0	1	1.0	18.0	0	1	1.0	17.8	No Difference
35	0	1	1.0	14.0	0	1	1.0	15.0	Poor Power
36	1	1	1.0	8.4	0	1	0.8	8.4	No Difference
37	10	1	1.0	13.6	11	1	1.2	13.8	No Difference
38	0	1	1.0	16.0	0	1	1.0	16.0	Hard Start
39	0	2	3.0	17.0	0	1	2.0	17.0	No Difference
40	166	1	1.0	19.2	184	1	1.5	20.3	No Difference
41	1	1	1.0	12.0	0	1	1.0	12.5	No Difference
42	35	1	1.0	17.0	83	1	1.0	16.8	No Difference
43	0	1	1.0	19.0	0	1	1.0	19.0	No Difference

TABLE 4.7-1
(Continued)

DRIVEABILITY

VEHICLE NO.	VACUUM ADVANCE CONNECTED				VACUUM ADVANCE DISCONNECTED				CUSTOMER OPINION
	DEMERIT POINTS	START ATTEMPTS	TOTAL START TIME	ELAPSED TIME 0-70 MPH	DEMERIT POINTS	START ATTEMPTS	START TIME	ELAPSED TIME 0-70 MPH	
44	36	1	1.0	19.0	36	1	1.0	19.2	No Difference
45	15	4	5.0	15.0	10	2	3.0	16.0	No Difference
46	34	1	1.0	16.0	28	1	1.0	17.0	Hard Start
47	15	1	1.0	14.0	16	1	1.0	14.2	No Difference
48	22	2	4.0	14.2	30	1	1.0	14.4	No Difference
49	51	2	7.0	17.0	45	2	6.0	18.0	Hard Start
50	1	1	1.0	14.2	8	1	1.0	15.0	No Difference
51	26	2	4.0	16.0	21	2	3.0	17.0	Less Accel Power
52	0	1	1.0	13.3	0	1	1.0	13.4	No Difference
53	0	1	1.0	18.6	0	1	1.0	18.0	No Difference
54	6	1	1.0	17.0	10	1	1.0	17.0	No Difference
55	0	1	1.0	15.2	0	1	1.0	18.0	No Difference
56	0	1	1.0	17.0	0	1	1.0	17.2	No Difference
57	20	1	1.0	13.2	6	1	1.0	13.4	No Difference
58	1	1	1.0	17.0	0	1	1.0	17.2	No Difference
59	0	1	1.0	19.0	0	2	4.0	19.2	No Difference
60	7	1	1.0	18.6	7	1	1.0	18.9	No Difference
61	24	1	4.0	13.2	5	1	2.0	12.4	No Difference
62	7	2	3.0	19.1	8	2	4.0	18.0	No Difference

TABLE 4.7-1
(Continued)

DRIVEABILITY

	VACUUM ADVANCE CONNECTED				VACUUM ADVANCE DISCONNECTED				
VEHICLE NO.	DEMERIT POINTS	START ATTEMPTS	TOTAL START TIME	ELAPSED TIME 0-70 MPH	DEMERIT POINTS	START ATTEMPTS	START TIME	ELAPSED TIME 0-70 MPH	CUSTOMER OPINION
63	10	1	1.0	14.0	3	1	1.0	13.8	No Difference
64	17	1	1.0	15.0	17	1	1.0	15.5	Bad Idle
65	0	1	1.0	21.0	0	1	1.0	22.0	Surging
66	18	1	1.0	17.5	24	1	1.0	16.2	No Difference
67	11	1	1.0	16.2	8	1	1.5	16.0	No Difference
68	0	1	1.0	14.0	0	1	1.0	13.8	No Difference
69	0	1	1.0	20.2	0	1	1.0	19.0	No Difference
70	14	1	1.0	15.0	14	1	1.0	14.0	Bad Passing Accel
71	0	1	1.0	17.1	0	1	1.0	18.2	No Difference
72	0	1	1.0	22.9	0	1	1.0	23.4	Terrible
73	7	1	1.0	19.0	5	1	1.0	18.0	No Difference
74	50	1	1.0	28.6	71	1	1.0	30.1	No Difference
75	0	2	1.0	20.0	19	1	1.0	19.0	No Difference
76	0	1	1.0	16.7	0	1	1.0	17.0	No Difference
77	0	1	1.5	30.5	16	1	1.0	31.0	No Difference
78	0	1	1.0	15.3	0	1	1.0	16.0	Less Accel Power
79	13	1	1.0	16.0	13	1	1.0	16.2	Sluggish
80	0	1	1.0	9.8	0	1	1.0	9.0	No Difference
81	0	1	1.0	17.0	19	1	2.0	16.5	Hard Start
82	0	1	1.0	13.9	1	1	1.0	14.1	No Difference

TABLE 4.7-1
(Continued)

DRIVEABILITY

VEHICLE NO.	VACUUM ADVANCE CONNECTED				VACUUM ADVANCE DISCONNECTED				CUSTOMER OPINION
	DEMERIT POINTS	START ATTEMPTS	TOTAL START TIME	ELAPSED TIME 0-70 MPH	DEMERIT POINTS	START ATTEMPTS	START TIME	ELAPSED TIME 0-70 MPH	
83	2	1	1.0	14.0	13	1	1.0	14.5	No Difference
84	0	1	1.0	14.1	0	1	1.0	18.0	No Difference
85	17	1	1.0	22.1	19	1	1.0	22.9	Terrible
86	4	1	1.0	19.2	3	1	1.0	20.1	Hesitates
87	0	1	1.0	10.2	0	1	1.0	9.8	No Difference
88	0	1	1.0	18.2	0	1	1.0	14.9	No Difference
89	14	1	1.0	14.0	14	1	1.0	14.0	No Difference
90	0	1	1.0	17.8	0	1	1.0	18.2	No Difference
91	0	1	1.0	18.9	0	1	1.0	16.1	No Difference
92	15	1	1.0	19.0	15	1	1.0	19.5	Bad Mileage
93	0	1	1.0	19.0	0	1	1.0	18.9	No Difference
94	0	1	1.0	19.0	0	1	1.0	20.1	No Difference
95	--	-	---	----	--	-	---	----	Won't Run
96	--	-	---	----	--	-	---	----	Won't Run
97	14	1	2.0	33.0	28	1	2.0	32.5	No Difference
98	27	1	1.0	16.2	30	1	1.0	16.5	No Difference
99	14	1	2.5	15.0	0	1	1.5	15.0	No Difference
100	0	1	1.0	16.2	0	1	1.0	17.1	No Difference

TABLE 4.7-1
(Continued)

4.8 VEHICLE STATE OF TUNE INFORMATION

After each vehicle was tested, certain state of tune information was measured and recorded. The state of tune for a given vehicle can be determined by comparing its ratings to the manufacturer's recommended settings. Table 4.8-1 presents the manufacturer's tuneup specifications by engine. Only the more common engines are presented. The tuneup items are delineated on the second page.

