APPENDIX A

Acceleration Simulation Mode: Pennsylvania Procedures, Standards, Equipment Specifications and Quality Control Requirements

§ 1. ASM Exhaust Emission Standards and Calculations.

(a) *ASM Emissions Standards*

(1) *ASM Start-Up Standards.* The following standards shall be used for ASM tests performed until notice by the Department that the standards in subsection (2)(i) or (2)(ii) shall apply. The exhaust emission standards for the following model years are cross referenced by the number in the column in (a)(3) below:

(A) Light Duty Vehicles

	Hydrocarbons	*Carbon Monoxide*	*Oxides of Nitrogen*
Model Years	*Table § 1(a)(3)(I)*	*Table § 1(a)(3)(II)*	*Table § 1(a)(3)(III)*
1996+ TIER 1	1	21	41
1991-1995	2	22	42
1983-1990	4	23	43
1981-1982	4	26	43
1980	4	26	48
1977-1979	11	30	48
1975-1976	11	30	50

(B) Light Duty Trucks 1 (less than 6,000 pounds GVWR).

	Hydrocarbons	*Carbon Monoxide*	*Oxides of Nitrogen*
Model Years	*Table § 1(a)(3)(I)*	*Table § 1(a)(3)(II)*	*Table § 1(a)(3)(III)*
1996+ TIER 1			
(‹3750 LVW)	1	21	41
(›3750 LVW)	2	22	42
1991-1995	5	26	43

1988-1990	7	29	44
1984-1987	7	29	49
1979-1983	11	31	49
1975-1978	12	32	50

(C) Light Duty Trucks 2 (greater than 6,000 pounds GVWR).

Model Years	*Hydrocarbons Table § 1(a)(3)(I)*	*Carbon Monoxide Table § 1(a)(3)(II)*	*Oxides of Nitrogen Table § 1(a)(3)(III)*
1996+ TIER 1 (‹=5750 LVW)	2	22	42
(›5750 LVW)	5	26	45
1991-1995	5	26	46
1988-1990	7	29	47
1984-1987	7	29	49
1979-1983	11	31	49
1975-1978	12	32	50

(2) *ASM final standards.*

(i) *ASM equivalent test weight methodology.* Upon notice by the Department in the *Pennsylvania Bulletin*, the following exhaust emission standards will be used for ASM tests performed. The exhaust emissions standards for the following model years are cross-referenced by the number in the column in (a)(3) below:

(A) Light Duty Vehicles.

Model Years	*Hydrocarbons Table § 1(a)(3)(I)*	*Carbon Monoxide Table § 1(a)(3)(II)*	*Oxides of Nitrogen Table § 1(a)(3)(III)*
1996+ TIER 1	1	21	41
1983-1995	1	21	41
1981-1982	1	23	41
1980	1	23	45
1977-1979	6	27	45
1975-1976	6	27	48

(B) Light Duty Trucks 1 (less than 6,000 pounds GVWR).

Model Years	*Hydrocarbons Table § 1(a)(3)(I)*	*Carbon Monoxide Table § 1(a)(3)(II)*	*Oxides of Nitrogen Table § 1(a)(3)(III)*
1996+ TIER 1 (‹=3750 LVW)	1	21	41
(›3750 LVW)	1	21	41
1988-1995	3	24	42
1984-1987	3	24	46
1979-1983	8	28	46
1975-1978	9	29	48

(C) Light Duty Trucks 2 (greater than 6,000 pounds GVWR).

Model Years	*Hydrocarbons Table § 1(a)(3)(I)*	*Carbon Monoxide Table § 1(a)(3)(II)*	*Oxides of Nitrogen Table § 1(a)(3)(III)*
1996+ TIER 1 (‹=5750 LVW)	1	21	41
(›5750 LVW)	1	21	41
1988-1995	3	24	44
1984-1987	3	24	46
1979-1983	8	28	46
1975-1978	9	29	48

(ii) *ASM vehicle engine displacement methodology.* Upon notice by the Department in the *Pennsylvania Bulletin*, the exhaust emission standards used for ASM tests performed shall be in accordance with the following tables:

LDV Exhaust Emission Standards for the ASM 5015 test

	HC	*CO*	*NOx*
5015 LDV MY 1980 and newer	275 liters* ppm		

5015 LDV MY 1980 to 1982		1.3 liters*%	
5015 LDV MY 1983 and newer		1.1 liters*%	
5015 LDV MY 1980 only			8,500 liters* ppm
5015 LDV MY 1981 and newer			3,600 liters* ppm

LDT Exhaust Emission Standards for the ASM 5015 test

	HC	*CO*	*NOx*
5015 LDT MY 1980 to 1983	1,140 liters* ppm		
5015 LDT MY 1984 to 1995	537 liters* ppm		
5015 LDT MY 1996 and newer	275 liters* ppm		
5015 LDT MY 1980 to 1983		9.7 liters*%	
5015 LDT MY 1984 to 1995		5.4 liters*%	
5015 LDT MY 1996 and newer		1.1 liters*%	
5015 LDT MY 1980 to 1987			14,145 liters* ppm
5015 LDT MY 1988 to 1995			7,380 liters* ppm
5015 LDT MY 1996 and newer			6,150 liters* ppm

All 5015 cut points are applied by the following method: The vehicle's engine displacement in liters multiplied by the exhaust constituent (HC, CO, or NOx) levels in concentration (HC and NOx in ppm; CO in % ten second average values). This liter*concentration value is compared to the appropriate cut point and if the value is above the cut point the vehicle is considered having failed the test.

(3) ASM 2525 and 5015 concentration tables follow (although both 2525 and 5015 standards are shown, the Pennsylvania test consists only of the 5015 mode):

(i) ASM2525 and ASM5015 hydrocarbon (PPM C6) Table

Column Number – –›	*1*	*1*	*2*	*2*	*3*	*3*	*4*	*4*	*5*	*5*	*6*	*6*	*7*	*7*	*8*	*8*
Vehicle ETW	5015	2525	5015	2525	5015	2525	5015	2525	5015	2525	5015	2525	5015	2525	5015	2525
1750	142	136	224	216	257	249	291	282	324	315	374	364	390	381	407	397
1875	134	129	212	205	243	236	275	266	306	297	353	344	368	359	384	375
2000	127	123	201	194	230	223	260	252	289	281	333	325	348	339	363	354
2125	121	116	191	184	219	212	246	239	274	267	316	308	329	321	343	335
2250	115	111	182	175	208	201	234	227	260	253	299	292	312	305	325	318
2375	109	106	173	167	198	192	223	216	247	241	284	277	297	290	309	302
2500	105	101	166	160	189	183	212	206	236	230	271	264	283	276	294	288
2625	100	97	159	153	181	175	203	197	225	219	259	252	270	263	281	274
2750	96	93	152	147	173	168	194	189	216	210	247	241	258	252	269	262
2875	92	89	146	141	167	161	187	181	207	201	237	231	247	241	257	251
3000	89	86	141	136	160	155	180	174	199	194	228	222	237	232	247	241
3125	86	83	136	132	155	150	173	168	191	186	219	214	228	223	238	232
3250	83	80	132	127	149	145	167	162	185	180	211	206	220	215	229	224
3375	81	78	128	123	145	140	162	157	179	174	204	199	213	208	221	216
3500	78	76	124	120	140	136	157	152	173	169	198	193	206	201	214	209
3625	76	74	120	117	136	132	152	148	168	164	192	187	200	195	207	203
3750	74	72	117	114	133	129	148	144	163	159	186	182	194	189	201	197
3875	72	70	114	111	129	125	144	140	159	155	181	177	188	184	196	191
4000	71	68	112	108	126	122	140	137	155	151	176	172	183	179	191	186
4125	69	67	109	106	123	119	137	133	151	147	172	168	179	175	186	181
4250	67	65	107	103	120	117	134	130	147	143	167	164	174	170	181	177
4375	66	64	104	101	118	114	131	127	144	140	164	160	170	166	177	173
4500	65	63	102	99	115	112	128	124	141	137	160	156	166	162	172	169
4625	63	61	100	97	113	109	125	122	137	134	156	152	162	159	169	165
4750	62	60	98	95	110	107	122	119	134	131	153	149	159	155	165	161