Table 4.8-2 presents the vehicle tuneup information recorded from each test vehicle before and after the VSAD. The idle RPM shows the engine revolutions per minute at normal idle and the D-N indicates whether the automatic transmission was in drive or neutral while the idle RPM was being measured. For vehicles with manual transmissions, the idle RPM was measured in neutral. The DWEL is the distributor cam angle in degrees. The Basic Ignition Timing and the Total Ignition Timing are expressed in degrees plus or minus center. The Basic Ignition Timing is measured at idle while the Total Timing Advance is measured at 2500 RPM. The difference ($\triangle$) between the Total Timing before and after VSAD is presented. This difference indicates the reduction in spark timing advance caused by the VSAD. The negative $\triangle$ indicates a reduction in spark timing advance. The mean difference ($\triangle$) in Total Timing for all 98 vehicles tested is -18.1° and the standard deviation is 6.57°. If the differences for the six cars with inoperative vacuum spark advance mechanisms are eliminated, the mean for the 92 remaining test vehicles is -19.3° and the standard deviation is 4.74°.

SUMMARY OF MANUFACTURERS TUNE-UP SPECIFICATIONS

	TUNE-UP ITEM*	1966	1967	1968	1969	1970	1971
AMERICAN MOTORS 232-IV-M	A	TDC	TDC	TDC	TDC	3°BTC	3°BTC
	B	575(N)	525(N)	600(N)	600(N)	600(N)	700(N) DEC. NO_x
	C	13.0-1 AF	14.0-1 AF INC. NO_x	14.0-1 AF	14.0-1 AF	14.0-1 AF	13.5-1 AF DEC. NO_x
	D	8.5-1 COMP.	8.5-1 COMP.	8.5-1 COMP.	8.5-1 COMP.	8.5-1 COMP.	TCS 8.0-1 COMP. DEC. NO_x
BUICK 300-350 2V-A	A	2.5°BTC	2.5°BTC	TDC DEC. NO_x	TDC DEC. NO_x	6°BTC INC. NO_x	4°BTC
	B	600(D)	600(D)	600(D)	600(D)	600(D)	600(D)
	C	Lean Mixture INC. NO_x	Lean Mixture INC. NO_x	Lean Mixture	Lean Mixture	Lean Mixture	Lean Mixture
	D	9.0-1 COMP.	9.0-1 COMP.	9.0-1 COMP.	9.0-1 COMP.	9.0-1 COMP.	TCS 8.5-1 COMP. DEC. NO_x
CHEVROLET 283-327-350 2V-A	A	4°BTC	4°BTC	2°BTC DEC. NO_x	2°BTC DEC. NO_x	4°BTC	6°BTC INC. NO_x
	B	600(D)	600(D)	600(D)	600(D)	600(D)	550(D)
	C	Lean Mixture	Lean Mixture	Lean Mixture	Lean Mixture	Lean Mixture	Lean Mixture
	D	9.25-1 COMP.	9.25-1 COMP.	9.25-1 COMP.	10.0-1 COMP. INC. NO_x	9.0-1 COMP. DEC. NO_x	TCS 8.5-1 COMP. DEC. NO_x
CHRYSLER 318-2V-A	A	5°ATC	5°ATC DEC. NO_x	2.5°ATC INC. NO_x	TDC INC. NO_x	TDC	TDC
	B	600(D)	600(D)	600(D)	600(D)	700(D) DEC. NO_x	700(D)
	C	Lean Mixture 14.2-1 AF Ratio	Lean Mixture 14.2-1 AF Ratio	Lean Mixture 14.2:1 AF Ratio	Lean Mixture 14.2:1 AF Ratio	Lean Mixture 14.2:1 AF Ratio	Lean Mixture 14.2:1 AF Ratio
	D	9.0-1 COMP.	9.2-1 COMP. INC. NO_x	9.2-1 COMP.	9.2-1 COMP.	8.8-1 COMP. DEC. NO_x	TCS DEC. NO_x
383-2V-A	A	5°ATC	5°BTC INC. NO_x	7.5°BTC	5°BTC DEC. NO_x	2.5°BTC DEC. NO_x	2.5°BTC
	B	600(D)	600(D)	600(D)	600(D)	650(D) DEC. NO_x	700(D)
	C	Lean Mixture 14.2-1 AF Ratio	Lean Mixture 14.2-1 AF Ratio	Lean Mixture 14.2-1 AF Ratio	Lean Mixture 14.2-1 AF Ratio	Lean Mixture 14.2-1 AF Ratio	Lean Mixture 14.2-1 AF Ratio
	D	9.2-1 COMP.	9.2-1 COMP.	9.2-1 COMP.	9.2-1 COMP.	8.7-1 DEC. NO_x	TCS 8.7-1 COMP. DEC. NO_x
FORD 289-302 2V-A	A	TDC	TDC	6°BTC	6°BTC	6°BTC	6°BTC
	B	525-550(D)	550(D)	550(D)	550(D)	600(D)	575(D)
	C	Lean Mixture	14.0-1AF INC. NO_x	14.0-1AF	14.0-1AF	14.0-1AF	12.5-1 DEC. NO_x
	D	Air System	IMCO System	IMCO System	IMCO System	9.5-1 COMP.	Special Distributor 9.0-1 COMP. DEC. NO_x

TABLE 4.8-1

	TUNE-UP ITEM*	1966	1967	1968	1969	1970	1971
FORD 351-2V-A "C" and "W"	A	NA	NA	NA	6°BTC	C-6°BTC W-10°BTC	6°BTC DEC. NO_x
	B	NA	NA	NA	550-D	600(D)	C = 625(D) W = 575(D)
	C	NA	NA	NA	14.0-1AF	14.0-1AF	13.9-1 DEC. NO_x
	D	NA	NA	NA	9.5-1 COMP.	9.5-1 COMP.	Special Distributor 9.0-1 COMP. DEC. NO_x
FORD 390-2V-A	A	10°BTC	6°BTC DEC. NO_x	6°BTC	6°BTC	6°BTC	6°BTC
	B	525-550(D)	550(D)	550(D)	550(D)	600(D) DEC. NO_x	600(D)
	C	Lean Mixture INC. NO_x	14.0-1 AF INC. NO_x	14.0-1 AF	14.0-1 AF	14.4-1 AF INC. NO_x	14.5-1 AF INC. NO_x
	D	9.5-1 COMP.	9.5-1 COMP.	9.5-1 COMP.	9.5-1 COMP.	9.5-1 COMP.	Special Distributor 8.6-1 COMP. DEC. NO_x
OLDSMOBILE 330-350 2V-A	A	7.5°BTC	7.5°BTC	5°BTC DEC. NO_x	6°BTC	8°BTC INC. NO_x	10°BTC @ 1100 RPM
	B	600(D)	600(D)	575(D)	625(D) DEC. NO_x	575(D)	600(D)
	C	Lean Mixture	Lean Mixture	Lean Mixture	Lean Mixture	Lean Mixture	Lean Mixture
	D	9.0-1 COMP.	9.0-1 COMP.	9.0-1 COMP.	9.0-1 COMP.	9.0-1 COMP.	Distributor Control Switch 8.5-1 COMP. DEC. NO_x
PONTIAC 389-400 2V-A	A	6°BTC	6°BTC	9°BTC	9°BTC	9°BTC	8°BTC
	B	600(D)	600(D)	600(D)	650(D)	650(D)	600(D)
	C	Lean Mixture	Lean Mixture	Lean Mixture	Lean Mixture	Lean Mixture	Lean Mixture
	D	8.6-1 COMP.	8.6-1 COMP.	8.6-1 COMP.	8.6-1 COMP.	8.8-1 COMP.	TCS 8.2-1 COMP. DEC. NO_x

*A = Basic Ignition Timing
B = Engine Idle Speed - RPM Drive (D) or Neutral (N)
C = Idle Mixture Condition
D = Additional Items Pertinent to NO_x Emissions

INC. NO_x = Increases NO_x Emissions
DEC. NO_x = Decreases NO_x Emissions
COMP. = Engine Compression Ratio
AF = Air-Fuel Ratio
T.C.S. = Transmission Controlled Spark. (T.C.S. retards distributor timing advance in the lower gear ranges to give better fuel mixture distribution and permit more efficient combustion.)
DISTRIBUTOR VACUUM CONTROL SWITCH = Same as T.C.S.
"C" = Cleveland Engine
"W" = Windsor Engine

TABLE 4.8-1
(Continued)

AESi
AUTOMOTIVE ENVIRONMENTAL SYSTEMS, INC.

VEHICLE TUNEUP INFORMATION

Car No.	Idle RPM Before	Idle RPM After	D-N	Dwell Before	Dwell After	Basic Ignition Timing Before	Basic Ignition Timing After	Total Timing Advance Before	Total Timing Advance After	Total Timing Advance Δ
1	600	600	D	29.0	29.0	0.0	0.0	40.0	18.0	-22.0
2*	650	560	D	32.8	32.8	8.0	2.5	42.0	19.0	-23.0
3	480	540	D	28.0	28.0	5.0	5.0	41.0	23.0	-19.0
4	460	500	D	27.5	27.0	4.5	4.5	41.5	24.0	-17.5
5*	680	600	D	23.0	26.0	23.0	4.0	45.0	22.0	-23.0
6*	680	600	D	28.0	28.0	10.0	6.0	36.0	17.0	-19.0
7	620	630	D	30.0	30.0	8.0	7.5	42.0	23.0	-19.0
8	700	700	D	37.0	37.0	4.0	4.0	38.0	16.0	-22.0
9*	760	460	D	25.0	25.0	13.0	4.0	45.0	25.0	-20.0
10	560	560	D	29.8	29.8	-2.0	-2.0	34.0	19.0	-15.0
11	650	700	D	31.0	31.0	5.0	5.0	40.0	20.0	-20.0
12	560	560	D	28.5	28.5	-4.0	-4.0	48.0	25.0	-23.0
13	550	600	D	28.0	28.0	21.0	21.0	37.0	32.0	- 5.0
14	550	560	D	28.0	28.0	7.0	7.0	41.0	21.0	-20.0
15	750	765	D	32.0	32.0	11.0	11.0	51.0	30.0	-21.0
16	640	640	D	19.5	19.5	7.0	7.0	46.0	25.0	-21.0
17*	750	750	D	29.0	28.0	18.5	7.0	51.0	23.0	-28.0
18	480	480	D	32.0	32.0	9.0	9.0	48.0	34.0	-14.0
19	700	700	D	51.0	51.0	13.0	12.5	47.0	27.0	-20.0
20	680	680	D	26.0	26.0	5.0	5.0	33.0	19.0	-14.0
21**	620	620	D	29.0	29.0	8.0	5.0	25.0	24.0	- 1.0
22	600	600	D	29.0	29.0	5.0	5.0	39.0	18.0	-21.0
23	520	520	D	33.0	33.0	4.0	4.0	42.0	21.0	-21.0
24	595	595	D	31.0	31.0	12.0	11.0	52.0	33.0	-19.0
25	620	620	D	25.0	25.0	12.0	12.0	55.0	33.0	-22.0
26	700	700	D	30.0	30.0	6.0	6.0	44.0	24.0	-20.0
27	520	520	D	25.0	25.0	8.0	8.0	44.0	25.0	-19.0
28	490	490	D	30.0	30.0	6.0	5.0	38.0	22.0	-16.0
29	500	500	D	27.0	27.0	-2.0	-2.0	40.0	19.0	-21.0
30**	550	550	N	37.0	37.0	9.0	11.0	30.0	30.0	0.0
31	600	600	D	31.0	31.0	4.0	4.0	50.0	27.0	-23.0
32	520	520	D	27.0	27.0	7.0	6.0	47.0	24.0	-23.0
33	650	650	D	24.0	24.0	5.0	6.0	44.0	22.0	-22.0
34	650	650	D	26.0	26.0	3.0	3.0	37.0	12.0	-25.0
35	695	695	D	25.0	25.0	2.0	3.5	38.0	20.0	-18.0
36	545	545	D	27.0	27.0	7.0	7.0	58.0	34.0	-24.0
37	530	530	D	23.0	23.0	8.0	8.0	58.0	39.0	-19.0
38	520	520	D	27.0	27.0	3.0	3.0	42.0	21.0	-21.0
39*	950	950	N	24.0	24.0	25.0	5.0	41.0	22.0	-19.0
40	470	470	D	27.0	27.0	-10.0	-10.0	35.0	15.0	-20.0
41	745	745	D	26.5	26.5	2.0	2.0	40.0	25.5	-14.5
42**	625	625	D	27.0	27.0	9.0	9.0	26.0	26.0	0.0
43	695	870	N	41.0	41.0	2.0	16.5	40.0	16.5	-23.5
44	500	500	D	28.0	28.0	6.0	6.0	55.0	36.0	-19.0
45	530	530	D	33.5	33.5	3.0	3.0	42.5	22.5	-20.0