4875	61	59	96	93	108	105	120	117	132	128	149	146	155	152	161	157
5000	60	58	94	92	106	103	117	114	129	126	146	143	152	148	157	154
5125	58	57	93	90	104	101	115	112	126	123	143	139	148	145	154	150
5250	57	56	91	88	102	99	112	110	123	120	140	136	145	142	150	147
5375	56	55	89	86	100	97	110	107	121	118	137	133	142	139	147	144
5500	55	54	87	85	98	95	108	105	118	115	134	130	139	136	144	141
5625	54	53	86	83	96	93	106	103	116	113	131	128	136	133	141	138
5750	53	52	84	82	94	91	104	101	113	111	128	125	133	130	138	135
5875	52	51	83	80	92	90	102	99	111	108	125	122	130	127	135	132
6000	51	50	81	79	90	88	100	97	109	106	123	120	127	124	132	129
6125	50	49	80	78	89	86	98	95	107	104	120	118	125	122	129	126
6250	50	48	79	76	87	85	96	94	105	102	118	115	123	120	127	124
6375	49	48	77	75	86	84	95	92	103	101	116	113	120	118	125	122
6500	48	47	76	74	85	83	93	91	102	99	114	112	119	116	123	120
6625	48	46	76	74	84	82	92	90	101	98	113	110	117	114	121	119
6750	47	46	75	73	83	81	91	89	100	97	112	109	116	113	120	117
6875	47	46	75	73	83	81	91	89	99	97	111	109	115	113	119	117
7000	47	46	74	72	83	80	91	88	99	96	111	108	115	112	119	116
7125	47	46	74	72	82	80	90	88	98	96	111	108	115	112	119	116
7250	47	46	74	72	82	80	90	88	98	96	111	108	115	112	119	116
7375	47	46	74	72	82	80	90	88	98	96	111	108	115	112	119	116
7500	47	46	74	72	82	80	90	88	98	96	111	108	115	112	119	116

ASM2525 and ASM5015 Hydrocarbon (ppm C6) Table (cont.)

Column Number – –›	*9*	*9*	*10*	*10*	*11*	*11*	*12*	*12*	*13*	*13*
Vehicle ETW	5015	2525	5015	2525	5015	2525	5015	2525	5015	2525
1750	457	447	706	694	774	761	843	828	1118	1098
1875	431	421	665	653	729	717	794	780	1052	1034
2000	407	398	627	616	688	676	749	736	992	975
2125	385	376	592	582	650	638	707	695	938	921
2250	365	357	560	551	615	604	669	658	887	872
2375	346	339	531	522	583	573	635	624	841	827
2500	329	322	505	496	554	544	603	593	800	786

2625	314	307	481	472	528	518	574	564	761	748
2750	300	294	459	451	503	495	548	539	726	714
2875	287	281	439	431	481	473	524	515	695	683
3000	276	270	420	413	461	453	502	493	666	654
3125	265	260	404	397	443	435	482	474	639	628
3250	256	250	388	382	426	419	464	456	615	604
3375	247	241	374	368	411	404	447	440	593	583
3500	239	234	362	355	397	390	432	424	573	563
3625	231	226	350	344	384	377	418	411	554	544
3750	224	220	339	333	372	365	405	398	537	527
3875	218	213	329	323	361	355	393	386	521	512
4000	212	208	320	314	351	345	382	375	506	497
4125	206	202	311	305	341	335	371	365	492	484
4250	201	197	303	297	332	326	361	355	479	471
4375	196	192	295	290	323	318	352	346	467	459
4500	192	188	287	282	315	310	343	337	455	447
4625	187	183	280	275	308	302	335	329	444	436
4750	183	179	273	269	300	295	327	321	433	425
4875	179	175	267	262	293	288	319	313	423	415
5000	175	171	260	256	286	281	311	305	412	405
5125	171	167	254	250	279	274	304	298	402	395
5250	167	163	248	244	272	267	296	291	393	386
5375	163	159	242	238	266	261	289	284	383	376
5500	159	156	236	232	259	255	282	277	374	367
5625	156	152	231	226	253	248	276	271	365	359
5750	152	149	225	221	247	243	269	264	357	350
5875	149	146	220	216	241	237	263	258	348	342
6000	146	143	215	211	236	232	257	252	341	334
6125	143	140	210	206	231	227	251	247	333	327
6250	140	137	206	202	226	222	246	242	326	320
6375	138	135	202	198	222	218	242	237	320	314
6500	136	133	199	195	218	214	238	233	315	309
6625	134	131	196	192	215	211	234	230	310	304
6750	132	129	194	190	213	209	232	227	307	301
6875	132	129	193	189	211	207	230	225	305	299

7000	131	128	192	188	211	207	229	225	304	298
7125	131	128	192	188	211	206	229	225	304	298
7250	131	128	192	188	211	206	229	225	304	298
7375	131	128	192	188	211	206	229	225	304	298
7500	131	128	192	188	211	206	229	225	304	298

(ii) ASM2525 and ASM5015 Carbon Monoxide (%CO) Table

Column Number – –›	*21*	*21*	*22*	*22*	*23*	*23*	*24*	*24*	*25*	*25*	*26*	*26*	*27*	*27*	*28*	*28*
Vehicle ETW	5015	2525	5015	2525	5015	2525	5015	2525	5015	2525	5015	2525	5015	2525	5015	2525
1750	0.80	0.77	1.26	1.22	1.64	1.83	2.02	2.43	2.21	2.73	2.78	3.64	2.97	3.94	3.16	4.24
1875	0.75	0.73	1.19	1.16	1.55	1.72	1.91	2.29	2.09	2.58	2.63	3.43	2.81	3.71	2.98	4.00
2000	0.71	0.69	1.13	1.09	1.47	1.63	1.81	2.17	1.97	2.43	2.48	3.24	2.65	3.51	2.82	3.77
2125	0.68	0.66	1.07	1.04	1.39	1.54	1.71	2.05	1.87	2.30	2.35	3.06	2.51	3.32	2.67	3.57
2250	0.64	0.62	1.02	0.99	1.32	1.47	1.62	1.94	1.77	2.18	2.23	2.90	2.38	3.14	2.53	3.38
2375	0.61	0.59	0.97	0.94	1.26	1.39	1.54	1.85	1.69	2.07	2.12	2.76	2.26	2.98	2.40	3.21
2500	0.59	0.57	0.93	0.90	1.20	1.33	1.47	1.76	1.61	1.97	2.02	2.62	2.15	2.84	2.29	3.05
2625	0.56	0.54	0.89	0.86	1.15	1.27	1.41	1.68	1.53	1.88	1.92	2.50	2.05	2.70	2.18	2.91
2750	0.54	0.52	0.85	0.82	1.10	1.21	1.34	1.60	1.47	1.80	1.84	2.39	1.96	2.58	2.09	2.78
2875	0.52	0.50	0.82	0.79	1.05	1.16	1.29	1.54	1.41	1.72	1.76	2.29	1.88	2.47	2.00	2.66
3000	0.50	0.48	0.79	0.76	1.01	1.12	1.24	1.48	1.35	1.66	1.69	2.19	1.80	2.37	1.92	2.55
3125	0.48	0.46	0.76	0.73	0.98	1.08	1.19	1.42	1.30	1.59	1.63	2.11	1.74	2.28	1.84	2.45
3250	0.46	0.45	0.73	0.71	0.94	1.04	1.15	1.37	1.26	1.53	1.57	2.03	1.67	2.20	1.78	2.36
3375	0.45	0.43	0.71	0.69	0.91	1.00	1.11	1.32	1.21	1.48	1.52	1.96	1.62	2.12	1.72	2.28
3500	0.44	0.42	0.69	0.67	0.88	0.97	1.08	1.28	1.17	1.43	1.47	1.89	1.56	2.05	1.66	2.20
3625	0.42	0.41	0.67	0.65	0.86	0.94	1.05	1.24	1.14	1.39	1.42	1.84	1.52	1.98	1.61	2.13
3750	0.41	0.40	0.65	0.63	0.83	0.92	1.02	1.20	1.11	1.35	1.38	1.78	1.47	1.92	1.56	2.07
3875	0.40	0.39	0.63	0.61	0.81	0.89	0.99	1.17	1.08	1.31	1.34	1.73	1.43	1.87	1.52	2.01
4000	0.39	0.38	0.62	0.60	0.79	0.87	0.96	1.14	1.05	1.28	1.31	1.68	1.39	1.82	1.48	1.95
4125	0.38	0.37	0.60	0.58	0.77	0.85	0.94	1.11	1.02	1.24	1.27	1.64	1.36	1.77	1.44	1.90
4250	0.37	0.36	0.59	0.57	0.75	0.83	0.92	1.08	1.00	1.21	1.24	1.60	1.32	1.72	1.40	1.85
4375	0.36	0.35	0.58	0.56	0.74	0.81	0.89	1.06	0.97	1.18	1.21	1.56	1.29	1.68	1.37	1.81