TABLE 4.8-2

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AUTOMOTIVE ENVIRONMENTAL SYSTEMS, INC.

VEHICLE TUNEUP INFORMATION

Car No.	Idle RPM Before	Idle RPM After	D-N	Dwell Before	Dwell After	Basic Ignition Timing Before	Basic Ignition Timing After	Total Timing Advance Before	Total Timing Advance After	Total Timing Advance Δ
46	600	600	D	45.0	45.0	8.5	8.5	40.0	21.0	-19.0
47**	600	700	N	17.0	17.0	16.0	16.0	36.0	36.0	0.0
48**	600	600	D	28.0	28.0	12.0	12.0	19.0	18.0	- 1.0
49	620	620	D	29.0	29.0	8.0	8.0	22.0	6.0	-16.0
50	530	530	D	34.0	34.0	6.0	6.0	54.0	33.0	-21.0
51	510	510	D	29.0	29.0	-2.0	-2.0	37.0	20.5	-16.5
52	530	530	D	28.0	28.0	8.0	8.0	18.0	10.0	- 8.0
53	620	620	D	32.0	32.0	-2.0	-2.0	32.0	14.0	-18.0
54	590	590	D	30.0	30.0	8.0	8.0	32.0	25.0	- 7.0
55	500	500	D	30.0	30.0	5.5	5.5	42.0	26.0	-16.0
56	590	590	D	30.0	30.0	4.0	4.0	40.0	23.0	-17.0
57	500	500	D	30.0	30.0	4.5	4.5	37.0	18.5	-18.5
58	590	590	D	32.0	32.0	9.5	9.5	45.5	24.0	-21.5
59**	520	520	N	44.0	44.0	2.0	2.0	30.0	32.0	+ 2.0
60	710	710	D	31.0	31.0	5.0	5.0	41.0	24.0	-17.0
61	550	550	D	27.0	27.0	5.0	5.0	42.0	18.0	-24.0
62	500	500	D	28.0	28.0	8.0	8.0	32.5	18.0	-14.5
63	600	600	D	26.0	26.0	9.0	9.0	60.0	23.0	-37.0
64	610	610	D	27.0	27.0	18.0	18.0	29.0	17.0	-12.0
65	600	600	D	47.0	47.0	0.0	0.0	38.0	17.0	-21.0
66	680	680	D	29.0	29.0	-2.0	-2.0	24.0	8.0	-16.0
67	540	540	D	31.0	31.0	-2.0	-2.0	37.0	20.0	-17.0
68	530	530	D	30.0	30.0	0.0	0.0	39.0	5.0	-34.0
69	480	480	N	52.0	52.0	8.0	8.0	45.0	25.0	-20.0
70	500	500	D	29.0	29.0	5.0	5.0	40.0	22.0	-18.0
71	520	520	D	32.0	32.0	6.0	6.0	46.0	22.0	-24.0
72	720	720	D	29.0	29.0	2.0	2.0	47.0	22.0	-25.0
73	650	650	D	41.0	41.0	6.0	6.0	38.0	19.0	-19.0
74	590	590	D	30.0	30.0	3.0	3.0	23.0	19.0	- 4.0
75	630	630	D	31.0	31.0	-2.0	-2.0	44.0	19.0	-25.0
76	600	600	D	40.0	40.0	12.0	12.0	48.0	33.0	-15.0
77	580	580	D	32.0	32.0	8.0	8.0	58.0	36.0	-22.0
78	620	620	D	30.0	30.0	5.0	5.0	41.0	20.0	-21.0
79	560	560	D	30.0	30.0	6.0	6.0	48.0	30.0	-18.0
80	660	660	N	28.0	28.0	4.0	4.0	43.0	27.0	-16.0
81	480	480	D	29.0	29.0	-4.0	-4.0	36.0	15.5	-20.5
82	600	600	D	19.0	19.0	6.0	6.0	40.0	24.0	-16.0
83	640	640	D	27.0	27.0	12.0	12.0	28.0	12.0	-16.0
84	620	620	D	30.0	30.0	2.0	2.0	36.0	17.0	-19.0
85	610	610	N	48.0	48.0	-5.0	-5.0	28.0	14.5	-13.5
86	550	550	D	26.0	26.0	7.0	7.0	38.0	18.0	-20.0
87	710	710	N	31.0	31.0	2.0	2.0	44.0	25.0	-19.0
88	645	645	D	30.0	30.0	7.0	7.0	34.0	23.0	-11.0
89	650	650	D	32.0	32.0	10.0	10.0	47.0	26.0	-21.0
90	500	500	D	26.0	26.0	4.0	4.0	42.0	20.0	-22.0

TABLE 4.8-2
(Continued)

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VEHICLE TUNEUP INFORMATION

Car No.	Idle RPM Before	Idle RPM After	D-N	Dwell Before	Dwell After	Basic Ignition Timing Before	Basic Ignition Timing After	Total Timing Advance Before	Total Timing Advance After	Total Timing Advance △
91	700	700	D	30.0	30.0	1.0	1.0	41.0	18.0	-23.0
92	530	530	D	33.0	33.0	5.0	5.0	50.0	23.0	-27.0
93	630	630	D	26.0	26.0	6.0	6.0	52.0	36.0	-16.0
94	550	550	D	27.0	27.0	6.0	6.0	39.0	16.0	-23.0
95	980	---	N	53.0	----	2.0	---	2.0	----	-----
96	1000	---	N	55.0	----	-3.0	---	25.0	----	-----
97	600	600	D	47.0	47.0	8.0	8.0	35.0	18.0	-17.0
98	540	540	D	26.0	26.0	13.0	13.0	50.0	33.0	-17.0
99	600	600	D	29.0	29.0	7.0	7.0	36.0	20.0	-16.0
100	610	610	D	25.0	25.0	1.0	1.0	43.0	21.0	-22.0

* Vacuum advance operating at idle.
**Vacuum advance inoperative.

TABLE 4.8-2
(Continued)

4.9 VEHICLE FUEL MILEAGE

The mass emissions data were used to calculate the fuel mileage for each vehicle. Both the before VSAD and after VSAD fuel mileage were calculated using the appropriate mass emissions. The formula used for calculating vehicle fuel mileage is based upon the assumption that the grams of carbon atoms contained in the fuel going into the engine must equal the grams of carbon atoms contained in the exhaust coming out of the engine. Carbon atoms are contained in the carbon dioxide, carbon monoxide, and hydrocarbon effluents but not in the oxides of nitrogen. Figure 4.9-1 presents the derivation of the formula used for calculating fuel mileage.

Figure 4.9-2 presents the fuel mileage results for the 1972 Federal test. The car number is presented and then the before VSAD mass emissions and the corresponding fuel mileage in miles per gallon (m.p.g.). This is followed by the after VSAD mass emissions and the corresponding fuel mileage. Lastly, the difference in the before and after VSAD mileage is presented. A negative difference indicates a reduction in fuel mileage while a positive value indicates an increase. Following the individual vehicle data, the mean and standard deviation are presented for the before and after VSAD fuel mileage as well as the difference.

Figure 4.9-3 presents the fuel mileage results for the 50 mph steady state tests. These data are presented in the same format as the 1972 Federal test data.

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MILES PER GALLON CMASS EMISSIONS

If mass emissions are expressed in grams per mile, then using the following formula will enable the calculation of mileage. This formula can be used with any test cycle so long as the results are in grams per mile for HC, CO, and CO_2.

$$M.P.G. = 2400/(.2729\ CO_2 + .4288\ CO + .8665\ HC) \quad (1)$$

This formula is derived in the following way:

Mole Weight of Carbon = 12.01
" " " Carbon Dioxide = 44.01
" " " Carbon Monoxide = 28.01
" " " Hydrocarbons = 13.86 } assuming CH = 1.84
" " " Fuel = 13.86

Assuming: grams carbon atoms in fuel going into engine = grams carbon atoms in exhaust coming out of engine

$$\frac{12.01}{13.86}\ \text{Fuel (gm/mi)} = \frac{12.01}{44.01}\ CO_2\ \text{(gm/mi)} + \frac{12.01}{28.01}\ CO\ \text{(gm/mi)} + \frac{12.01}{13.86}\ HC\ \text{(gm/mi)} \Longrightarrow \quad (2)$$

$$.8665\ \text{Fuel (gm/mi)} = .2729\ CO_2\ \text{(gm/mi)} + .4288\ CO\ \text{(gm/mi)} + .8665\ HC\ \text{(gm/mi)} \Longrightarrow \quad (3)$$

$$\text{Fuel (gm/mi)} = \frac{.2729\ CO_2\ \text{(gm/mi)} + .4288\ CO\ \text{(gm/mi)}\ .8665\ HC\ \text{(gm/mi)}}{.8665} \quad (4)$$

Now, convert units to gallons/mile:

$$\frac{\text{Fuel Grams}}{\text{Mile}} \times \frac{1\ \text{pound}}{454\ \text{gms}} \times \frac{1\ \text{gallon}}{6.1\ \text{lbs.}} = \text{Fuel (gms/mi)} \times \frac{1}{2769.4} = \text{Fuel (gal./mi)}$$

Apply conversion factor to formula (4):

$$\text{Fuel (gal./mi)} = \frac{.2729\ CO_2\ \text{(gm/mi)} + .4288\ CO\ \text{(gm/mi)} + .8665\ \text{(gm/mi)}}{.8665 \times 2769.4} \quad (5)$$

Invert to get fuel in miles/gallon

$$M.P.G. = \frac{2400.}{.2729\ CO_2\ \text{(gm/mi)} + .4288\ CO\ \text{(gm/mi)} + .8665\ HC\ \text{(gm/mi)}} \quad (6)$$

Reference: SAE Paper #710604, Development of a Fuel-Based Mass Emission Measurement Procedure, by Donald L. Stivender, Research Laboratories, General Motors Corporation.