4500	0.36	0.35	0.57	0.55	0.72	0.79	0.87	1.03	0.95	1.16	1.18	1.52	1.26	1.64	1.34	1.76
4625	0.35	0.34	0.55	0.54	0.70	0.77	0.85	1.01	0.93	1.13	1.15	1.48	1.23	1.60	1.30	1.72
4750	0.34	0.33	0.54	0.53	0.69	0.76	0.84	0.99	0.91	1.10	1.13	1.45	1.20	1.57	1.28	1.68
4875	0.34	0.33	0.53	0.52	0.67	0.74	0.82	0.97	0.89	1.08	1.10	1.42	1.17	1.53	1.25	1.64
5000	0.33	0.32	0.52	0.51	0.66	0.73	0.80	0.95	0.87	1.05	1.08	1.38	1.15	1.49	1.22	1.60
5125	0.32	0.31	0.51	0.50	0.65	0.71	0.78	0.92	0.85	1.03	1.05	1.35	1.12	1.46	1.19	1.57
5250	0.32	0.31	0.50	0.49	0.63	0.70	0.77	0.90	0.83	1.01	1.03	1.32	1.10	1.43	1.16	1.53
5375	0.31	0.30	0.49	0.48	0.62	0.68	0.75	0.89	0.81	0.99	1.01	1.29	1.07	1.39	1.14	1.50
5500	0.30	0.30	0.48	0.47	0.61	0.67	0.73	0.87	0.80	0.97	0.99	1.26	1.05	1.36	1.11	1.46
5625	0.30	0.29	0.47	0.46	0.59	0.65	0.72	0.85	0.78	0.94	0.97	1.24	1.03	1.33	1.09	1.43
5750	0.29	0.29	0.46	0.45	0.58	0.64	0.70	0.83	0.76	0.92	0.94	1.21	1.01	1.30	1.07	1.40
5875	0.29	0.28	0.45	0.44	0.57	0.63	0.69	0.81	0.75	0.91	0.92	1.18	0.98	1.27	1.04	1.37
6000	0.28	0.28	0.44	0.44	0.56	0.62	0.67	0.80	0.73	0.89	0.91	1.16	0.96	1.25	1.02	1.34
6125	0.28	0.27	0.44	0.43	0.55	0.61	0.66	0.78	0.72	0.87	0.89	1.13	0.94	1.22	1.00	1.31
6250	0.27	0.27	0.43	0.42	0.54	0.60	0.65	0.77	0.71	0.85	0.87	1.11	0.93	1.20	0.98	1.28
6375	0.27	0.26	0.42	0.42	0.53	0.59	0.64	0.76	0.69	0.84	0.86	1.09	0.91	1.18	0.96	1.26
6500	0.26	0.26	0.42	0.41	0.52	0.58	0.63	0.74	0.68	0.83	0.84	1.08	0.90	1.16	0.95	1.24
6625	0.26	0.26	0.41	0.41	0.52	0.57	0.62	0.73	0.67	0.82	0.83	1.06	0.88	1.14	0.94	1.23
6750	0.26	0.26	0.41	0.41	0.51	0.57	0.61	0.73	0.67	0.81	0.82	1.05	0.88	1.13	0.93	1.21
6875	0.26	0.25	0.40	0.40	0.51	0.56	0.61	0.72	0.66	0.80	0.82	1.04	0.87	1.12	0.92	1.20
7000	0.25	0.25	0.40	0.40	0.51	0.56	0.61	0.72	0.66	0.80	0.82	1.04	0.87	1.12	0.92	1.20
7125	0.25	0.25	0.40	0.40	0.51	0.56	0.61	0.72	0.66	0.80	0.81	1.04	0.87	1.12	0.92	1.20
7250	0.25	0.25	0.40	0.40	0.50	0.56	0.61	0.72	0.66	0.80	0.81	1.04	0.86	1.12	0.92	1.20
7375	0.25	0.25	0.40	0.40	0.50	0.56	0.61	0.72	0.66	0.80	0.81	1.04	0.86	1.12	0.92	1.20
7500	0.25	0.25	0.40	0.40	0.50	0.56	0.61	0.72	0.66	0.80	0.81	1.04	0.86	1.12	0.92	1.20

ASM2525 and ASM5015 Carbon Monoxide (%CO) Table (cont.)

Column Number –›	*29*	*29*	*30*	*30*	*31*	*31*	*32*	*32*	*33*	*33*	*34*	*34*
Vehicle ETW	5015	2525	5015	2525	5015	2525	5015	2525	5015	2525	5015	2525
1750	3.54	4.85	3.92	5.45	4.31	6.06	5.07	7.26	5.26	7.44	8.02	9.90
1875	3.34	4.57	3.70	5.14	4.06	5.70	4.78	6.84	4.96	7.05	7.56	9.90

2000	3.16	4.31	3.49	4.85	3.83	5.38	4.51	6.45	4.68	6.68	7.14	9.90
2125	2.99	4.08	3.31	4.58	3.63	5.09	4.26	6.10	4.43	6.34	6.75	9.66
2250	2.83	3.86	3.13	4.34	3.44	4.82	4.04	5.78	4.20	6.00	6.40	9.14
2375	2.69	3.66	2.98	4.12	3.26	4.57	3.83	5.48	3.98	5.69	6.07	8.67
2500	2.56	3.48	2.83	3.91	3.10	4.35	3.65	5.21	3.79	5.41	5.78	8.25
2625	2.44	3.32	2.70	3.73	2.96	4.14	3.48	4.96	3.61	5.15	5.51	7.85
2750	2.33	3.17	2.58	3.56	2.83	3.95	3.32	4.73	3.45	4.92	5.26	7.50
2875	2.23	3.03	2.47	3.41	2.71	3.78	3.18	4.53	3.30	4.70	5.03	7.17
3000	2.14	2.91	2.37	3.27	2.60	3.62	3.05	4.34	3.17	4.51	4.83	6.87
3125	2.06	2.79	2.28	3.14	2.50	3.48	2.93	4.17	3.04	4.33	4.64	6.60
3250	1.99	2.69	2.20	3.02	2.40	3.35	2.82	4.01	2.93	4.17	4.47	6.35
3375	1.92	2.60	2.12	2.91	2.32	3.23	2.72	3.87	2.83	4.02	4.31	6.13
3500	1.86	2.51	2.05	2.82	2.24	3.12	2.63	3.74	2.73	3.88	4.17	5.92
3625	1.80	2.43	1.99	2.73	2.17	3.02	2.55	3.62	2.65	3.76	4.04	5.73
3750	1.74	2.36	1.93	2.64	2.11	2.93	2.47	3.51	2.57	3.64	3.91	5.55
3875	1.69	2.29	1.87	2.57	2.05	2.85	2.40	3.40	2.49	3.54	3.80	5.39
4000	1.65	2.22	1.82	2.49	1.99	2.77	2.33	3.31	2.43	3.44	3.70	5.24
4125	1.61	2.16	1.77	2.43	1.94	2.69	2.27	3.22	2.36	3.34	3.60	5.09
4250	1.56	2.11	1.73	2.36	1.89	2.62	2.21	3.13	2.30	3.25	3.51	4.96
4375	1.53	2.06	1.68	2.31	1.84	2.55	2.16	3.05	2.24	3.17	3.42	4.83
4500	1.49	2.01	1.64	2.25	1.80	2.49	2.11	2.98	2.19	3.09	3.34	4.71
4625	1.46	1.96	1.61	2.19	1.76	2.43	2.06	2.90	2.14	3.02	3.26	4.60
4750	1.42	1.91	1.57	2.14	1.72	2.37	2.01	2.83	2.09	2.95	3.18	4.49
4875	1.39	1.87	1.53	2.09	1.68	2.32	1.96	2.77	2.04	2.87	3.11	4.38
5000	1.36	1.82	1.50	2.04	1.64	2.26	1.92	2.70	1.99	2.81	3.03	4.28
5125	1.33	1.78	1.46	2.00	1.60	2.21	1.87	2.64	1.95	2.74	2.97	4.18
5250	1.30	1.74	1.43	1.95	1.56	2.16	1.83	2.58	1.90	2.68	2.90	4.08
5375	1.27	1.70	1.40	1.90	1.53	2.11	1.79	2.51	1.86	2.61	2.83	3.98
5500	1.24	1.66	1.37	1.86	1.49	2.06	1.75	2.46	1.82	2.55	2.77	3.89
5625	1.21	1.62	1.34	1.82	1.46	2.01	1.71	2.40	1.77	2.49	2.70	3.80
5750	1.19	1.59	1.31	1.78	1.43	1.96	1.67	2.34	1.74	2.43	2.64	3.71
5875	1.16	1.55	1.28	1.74	1.40	1.92	1.63	2.29	1.70	2.38	2.59	3.62
6000	1.14	1.52	1.25	1.70	1.37	1.88	1.60	2.24	1.66	2.33	2.53	3.54
6125	1.11	1.49	1.23	1.66	1.34	1.84	1.57	2.19	1.63	2.28	2.48	3.47
6250	1.09	1.46	1.20	1.63	1.31	1.80	1.54	2.15	1.60	2.23	2.43	3.40