FIGURE 4.9-1

MASS EMISSION FUEL MILEAGE
1972 FEDERAL TEST

	BEFORE VSAD				AFTER VSAD				
CAR	HC	CO	CO2	MPG	HC	CO	CO2	MPG	DIF
1	2.63	19.28	639.08	12.98	2.11	21.02	704.56	11.82	-1.16
2	3.79	20.15	706.59	11.72	2.53	22.40	819.17	10.20	-1.52
3	3.27	83.08	584.11	12.13	2.30	71.62	653.59	11.37	-.76
4	3.72	38.43	548.82	14.16	2.58	37.53	563.99	13.93	-.23
5	4.75	64.16	428.45	16.16	3.94	68.54	439.18	15.72	-.43
6	4.63	23.87	622.56	13.03	6.04	17.41	664.17	12.37	-.66
7	3.59	56.28	530.21	13.96	2.99	52.19	556.36	13.57	-.38
8	1.95	19.63	643.73	12.92	1.36	21.58	681.21	12.22	-.69
9	2.35	38.37	616.50	12.85	1.65	36.87	685.81	11.74	-1.11
10	3.97	73.68	545.19	13.06	2.91	74.70	604.44	12.03	-1.03
11	3.47	88.18	583.58	12.00	3.29	90.82	595.83	11.74	-.25
12	5.68	125.02	523.86	11.91	4.22	126.17	544.22	11.63	-.28
13	4.45	47.07	514.47	14.60	3.43	43.21	521.03	14.66	.07
14	3.73	54.01	650.26	11.77	2.37	33.18	705.04	11.50	-.27
15	7.41	275.38	553.14	8.71	6.89	282.87	572.66	8.46	-.24
16	2.42	5.88	578.51	14.77	1.73	6.55	620.03	13.83	-.94
17	2.14	10.01	517.67	16.28	1.65	8.02	564.56	15.10	-1.18
18	2.67	30.93	576.13	13.89	2.04	26.66	650.66	12.58	-1.31
19	2.51	38.32	437.79	17.37	1.53	22.45	297.43	26.05	8.68
20	3.07	43.78	541.05	14.19	2.80	44.16	557.54	13.83	-.36
21	3.66	80.43	519.55	13.37	3.72	82.39	566.69	12.42	-.95
22	3.37	23.96	484.09	16.52	2.39	26.92	508.68	15.74	-.77
23	20.28	138.83	655.89	9.37	19.56	134.23	625.99	9.78	.41
24	3.62	29.03	511.58	15.46	2.77	29.67	565.15	14.17	-1.29
25	11.72	173.71	320.83	13.94	10.19	178.06	343.28	13.42	-.52
26	4.19	34.91	611.11	12.95	3.46	34.13	653.64	12.24	-.70
27	3.65	91.46	620.59	11.33	4.24	94.74	653.75	10.78	-.56
28	3.79	48.88	623.94	12.34	2.76	51.90	621.77	12.35	.01
29	3.94	41.62	503.72	15.12	3.14	37.34	518.45	14.98	-.14
30	3.62	36.26	485.24	15.88	3.62	36.53	475.19	16.16	.28
31	7.45	108.88	565.10	11.57	6.74	114.36	591.56	11.09	-.48
32	5.11	110.79	543.32	11.99	4.16	103.28	576.47	11.70	-.29
33	3.01	29.24	670.49	12.11	1.31	19.68	432.99	18.79	6.67
34	16.37	99.19	531.97	11.89	16.29	102.82	551.62	11.50	-.39
35	3.34	84.68	585.84	12.06	2.11	70.53	703.91	10.71	-1.35
36	5.26	94.74	612.41	11.28	8.17	68.39	683.10	10.77	-.51
37	2.84	29.26	305.37	24.34	2.71	19.56	309.31	25.19	.85
38	4.33	74.55	453.70	14.66	3.65	70.64	503.30	14.05	-.61
39	4.86	46.37	584.82	13.07	3.31	33.42	637.49	12.55	-.51
40	2.70	39.59	446.22	17.01	4.41	42.51	481.53	15.64	-1.37
41	3.14	7.53	570.54	14.85	2.04	10.27	577.30	14.66	-.19
42	2.33	49.28	388.69	18.57	2.37	31.54	441.62	17.63	-.94
43	1.98	15.00	461.62	17.89	1.23	14.87	485.04	17.17	-.73
44	3.33	95.67	565.62	12.10	2.62	78.83	574.49	12.44	.34
45	2.82	21.24	472.17	17.09	1.40	17.56	523.81	15.82	-1.27
46	4.40	5.15	703.94	12.11	3.18	5.83	771.26	11.12	-.99
47	5.56	41.15	604.56	12.89	4.96	39.35	600.02	12.98	.18
48	3.83	44.94	556.40	13.76	3.73	45.94	557.89	13.70	-.06
49	5.27	48.44	537.07	13.96	4.99	42.77	549.48	13.90	-.06

FIGURE 4.9-2

MASS EMISSION FULL MILEAGE
1972 FEDERAL TEST
(Continued)