6375	1.07	1.43	1.18	1.60	1.29	1.77	1.51	2.11	1.57	2.19	2.39	3.34
6500	1.06	1.41	1.16	1.57	1.27	1.74	1.48	2.07	1.54	2.15	2.35	3.28
6625	1.04	1.39	1.15	1.55	1.25	1.72	1.46	2.04	1.52	2.12	2.32	3.23
6750	1.03	1.37	1.14	1.54	1.24	1.70	1.45	2.02	1.50	2.10	2.29	3.20
6875	1.02	1.36	1.13	1.52	1.23	1.68	1.44	2.00	1.49	2.08	2.28	3.17
7000	1.02	1.36	1.12	1.52	1.23	1.68	1.43	2.00	1.49	2.08	2.27	3.17
7125	1.02	1.36	1.12	1.52	1.22	1.68	1.43	2.00	1.49	2.08	2.27	3.17
7250	1.02	1.36	1.12	1.52	1.22	1.68	1.43	2.00	1.49	2.08	2.27	3.17
7375	1.02	1.36	1.12	1.52	1.22	1.68	1.43	2.00	1.49	2.08	2.27	3.17
7500	1.02	1.36	1.12	1.52	1.22	1.68	1.43	2.00	1.49	2.08	2.27	3.17

(iii) ASM2525 and ASM5015 Nitric Oxide (PPM NO) Table

Column Number – –›	*41*	*41*	*42*	*42*	*43*	*43*	*44*	*44*	*45*	*45*	*46*	*46*	*47*	*47*	*48*	*48*
Vehicle ETW	5015	2525	5015	2525	5015	2525	5015	2525	5015	2525	5015	2525	5015	2525	5015	2525
1750	1212	1095	1819	1642	2272	2114	2725	2587	3178	3060	3631	3532	4084	4005	4990	4950
1875	1142	1031	1713	1547	2181	1991	2649	2435	3117	2879	3586	3323	4054	3767	4990	4655
2000	1077	973	1616	1460	2058	1877	2499	2295	2941	2713	3383	3131	3824	3548	4707	4384
2125	1018	920	1527	1380	1944	1774	2360	2167	2776	2561	3192	2955	3609	3348	4441	4136
2250	964	871	1446	1307	1839	1678	2232	2050	2625	2422	3018	2794	3411	3165	4197	3909
2375	915	827	1372	1240	1744	1592	2115	1943	2487	2295	2859	2646	3231	2998	3974	3701
2500	869	786	1304	1179	1657	1512	2009	1845	2361	2179	2714	2512	3066	2845	3771	3512
2625	828	749	1242	1123	1577	1440	1912	1756	2246	2073	2581	2389	2916	2706	3585	3339
2750	791	715	1186	1072	1504	1374	1823	1675	2142	1976	2460	2277	2779	2579	3416	3181
2875	756	684	1134	1026	1438	1313	1742	1601	2046	1888	2350	2175	2654	2463	3261	3037
3000	725	656	1088	984	1378	1258	1668	1533	1959	1808	2249	2082	2539	2357	3120	2906
3125	696	630	1045	945	1323	1208	1601	1471	1879	1734	2157	1997	2435	2260	2992	2787
3250	670	607	1006	910	1273	1163	1539	1415	1806	1667	2073	1920	2340	2172	2874	2677
3375	647	585	970	878	1227	1121	1483	1363	1740	1606	1997	1849	2253	2092	2767	2577
3500	625	566	937	848	1184	1082	1432	1316	1679	1550	1926	1784	2174	2018	2668	2486
3625	605	547	907	821	1146	1047	1384	1273	1623	1498	1862	1724	2100	1950	2578	2401
3750	586	531	879	796	1110	1014	1340	1233	1571	1451	1802	1669	2033	1887	2494	2323

3875	569	515	853	773	1077	984	1300	1195	1523	1407	1747	1618	1970	1829	2417	2251
4000	553	501	829	751	1046	956	1262	1161	1479	1365	1695	1570	1912	1775	2345	2184
4125	538	487	807	731	1017	930	1227	1128	1437	1327	1647	1526	1857	1724	2277	2122
4250	524	475	786	712	990	905	1194	1098	1398	1291	1602	1484	1806	1677	2214	2063
4375	510	463	766	694	964	882	1162	1069	1360	1257	1559	1444	1757	1632	2154	2007
4500	498	451	747	677	939	859	1132	1042	1325	1224	1518	1406	1711	1589	2096	1953
4625	486	440	728	661	916	838	1104	1015	1291	1193	1479	1370	1666	1548	2042	1903
4750	474	430	711	645	893	818	1076	990	1259	1163	1441	1336	1624	1508	1989	1854
4875	463	420	694	630	872	798	1049	966	1227	1134	1405	1302	1583	1470	1938	1806
5000	452	410	677	615	850	778	1023	942	1196	1106	1369	1269	1542	1433	1889	1760
5125	441	400	661	600	830	760	998	919	1167	1078	1335	1237	1503	1397	1840	1715
5250	431	391	646	586	810	741	974	896	1138	1051	1301	1206	1465	1362	1793	1672
5375	420	382	631	573	790	723	950	874	1109	1025	1269	1176	1428	1327	1747	1629
5500	410	373	616	559	771	706	926	853	1082	1000	1237	1147	1392	1294	1703	1587
5625	401	364	601	546	752	689	904	832	1055	975	1206	1118	1357	1261	1659	1547
5750	391	356	587	534	734	673	882	812	1029	951	1176	1090	1323	1230	1617	1508
5875	383	348	574	522	717	657	860	793	1004	928	1147	1064	1290	1199	1577	1471
6000	374	340	561	510	701	642	840	774	980	906	1120	1039	1259	1171	1539	1435
6125	366	333	549	499	685	628	822	757	958	886	1094	1015	1230	1144	1503	1401
6250	359	326	538	489	671	615	804	741	937	867	1070	993	1203	1119	1469	1371
6375	352	320	528	480	658	604	788	727	919	850	1049	973	1179	1096	1439	1343
6500	346	315	519	473	647	593	775	714	902	835	1030	956	1158	1077	1413	1318
6625	341	311	512	466	638	585	763	704	889	823	1014	941	1140	1060	1391	1298
6750	338	307	507	461	631	578	755	696	879	813	1003	931	1127	1048	1374	1283
6875	335	305	503	458	626	574	749	691	872	807	995	924	1118	1040	1364	1273
7000	335	305	502	457	624	573	747	689	870	805	992	921	1115	1037	1360	1269
7125	335	305	502	457	625	573	747	689	870	805	992	921	1115	1037	1360	1269
7250	335	305	502	457	625	573	747	689	870	805	992	921	1115	1037	1360	1269
7375	335	305	502	457	625	573	747	689	870	805	992	921	1115	1037	1360	1269
7500	335	305	502	457	625	573	747	689	870	805	992	921	1115	1037	1360	1269

ASM2525 and ASM5015 Nitric Oxide (PPM NO) Table (cont.)

Column Number – –›	*49*	*49*	*50*	*50*	*51*	*51*

Vehicle ETW	5015	2525	5015	2525	5015	2525
1750	4990	4960	4990	4980	4990	4990
1875	4990	4738	4990	4906	4990	4990
2000	4778	4535	4919	4838	4990	4990
2125	4578	4349	4853	4776	4990	4990
2250	4395	4179	4792	4720	4990	4990
2375	4228	4024	4736	4668	4990	4990
2500	4076	3881	4685	4620	4990	4990
2625	3936	3752	4639	4577	4990	4990
2750	3809	3579	4596	4374	4990	4772
2875	3669	3417	4484	4176	4892	4556
3000	3510	3270	4290	3996	4680	4359
3125	3366	3135	4114	3832	4488	4180
3250	3234	3012	3952	3681	4311	4016
3375	3113	2899	3804	3544	4150	3866
3500	3002	2796	3669	3418	4002	3728
3625	2900	2701	3544	3302	3867	3602
3750	2806	2614	3429	3195	3741	3485
3875	2719	2533	3323	3096	3625	3377
4000	2638	2457	3224	3003	3517	3276
4125	2562	2387	3131	2917	3416	3182
4250	2490	2320	3044	2836	3321	3094
4375	2423	2258	2961	2759	3230	3010
4500	2359	2198	2883	2686	3145	2930
4625	2297	2140	2807	2616	3063	2854
4750	2238	2085	2735	2549	2983	2780
4875	2180	2032	2665	2483	2907	2709
5000	2125	1980	2597	2420	2833	2640
5125	2070	1930	2530	2359	2760	2573
5250	2017	1881	2466	2298	2690	2507
5375	1966	1833	2403	2240	2621	2443
5500	1916	1786	2341	2183	2554	2381
5625	1867	1740	2282	2127	2489	2321
5750	1820	1697	2224	2074	2426	2262
5875	1774	1654	2168	2022	2366	2206

6000	1731	1614	2116	1973	2308	2152
6125	1690	1577	2066	1927	2254	2102
6250	1653	1542	2020	1884	2204	2056
6375	1619	1510	1979	1846	2159	2014
6500	1590	1483	1943	1813	2119	1977
6625	1565	1460	1913	1785	2087	1947
6750	1546	1443	1890	1764	2062	1924
6875	1534	1432	1875	1750	2046	1909
7000	1530	1428	1870	1745	2040	1904
7125	1531	1428	1874	1745	2045	1904
7250	1531	1428	1874	1745	2045	1904
7375	1531	1428	1874	1745	2045	1904
7500	1531	1428	1874	1745	2045	1904

(b) *ASM Test Score Calculation*

(1) Exhaust gas measurement calculation.

(i) System response time

The analysis and recording of exhaust gas concentrations shall begin 12 seconds after the applicable test mode begins, or sooner if the system response time is less than 12 seconds. The analyzing and recording of exhaust gas concentrations shall not begin sooner than the time period equivalent to the response time of the slowest transducer.

(ii) Sample rate

Exhaust gas concentrations shall be analyzed at a minimum rate of once per second.

(iii) Emission measurement calculations.

Partial stream (concentration) emissions shall be calculated based on a running 10-second average. The values used for HC(J), CO(J), and NO(J) are the raw (uncorrected) tailpipe concentrations.

$$AVGHC = \frac{\sum_{j-10}^{j} HC(j) * DCF(j)}{10}$$

(a)

$$AVGCO = \frac{\sum_{j-10}^{j} CO(j) * DCF(j)}{10}$$

(b)

$$AVGNO = \frac{\sum_{j-10}^{j} NO(j) * K(h) * DCF(j)}{10}$$

(c)

(iv) Dilution correction factor.

The analyzer software shall multiply the raw emissions values by the dilution correction factor (DCF) during any valid ASM emissions test. The DCF accounts for exhaust sample dilution (either intentional or unintentional) during an emissions test. The analyzer software shall calculate the DCF using the following procedure, and shall select the appropriate vehicle fuel formula. If the calculated DCF exceeds 3.0 then a default value of 3.0 shall be used.

(a)

$$X = \frac{[CO_2]_{MEASURED}}{[CO_2]_{MEASURED} + [CO]_{MEASURED}}$$

Where $[CO_2]_{MEASURED}$ and $[CO]_{MEASURED}$ are the instantaneous ASM emissions test readings.

(b) Calculate $[CO_2]_{adjusted}$ using the following formulas.

(1) For gasoline:

$$[CO_2]_{adjusted} = \left(\frac{X}{4.644 + 1.88x}\right) * 100$$

(2) For Methanol or Ethanol:

$$[CO_2]_{adjusted} = \left(\frac{X}{4.73 + 1.88x}\right) * 100$$

(3) For Compressed Natural Gas (CNG):

$$[CO_2]_{adjusted} = \left(\frac{X}{4.64 + 1.88x}\right) * 100$$

(4) For Liquid Propane Gas (LPG):

$$[CO_2]_{adjusted} = \left(\frac{X}{5.39 + 1.88x}\right) * 100$$

(c) Calculate the DCF using the following formula.

$$DCF = \frac{[CO]_{ADJUSTED}}{[CO]_{MEASURED}}$$

(v) K_h = No humidity correction factor.

(a)

$$K_H = \frac{1}{[1 - 0.0047(H - 75)]}$$

(b) H = Absolute humidity in grains of water per pound of dry air.

$$= \frac{(43.478)RA*PD)}{P_B - (PD*RA/100)]}$$

(c) RA = Relative humidity of the ambient air percent.

(d) PD = Saturated vapor pressure, MM HG at the ambient dry bulb temperature. If the temperature is above 86°F, then it shall be used in lieu of the higher temperature, until EPA supplies final correction factors.

(e) P_B = Barometric pressure, MM HG.

(2) Pass/fail determination.

A pass or fail determination shall be made for each applicable test mode based on a comparison of the applicable short test standards and the measured value for HC, CO, and NO as described in Paragraph (b)(1)(iii) of this section. A vehicle shall pass the test mode if the emission values for HC, CO, and NO are simultaneously below or equal to the applicable short test standards for all three pollutants. A vehicle shall fail the test mode if the values for HC, CO, or NO, or any combination of the three, are above the applicable standards at the expiration of the test time.

§ 2. ASM short test procedure.

(a) *General requirements*

(1) Vehicle characterization.

(i) Vehicle type: LDGV, LDGT1, LDGT2, HDGT, and others as needed;

(ii) Chassis model year;

(iii) Make;

(iv) Model;

(v) Number of cylinders;

(vi) Cubic inch or liters displacement of the engine;

(vii) Transmission type; and

(viii) Equivalent test weight.

(2) Ambient conditions.

The ambient temperature, relative humidity and barometric pressure shall be recorded continuously during the test cycle or as a single set of readings up to 4 minutes before the start of the driving cycle.

(3) Restart.

If shut off, the vehicle shall be restarted as soon as possible before the test and shall be running at least 30 seconds prior to the start of the ASM driving cycle.

(4) Void test conditions.

The test shall immediately end and any exhaust gas measurements shall be voided if the instantaneous measured concentration of CO plus CO_2 falls below 6% or the vehicle's engine stalls at any time during the test sequence.

(5) Test time limit.

The test shall be aborted or terminated upon reaching the overall maximum test time.

(b) *Pre-inspection and preparation.*

(1) Accessories.

All accessories (air conditioning, heat, defogger, radio, automatic traction control if switchable, and the like) shall be turned off (if necessary, by the inspector).

(2) Exhaust leaks.

The vehicle shall be inspected for exhaust leaks by test personnel. Audio assessment while blocking exhaust flow shall be acceptable. Vehicles with leaking exhaust systems shall be rejected from testing.