	BEFORE VSAD				AFTER VSAD				
CAR	HC	CO	CO2	MPG	HC	CO	CO2	MPG	DIF
50	4.29	45.06	604.57	12.76	3.81	49.35	651.36	11.87	-.90
51	5.45	97.59	634.74	10.92	4.35	94.40	716.54	10.01	-.91
52	1.64	31.02	994.54	8.39	1.69	31.37	1029.48	8.11	-.28
53	4.04	84.34	529.91	13.02	3.72	76.73	610.69	11.84	-1.19
54	6.22	71.34	498.37	13.95	6.92	71.85	499.69	13.86	-.10
55	3.24	34.47	566.45	13.94	2.78	34.26	589.28	13.49	-.45
56	2.82	18.30	748.75	11.18	2.33	12.71	702.78	12.04	.86
57	3.50	107.13	602.47	11.25	2.93	101.86	635.98	10.92	-.33
58	3.09	34.60	623.94	12.78	2.48	31.99	630.63	12.77	-.01
59	2.81	10.65	394.72	20.92	2.74	10.88	394.44	20.93	.01
60	4.23	105.05	449.69	14.00	3.60	98.80	464.41	13.94	-.06
61	3.80	52.56	632.80	12.09	3.65	79.85	665.17	10.96	-1.13
62	7.25	94.39	492.68	13.24	6.70	108.29	514.19	12.46	-.78
63	7.42	224.04	539.22	9.61	6.49	216.05	537.17	9.80	.19
64	2.66	27.60	553.82	14.52	1.86	25.54	614.41	13.32	-1.21
65	2.06	38.76	431.45	17.63	1.17	39.56	551.33	14.25	-3.38
66	2.60	67.29	623.25	11.93	1.89	76.93	663.67	11.12	-.80
67	4.48	93.92	494.15	13.41	3.40	92.68	586.62	11.84	-1.57
68	3.95	44.24	514.64	14.74	2.57	46.06	598.19	12.96	-1.78
69	2.58	16.13	344.62	23.26	1.88	13.37	362.59	22.57	-.68
70	8.38	136.66	805.78	8.40	6.54	122.16	803.35	8.66	.26
71	6.78	134.18	596.93	10.60	5.60	149.39	649.31	9.75	-.85
72	2.30	33.01	519.03	15.21	1.57	34.30	578.17	13.80	-1.41
73	3.72	75.36	644.33	11.35	2.69	60.40	699.80	10.95	-.41
74	3.20	67.12	618.38	11.98	3.57	76.28	614.87	11.79	-.19
75	4.35	43.42	514.78	14.74	3.51	42.34	518.40	14.75	.02
76	1.96	14.76	436.52	18.87	1.31	13.85	494.85	16.89	-1.99
77	1.96	37.08	480.53	16.14	1.45	28.66	486.12	16.41	.28
78	3.62	80.42	598.15	11.95	2.71	69.05	647.29	11.51	-.44
79	3.06	88.49	561.44	12.38	2.23	76.18	579.28	12.46	.07
80	7.62	70.45	550.81	12.83	5.91	66.07	587.83	12.38	-.45
81	4.45	101.86	524.65	12.58	3.93	134.00	588.86	10.83	-1.75
82	10.91	235.53	482.89	9.91	11.88	243.20	525.82	9.30	-.61
83	5.45	175.68	722.09	8.66	7.18	155.52	621.42	9.90	1.24
84	4.36	55.57	456.39	15.77	4.32	74.48	498.75	13.97	-1.80
85	7.81	120.34	473.78	12.79	8.49	129.01	514.70	11.81	-.97
86	5.57	96.65	539.51	12.40	3.75	92.03	617.67	11.36	-1.04
87	5.79	86.29	679.39	10.55	5.37	98.63	716.14	9.90	-.65
88	2.43	47.13	61[illegible].09	12.56	2.42	47.16	615.88	12.61	.04
89	3.85	16.58	706.51	11.51	2.05	13.69	803.07	10.48	-1.32
90	2.53	31.36	504.63	15.65	1.72	31.22	563.76	14.22	-1.43
91	5.19	51.13	525.77	14.13	4.11	55.96	585.79	12.52	-1.61
92	3.09	54.51	673.71	11.43	2.40	76.37	763.20	9.87	-1.56
93	3.43	18.20	596.10	13.79	2.91	20.26	586.38	14.02	.22
94	3.23	79.42	646.36	11.25	2.23	63.12	676.32	11.24	-.02
97	1.90	29.45	276.94	26.71	1.93	33.29	288.90	25.32	-1.39
98	2.52	33.61	573.29	13.87	1.84	28.49	633.05	12.86	-1.01
99	2.96	42.80	582.50	13.34	2.51	51.80	678.67	11.45	-1.89
100	3.09	18.05	570.31	14.45	2.43	26.65	629.71	12.95	-1.51
MEAN				13.65				13.17	-.48
STD				3.02				3.25	1.38

(0320)>

FIGURE 4.9-2

MASS EMISSION FUEL MILEAGE
50 MPH STEADY STATE - NORMAL LOAD
(Continued)

	BEFORE VSAD				AFTER VSAD				
CAR	HC	CO	CO2	MPG	HC	CO	CO2	MPG	DIF
50	1.03	3.34	462.75	18.66	.39	2.69	512.95	16.96	-1.70
51	2.80	25.54	506.69	15.83	1.96	19.26	519.01	15.83	.01
52	.20	2.55	762.44	11.46	.23	2.63	761.13	11.48	.02
53	2.11	26.06	381.20	20.51	1.35	17.13	412.63	19.81	-.69
54	2.24	17.23	411.59	19.73	2.09	27.03	401.73	19.51	-.22
55	1.95	8.34	433.92	19.40	1.11	6.13	472.23	18.12	-1.29
56	1.45	3.84	540.49	15.96	1.06	3.92	463.20	18.60	2.65
57	.50	31.43	409.27	19.11	.27	24.73	464.21	17.45	-1.66
58	1.57	4.56	437.15	19.57	1.06	7.79	438.37	19.37	-.20
59	.43	2.00	278.35	31.09	.37	2.43	269.54	32.02	.93
60	1.23	7.47	383.59	22.02	.40	2.62	386.26	22.46	.44
61	2.02	28.28	485.10	16.41	2.05	66.70	525.27	13.82	-2.59
62	2.60	40.09	387.83	19.16	2.06	54.62	427.64	16.91	-2.24
63	5.60	248.16	331.67	11.89	3.80	144.12	343.66	15.11	3.21
64	.66	2.92	434.53	19.93	.31	2.57	485.59	17.93	-2.01
65	.88	2.31	309.57	27.53	.17	1.84	415.10	21.01	-6.82
66	1.27	25.24	403.43	19.60	.62	19.77	440.16	18.59	-1.01
67	1.90	19.49	365.92	21.85	.74	14.73	407.05	20.33	-1.51
68	2.13	10.34	353.65	22.74	1.03	14.78	423.52	19.54	-3.20
69	1.01	1.54	264.70	32.53	.62	1.95	256.53	33.62	1.09
70	.79	36.94	563.95	14.01	.61	32.33	544.42	14.73	.72
71	4.06	93.05	451.12	14.41	3.10	100.82	487.24	13.42	-1.00
72	1.01	2.17	379.46	22.78	.12	1.70	415.55	21.01	-1.77
73	2.47	49.14	496.04	15.08	.65	27.19	535.12	15.16	.08
74	1.20	7.63	421.56	20.09	1.20	8.26	421.11	20.08	-.01
75	3.03	25.83	357.02	20.11	1.74	20.40	343.08	20.91	.79
76	1.33	2.07	323.84	26.15	.43	1.94	350.02	24.13	-2.02
77	1.26	16.51	336.30	24.08	.40	11.59	334.15	24.87	.79
78	1.62	7.80	418.32	20.16	.84	7.94	449.33	18.93	-1.25
79	.67	50.61	424.13	17.32	.40	35.22	431.82	17.83	.45
80	1.43	4.17	402.84	21.25	1.16	5.11	403.83	21.16	-.08
81	3.17	81.39	374.96	17.15	2.49	93.82	402.82	15.54	-1.61
82	5.19	130.20	354.24	15.29	4.43	135.12	377.22	14.57	-.72
83	3.93	94.63	473.92	13.84	2.94	91.92	533.63	12.73	-1.12
84	2.11	13.00	349.34	22.88	1.35	35.00	377.94	20.11	-2.77
85	1.33	16.96	330.75	21.37	.71	13.42	357.03	23.12	1.76
86	3.74	30.46	398.17	19.64	2.43	31.93	404.74	19.00	-.63
87	2.47	45.91	347.09	18.83	1.69	45.86	390.42	18.80	-.03
88	1.31	14.56	431.19	19.19	1.14	17.53	442.72	18.55	-.64
89	.79	5.65	517.72	15.62	.37	6.10	552.07	15.35	-1.27
90	1.14	22.22	339.53	23.26	.40	11.32	375.79	22.22	-1.04
91	2.63	34.96	410.59	1[illegible].53	2.03	45.95	457.07	16.27	-2.26
92	2.47	50.45	462.95	15.43	1.44	51.59	521.50	14.48	-.95
93	1.50	16.83	430.52	19.16	1.03	13.21	441.96	1[illegible].67	-.17
94	.89	46.76	503.63	15.06	.13	20.39	532.53	15.04	-.04
97	1.02	4.27	252.69	33.46	.73	4.27	249.73	33.97	.49
98	.34	3.93	431.85	19.50	.46	9.45	435.50	19.45	-.14
99	1.81	30.24	392.85	19.71	1.02	23.21	445.79	18.11	-1.60
100	2.51	14.30	391.37	20.85	1.22	17.47	422.54	19.38	-1.47
MEAN				20.19				19.45	-.74
STD				4.36				4.35	1.38