(3) Fluid leaks.

Vehicles with excessive leaking engine oil, transmission fluid or coolant shall be rejected from testing.

(4) Mechanical condition.

Vehicles with obvious mechanical problems (engine, transmission, brakes or exhaust) that either create a safety hazard or could bias test results shall be rejected from testing.

(5) Operating temperature.

The vehicle shall be at proper operating temperature prior to the start of the test. The vehicle temperature gauge, if equipped and operating, shall be checked to assess temperature. Vehicles in overheated condition shall be rejected from testing.

(6) Tire condition.

Vehicles shall be rejected from testing if tread indicators, tire cords, bubbles, cuts or other damage are visible. Vehicles shall be rejected from testing if they have space-saver spare tires or if they do not have reasonably sized tires on the drive axle or axles. Vehicles may be rejected if they have different sized tires on the drive axle or axles. In test-and-repair facilities, drive wheel tires shall be checked with a gauge for adequate tire pressure. In test-only facilities, drive wheel tires shall be visually checked for adequate pressure level. Drive wheel tires that appear low shall be inflated to approximately 30 PSI, or to tire side wall pressure, or vehicle manufacturer’s recommendation. Alternatively, vehicles with apparent low tire pressure may be rejected from testing.

(7) Emission sample system purge/hang-up.

While a lane is in operation, the sample system shall be continuously purged after each test for at least 15 minutes if not taking measurements. If the HC reading, when the probe is sampling ambient air, exceeds 7 PPM C6 on an instantaneous measure, testing shall be prohibited. Testing may proceed after a determination is made that hang-up is less than 7 PPM C6 (that is, by eliminating the ambient background contribution to the measurement).

(8) Roll rotation.

The vehicle shall be maneuvered onto the dynamometer with the drive wheels positioned on the dynamometer rolls, prior to restraining the vehicle and test initiation. The rolls shall be rotated until the vehicle laterally stabilizes on the dynamometer. Vehicles that cannot be stabilized on the dynamometer shall be rejected from testing. Drive wheel tires shall be dried if necessary to prevent slippage.

(9) Cooling system.

When ambient temperatures exceed 72°F, testing shall not begin until the cooling system is positioned and activated. The cooling system blower shall be positioned to direct air to the vehicle cooling system, but shall not be directed at the catalytic converter.

(10) Vehicle restraint.

Testing shall not begin until the vehicle is restrained. Any restraint system shall meet the requirements of § 3(a)(5)(ii). In addition, the parking brake shall be set for front wheel drive vehicles prior to the start of the test, unless parking brake functions on front axle or if it is automatically disengaged when in gear.

(11) Dynamometer warm-up.

The dynamometer shall be in a warmed-up condition prior to official testing and use shall be locked out until it is warmed up. Dynamometers resting (not operated for at least 30 seconds and at least 15 mph) for more than 30 minutes shall pass the coast-down check specified in § 4(b)(1) prior to use in testing. Control charts may be used to demonstrate the need for less frequent warm- up.

Testing cannot occur below 41°F.

(12) Analyzer warm-up.

An emissions test shall not begin before the analyzer has been adequately warmed up. Turning on the analyzer for a time period of at least 4 times the period of time required to reach stability as demonstrated in the equipment certification (see § 7) shall constitute ‘‘warmed-up.’’

(c) *Test sequence.*

(1) The test sequence shall consist of a single ASM mode described in § 2(d) of this subpart. Vehicles that fail the first chance test as described in § 2(d) of this subpart shall receive a second chance test under § 2(e) of this subpart. The second chance test shall consist of a repetition of the mode or modes that were failed in the first chance test according to the conditions in § 2(e) of this subpart.

(2) The test sequence shall begin only after the following requirements are met:

(i) Load setting.

Prior to each mode, the system shall automatically select the load setting of the dynamometer from a supplied look-up table.

(ii) Accessories.

The vehicle shall be tested in as-received condition with all accessories turned off. The engine shall be at normal operating temperature.

(iii) Gear selection.

The vehicle shall be operated during each mode of the test with the gear selector in drive for automatic transmissions and in second (or third if more appropriate) for manual transmissions for the loaded modes. Engine RPM shall be measured per § 3(d)(6).

(iv) Sample probe.

The sample probe shall be inserted into the vehicle’s tailpipe to a minimum depth of 10 inches. If the vehicle’s exhaust system prevents insertion to this depth, a tailpipe extension shall be used.

(v) Multiple exhaust pipes.

Exhaust gas concentrations from vehicle engines equipped with functionally independent multiple exhaust pipes shall be sampled simultaneously.

(vi) Automatic gas zero.

The analyzer shall conduct an automatic zero adjustment using the zero gas specified in § 4(d)(iii).

(vii) Automatic zero adjustment.

The zero adjustment shall include HC, CO, CO_2 and NO channels.

(viii) Ambient air and HC hang-up determination.

The analyzer shall perform the automatic zeroing, O_2 calibration (if included) and ambient air reading, followed by an HC hang-up check. This process shall begin after initiation of data entry into the analyzer computer. The analyzer shall be locked out from testing until: (1) the ambient air (sampled through the probe) has less than 15 PPM HC and (2) the residual HC in the sampling system (probe sample—port sample) is less than 7 PPM.

(ix) Engine speed.

For 1996 and newer vehicles equipped with Federal OBD systems or California OBD II systems, engine speed in RPM may be monitored by the standardized plug throughout the test. RPM readings shall be recorded on a second-by-second basis. In test-and-repair stations, engine speed shall also be monitored on all pre-1996 vehicles and recorded in the test record. For vehicles that are not equipped for OBD measurement, an alternative means of measuring engine speed (RPM) shall be provided.

(d) *Overall test procedure.*

The test timer shall start (TT=0) when the conditions specified in paragraph (c)(2) are met. The dynamometer rolls reach 1.0 MPH due to the test vehicle's initial acceleration for testing purposes, and the mode timer initiates as specified in paragraph (d)(2). The test sequence shall have an overall maximum test time of 290 seconds (TT-290). The test shall be immediately terminated or aborted upon reaching the overall maximum test time. The test mode in § 2(d)(3) may precede the test mode in § 2(d)(2).

(1) Preconditioning cycle.

Vehicle preconditioning shall be performed prior to start of an official test. The preconditioning cycle must be approved by the Department. A state may waive the preconditioning requirement if it ensures that all vehicles are adequately warmed up prior to taking the final emissions

measurements as described at § 1(b)(iii). The following preconditioning cycle is approved:

(i) The preconditioning timer shall start once the dynamometer has reached a speed of 15 or 25 mph (PT=0), consistent with the speed of the first test mode. The vehicle will continue to be operated for a maximum of 30 seconds at this speed within ±5 MPH and within ±10% of the wheel force tolerance specified in § 2(d)(2). The duration of the preconditioning cycle may be adjusted if a Department determines through the use of statistical process control methods that an alternative preconditioning cycle duration is adequate to ensure that vehicles are fully warmed up prior to testing. If the speed or wheel force fall above or below the tolerance, the preconditioning timer will reset to zero. Preconditioning time shall not be included in the overall maximum test time.

(2) ASM5015 mode.

(i) Mode timer.

The mode timer shall start (MT=0) when the dynamometer speed (and corresponding wheel force) are maintained within 15±1.0 miles per hour for 5 continuous seconds. If the inertia simulation exceeds the tolerance specified in § 3(a)(4)(ii)(b) for more than 5 consecutive seconds after the mode timer is started, the test mode timer shall be set to TT=0. If this happens a second time, the test shall be aborted. The dynamometer shall apply the correct wheel force based on the required ASM horsepower load at 15 mph across the testing speed window (15±1.0 miles per hour) (that is, constant load over the speed range). The wheel force torque tolerance shall be ±5% of the correct wheel force at 15 MPH.

(ii) Look-up table.

The dynamometer power shall be automatically selected from an EPA-supplied or EPA-approved look-up table, based upon the vehicle identification information described in § 2(a)(1). Vehicles not listed in the look-up table and for which ETW is not available shall be tested using the following default settings:

	Default ASM5015 actual horsepower				
	settings				
Number of Cylinders	*for 8.6" dynamometers HP5015* [8]				
Vehicle type	*3*	*4*	*5 & 6*	*8*	*›8*
Sedans	7.9	11.4	13.8	16.4	16.0

Station wagons	8.1	11.7	13.8	16.1	16.1
Mini-vans	10.2	14.1	15.8	17.9	18.2
Pickup trucks	9.6	13.1	16.4	19.2	21.1
Sport/utility	10.1	13.4	15.5	19.4	21.1
Full vans	10.3	13.9	17.7	19.6	20.5

	Default ASM5015 actual horsepower				
	settings				
Number of Cylinders	*for 20" dynamometers HP5015* [20]				
Vehicle type	*3*	*4*	*5 & 6*	*8*	*›8*
Sedans	8.1	11.8	14.3	16.9	16.6
Station wagons	8.3	12.1	14.2	16.6	16.6
Mini-vans	10.4	14.5	16.3	18.5	18.7
Pickup trucks	9.8	13.4	16.8	19.8	21.7
Sport/utility	10.5	13.8	15.9	19.9	21.7
Full vans	10.8	14.4	18.2	20.2	21.1

If the dynamometer speed or wheel force falls outside the speed or wheel force tolerance for more than 2 consecutive seconds, or for more than 5 seconds total, the mode timer shall reset to zero and resume timing. The minimum mode length shall be determined as described in paragraph (d)(2)(iii). The maximum mode length shall be equal to 90 seconds elapsed time (MT = 90).

If the speed at the end of the 10 second period is more than 0.5 mph less (absolute drop, not cumulative) than the speed at the start of the 10 second period, testing shall continue until the speed stabilizes enough to meet this criterion.

(iii) Pass/fail determination.

The pass/fail analysis shall begin after an elapsed time of 22 seconds (MT = 22. A pass or fail determination shall be made for the vehicle and the mode shall be terminated as follows:

(a) The vehicle shall pass the ASM5015 mode and the mode shall be immediately terminated if, at any point between an elapsed time of 22 seconds (MT = 22) and 90 seconds (MT = 90), the 10 second running

average measured values for each pollutant are simultaneously less than or equal to the applicable test standards described in paragraph (a).

(b) The vehicle shall fail the ASM5015 mode and the mode shall be terminated if paragraph (d)(2)(iii)(a) is not satisfied by an elapsed time of 90 seconds (MT = 90).

(iv) If ASM5015 is the first test mode, upon termination of the ASM5015 mode, the vehicle shall immediately begin accelerating to the speed required for the ASM2525 mode, if applicable. The dynamometer shall smoothly transition during the acceleration period and shall automatically reset to the load required for the ASM 2525 mode, if applicable, once the roll speed is achieved.

(e) *Second chance tests.*

If a vehicle fails the 5015 test mode and completes all required test modes with emissions values for HC, CO and NO not greater than 150% of the applicable standard, the vehicle shall receive a second chance test for each failed test mode.

(1) If the vehicle fails the first-chance test, the test timer shall reset to zero (TT=0) and a second-chance test shall be performed, except as noted below. The second-chance test shall have an overall maximum test time of 110 seconds (TT=110) if one mode is repeated.

NOTE: Maximum mode time: 90 sec.
+Maximum transition: 15 sec.
+DYNE stabilization: 5 sec.
110 sec.

12 sec. transport and 10 sec. averaging are included in the mode time as in the initial test.

(2) Repetition of failed modes for single mode ASM tests.

(i) If the vehicle is failing at the end of the mode, then the test mode shall not end at 90 seconds but shall continue for up to 180 seconds.

§ 3. ASM short test equipment.

(a) *Dynamometer specifications.*

(1) General requirements

(i) Capacity

The dynamometer structure (for example, bearings, rollers, pit plates, and the like) shall accommodate all light-duty vehicles and light-duty trucks up to 9,000 pounds GVWR.

(ii) ASM load

Dynamometer ASM load horsepower ($HP5015_{YY}$) shall be automatically selected based on the vehicle parameters in the test record.

(iii) Alternative design

Alternative dynamometer specification or designs may be allowed upon a determination by the Department that, for the purpose of properly conducting an approved short test, the evidence supporting these deviations will not cause improper vehicle loading.

(2) Power absorption.

(i) Vehicle loading.

The vehicle loading used during the ASM driving cycles shall follow the equation in paragraph (a)(2)(ii) of this section at 15. Unless otherwise noted, any horsepower displayed during testing shall be $HP5015_{YY}$.

(ii) HP calculation

$IHPXXXX_{YY} = THPXXXX\text{-}PLHP_{ZZ\text{-}YY}$ -$GTRL_{@ZZ\ MPH\text{-}YY\text{-}}$ $HPXXXX_{YY} = IHPXXXX_{YY} + PLHP_{ZZ\text{-}YY}$

(iii) Range of power absorber.

The range of the power absorber shall be sufficient to test all light-duty vehicles and light-duty trucks up to 9,000 pounds GVWR, using both the ASM5015 and ASM2525. The absorption shall be adjustable in 0.1 hp increments at both 15 mph and 25 mph.

(iv) Parasitic losses.

The parasitic losses (PLHP) in each dynamometer system (such as windage, bearing friction and system drive friction) shall be characterized at 25 and 15 mph upon initial acceptance, and during each dynamometer calibration if required.

(v) Power absorber.

Only electric power absorbers shall be used unless alternatives are approved by the Department.

(vi) Power absorber accuracy.

The accuracy of the power absorber shall be 6.25 pounds of wheel force at 15 mph and 3.75 pounds of wheel force at 25 mph or ±2% of required wheel force, whichever is greater, in direction of rotation.

(3) Rolls

(i) Size and type.

The dynamometer shall be equipped with twin rolls. The rolls shall be coupled side-to-side. In addition, the front and rear rolls shall be coupled. The dynamometer roll diameter shall be between 8.5 and 21.0 inches. The spacing between the roll centers shall comply with the equation in paragraph (a)(3)(ii) to within 0.5 inch and -0.25 inch of the calculated value. The parasitic power losses shall be determined as indicated in § 4(b)(1)(iv). Fixed dynamometer rolls shall have an inside track width of no more than 30 inches and outside track width of at least 100 inches. Rolls moveable from side-to-side may be used if adequate measures are taken to prevent tire damage from lateral vehicle movement and the dynamometer sufficiently accommodates track widths of the full range of vehicles to be tested on the dynamometer. Alternative coupling methods, track widths, roll sizes and number of rolls may be used if approved by the Department and the Environmental Protection Agency and if adequate measures are taken to prevent tire damage from lateral vehicle movement and the dynamometer sufficiently accommodates track widths of the full range of vehicles to be tested on the dynamometer. General tire roll interface losses must be determined for alternative roll sizes, configurations and spacing.

(ii) Roll spacing

Roll spacing = (24.375+D) *SIN 31.5153

D = Dynamometer roll diameter.

Roll spacing and roll diameter are expressed in inches.

(iii) Design.

The roll size, surface finish and hardness shall be such that tire slippage is minimized under all weather conditions; that water removal is maximized;

that the specified accuracy of the distance and speed measurements are maintained; and that tire wear and noise are minimized.

(4) Inertia.

The dynamometer shall have a total test inertia weight of 2,000 pounds ±40 pounds. Any deviation from the 2,000 pound base inertia shall be quantified and the coast-down time shall be corrected accordingly. Any deviation from the stated inertia shall be quantified and the inertia simulation shall be corrected accordingly.

(i) Mechanical inertia.

Dynamometers shall be equipped with additional flywheel weights or diagnostic level inertia simulation, for transient simulations of up to +3.3 mph/s acceleration at 500 pound increments of mechanical inertia weight or 1 pound increments of electrically simulated positive inertia, to a total of 5,500 pounds up to speeds of 57 mph with a minimum load (power) of 25 horsepower at 14 mph over the inertia weight range of 2,000 to 6,000 pounds. A deviation from the stated inertia shall be quantified and the inertia simulation shall be corrected accordingly. Mechanical or electrical inertia simulation, or a combination of both, may be used, subject to review and approval.

(ii) Electrical inertia simulation.

Electrical inertia simulation, or a combination of electrical and mechanical simulation may be used in lieu of mechanical flywheels, provided that the performance of the electrically simulated inertia complies with the following specifications. Exceptions to these specifications may be allowed upon a determination by the Department that the exceptions would not significantly increase vehicle loading or emissions for the purpose of properly conducting an approved short test.