FIGURE 4.9-3

MASS EMISSION FUEL MILEAGE
50 MPH STEADY STATE - NORMAL LOAD

	BEFORE VSAD				AFTER VSAD				
CAR	HC	CO	CO2	MPG	HC	CO	CO2	MPG	DIF
1	1.17	5.49	421.94	20.25	.58	7.23	521.86	16.44	-3.81
2	2.27	7.82	540.72	15.70	1.10	8.88	606.55	14.09	-1.60
3	1.21	24.57	442.74	18.13	.70	12.76	481.28	17.46	-.66
4	1.87	23.44	381.29	20.74	1.08	16.47	421.37	19.51	-1.22
5	2.01	19.58	347.53	22.86	1.60	20.08	357.85	22.29	-.57
6	1.35	9.67	433.29	19.42	3.08	3.61	463.46	18.36	-1.06
7	1.98	7.01	365.07	23.00	.95	4.54	395.82	21.66	-1.34
8	1.49	7.05	390.06	21.67	.49	9.17	466.95	18.21	-3.46
9	1.18	15.01	445.91	18.53	.56	12.58	485.74	17.34	-1.25
10	2.39	16.49	414.19	19.64	1.43	20.81	449.27	18.08	-1.57
11	2.08	31.12	419.74	18.51	1.62	34.53	449.78	17.27	-1.23
12	3.67	69.72	401.78	16.82	2.56	57.63	414.26	17.15	.33
13	1.92	5.51	422.74	20.10	1.12	3.81	405.20	21.20	1.10
14	1.64	3.85	470.34	18.26	.37	2.52	517.21	16.84	-1.42
15	3.05	200.05	385.90	12.39	3.21	221.35	402.61	11.56	-.83
16	1.89	1.79	408.01	21.10	.91	2.13	433.28	20.01	-1.09
17	1.71	10.09	412.90	20.26	.85	4.47	458.89	18.77	-1.49
18	1.45	4.53	434.36	19.71	.56	3.80	482.05	17.94	-1.77
19	1.42	1.63	287.25	29.88	1.09	2.00	302.10	28.49	-1.39
20	2.20	2.62	411.76	20.80	1.23	2.85	442.12	19.52	-1.28
21	2.13	42.33	434.35	17.32	1.85	37.66	414.76	18.33	1.00
22	1.52	3.25	336.04	25.42	.66	3.00	367.63	23.49	-1.93
23	9.85	26.00	507.99	15.16	9.59	22.24	479.06	16.15	.99
24	2.31	6.75	375.71	22.34	1.51	6.64	392.35	21.58	-.76
25	3.17	65.97	255.79	23.80	1.78	59.89	262.09	24.30	.50
26	1.92	24.01	432.82	18.45	.98	20.35	492.97	16.65	-1.80
27	9.20	32.52	398.83	18.35	8.93	26.01	408.09	18.42	.07
28	2.25	2.31	478.85	17.96	.86	2.66	456.04	19.00	1.03
29	2.28	3.74	390.50	21.79	.98	3.16	426.87	20.22	-1.57
30	1.62	15.78	342.75	23.60	1.42	14.19	333.17	24.43	.83
31	3.40	76.27	445.76	15.26	2.60	66.62	466.68	15.17	-.08
32	2.89	36.83	454.09	16.88	1.92	39.02	403.27	18.68	1.81
33	1.48	3.42	467.59	18.41	6.87	3.76	470.77	17.64	-.77
34	2.02	43.71	497.37	15.36	9.97	48.38	448.70	15.81	.44
35	1.36	12.92	433.13	19.21	.48	7.74	486.49	17.58	-1.63
36	2.02	18.74	416.66	19.43	1.54	27.71	422.47	18.68	-.76
37	1.55	19.95	207.74	36.04	1.22	14.14	220.16	35.71	-.33
38	2.24	20.60	354.94	21.75	1.47	16.46	366.65	22.14	.40
39	2.58	15.54	370.19	21.83	1.26	6.90	379.42	22.31	.47
40	1.73	18.60	341.58	23.37	4.22	22.60	347.83	22.17	-1.20
41	1.49	2.06	377.23	22.83	.61	2.06	390.32	22.24	-.59
42	1.05	5.15	295.48	28.66	.94	5.95	300.42	28.12	-.54
43	1.32	5.38	332.77	25.46	.50	4.42	353.48	24.29	-1.17
44	1.18	31.23	419.75	18.61	.63	19.81	479.97	17.14	-1.47
45	1.26	7.35	314.69	26.63	.44	3.69	358.72	24.03	-2.60
46	.96	2.62	479.74	18.06	.36	2.24	555.68	15.69	-2.37
47	.90	17.61	424.47	19.33	.87	15.10	419.86	19.70	.37
48	1.10	11.66	479.28	17.55	1.07	11.15	474.44	17.75	.20
49	2.13	19.36	377.20	21.22	1.49	16.32	401.06	20.38	-.84

FIGURE 4.9-3