(a) System response. The torque response to a step change shall be at least 90% of the requested change within 300 milliseconds after a step change is commanded by the dynamometer control system, and shall be within 2% of the commanded torque by 300 milliseconds after the command is issued. Any overshoot of the commanded torque value shall not exceed 25% of the torque value.

(b) Simulation error. An inertia simulation error (ISE) shall be continuously calculated any time the actual dynamometer speed is between 10 mph and 60 mph. The ISE shall be calculated by the equation in § 3(a)(4)(ii)(c), and shall not exceed 3% of the inertia weight selected (IWS) for the vehicle under test.

(c) $ISE = [(IW_S - I_T)/(IV_S)] * 100$

(d)

$$I_T = I_M \frac{1}{V}\int_0^T (F_M - F_{RL})DT$$

Where:

I_T = Total inertia being simulated by the dynamometer (kg)

I_T (LB force) = I_T(KG) * 2.2046

I_M = Base (mechanical inertia of the dynamometer (kg)

V = Measured roll speed (M/S)

F_M = Force measured by the load cell (translated to the roll surface) (N)

F_{RL} = Road load force (N) required by $IHPXXXX_{YY}$ at the measured roll speed (v)

T = Time (sec)

(5) Other requirements.

(i) Vehicle speed and speed response.

The measurement of roll speed shall be accurate within 0.1 mph between speeds of 10 and 30 mph. The dynamometer controller shall be able to detect and resolve speed variations in less than 500 milliseconds to 0.10 mph/sec accuracy.

(ii) Vehicle restraint.

The vehicle shall be restrained during the ASM driving cycle. The restraint system shall be designed to insure that vertical and horizontal force on the drive wheels does not significantly affect emission levels. The restraint system shall allow unobstructed vehicle ingress and egress and shall be capable of safely restraining the vehicle under all reasonable operating conditions.

(iii) Vehicle cooling.

The test operator shall prevent overheating of the vehicle. The test shall be conducted with the hood open when the ambient temperature exceeds 72°F. The cooling method used shall direct air to the test vehicle's cooling system. The cooling system capacity shall be at least 3,000 SCFM within 12 inches of the intake to the vehicle's cooling system. The cooling system shall avoid improper cooling of the catalytic converter.

(iv) All-wheel drive.

If used, four-wheel drive dynamometers shall insure the application of correct vehicle loading as defined in paragraph (a)(2) and shall not damage the four wheel drive system of the vehicle. Front and rear wheel rolls shall be coupled and maintain speed synchronization within 0.2 mph. The four wheel drive system shall be able to uncouple the rear roll set so as to function as a two wheel drive system.

(v) Installation.

In all cases, installation must be performed so that the test vehicle is approximately level (±5°) while on the dynamometer during testing.

(b) *Emission sampling system*

(1) Materials and design.

The sampling system shall be designed to insure durable, leak free operation and be easily maintained. Materials that are in contact with the gases sampled shall not contaminate or change the character of the gases to be analyzed, including gases from vehicles not fueled by gasoline. The system shall be designed to be corrosion-resistant and be able to withstand typical vehicle exhaust temperatures when the vehicle is driven through the ASM5015 test cycle for 290 seconds.

(2) Sampling system.

The sampling system shall draw exhaust gas from the vehicle, shall remove particulate matter and aerosols from the sampled gas, shall drain condensed water from the sample if necessary, and shall deliver the resultant gas sample to the analyzers/sensors for analysis and then deliver the analyzed sample outside the building. The sampling system shall, at a minimum, consist of a tailpipe probe, flexible sample line, water removal system, a particulate trap, sample pump and flow control components.

(3) Sample probe.

(i) Insertion.

The sample probe shall allow at least a 16 inch insertion depth of the sample point into the vehicle's exhaust. In addition, the probe shall be inserted at least 10 inches into the vehicle's exhaust. Use of a tailpipe extension is permitted as long as the extension does not change the exhaust back pressure by more than 1 inch of water pressure.

(ii) Retention.

The probe shall incorporate a positive means of retention to prevent it from slipping out of the tailpipe during use.

(iii) Flexibility.

The probe shall be designed so that the tip extends 16 inches into the tailpipe. The probe tip shall be shielded so that debris is not scooped up by the probe when it is inserted into the tailpipe.

(iv) Probe tip.

Probe tips shall be designed and constructed to prevent sample dilution.

(v) Materials.

All materials in contact with exhaust gas prior to and throughout the measurement portion of the system shall be unaffected by and shall not affect the sample (that is, the materials shall not react with the sample, and they shall not taint the sample). Acceptable materials include stainless steel, teflon, silicon rubber and TEDLAR®. Dissimilar metals with thermal expansion factors of more than 5% shall not be used in either the construction of probes or connectors. The sample probe shall be constructed of stainless steel or other noncorrosive, nonreactive material which can withstand exhaust gas temperatures at the probe tip of up to 1,100°F.

(vi) System hoses and connections.

Hoses and all other sample handling components must be constructed of, or plated with a nonreactive, non-corrosive, high temperature material which will not affect, or be affected by, the exhaust constituents and tracer gases.

(vii) Dual exhaust.

The sample system shall provide for the testing of dual exhaust equipped vehicles. When testing a vehicle with functional dual exhaust pipes, a dual sample probe of a design certified by the analyzer manufacturer to provide

equal flow in each leg shall be used. The equal flow requirement is considered to be met if the flow rate in each leg of the probe has been measured under two sample pump flow rates (the normal rate and a rate equal to the onset of low flow), and if the flow rates in each of the legs are found to be equal to each other (within 15% of the flow rate in the leg having lower flow).

(4) Particulate filter.

The particulate filter shall be capable of trapping 97% of all particulate and aerosols 5 microns or larger. The filter element shall not absorb or adsorb hydrocarbons. The filter housing shall be transparent or translucent to allow the operator to observe the filter elements condition without removing the housing. The filter element shall be easily replaceable and shall provide for reliable sealing after filter element changes.

(5) Water trap.

The water trap shall be sized to remove exhaust sample water from vehicles fueled with gasoline, propane, compressed natural gas, reformulated gasoline, alcohol blends or neat, and oxygenated fuels. The filter element, bowl and housing shall be inert to these fuels as well as to the exhaust gases from vehicles burning these fuels. The condensed water shall be continuously drained from the water trap's bowl. Sufficient water shall be trapped, regardless of fuel, to prevent condensation in the sample system or in the optical bench's sample cell.

(6) Low flow indication.

The analyzer shall be prevented from performing an emissions test when the sample flow is below the acceptable level. The sampling system shall be equipped with a flow meter (or equivalent) that shall indicate sample flow degradation when measurement error exceeds 3% of the gas value used for checking, or causes the system response time to exceed 13 seconds to 90% of a step change in input (excluding no), whichever is less.

(7) Exhaust ventilation system.

The high quantities of vehicle emissions generated during loaded mode testing shall be properly vented to prevent buildup of hazardous concentrations of HC, CO, CO_2 and NO_x. Sufficient ventilation shall be provided in the station to maintain HC, CO, CO_2 and no levels below OSHA standards.

(i) Ventilation system.

The ventilation system shall discharge the vehicle and analyzer exhaust outside the building.

(ii) Exhaust collection system.

The flow of the exhaust collection system shall not cause dilution of the exhaust at the sample point in the probe.

(iii) Exhaust collection system flow.

The flow of the exhaust collection systems shall not cause a change of more than 1.0 inch of water pressure in the vehicle's exhaust system at the exhaust system outlet.

(c) *Analytical instruments.*

(1) General requirements.

(i) Analyzers.

The analyzer system shall consist of analyzers for HC, CO, NO and CO_2. And digital displays for exhaust concentrations of HC, CO, NO and CO_2, and for vehicle speed.

(ii) Alternative analytical equipment.

Alternative analytic equipment specification, materials, designs or detection methods may be allowed upon a determination by the Department and the Environmental Protection Agency, that for the purpose of properly conducting an approved short test, the evidence supporting such deviations will not significantly affect the proper measurement of emissions.

(iii) Sample rate.

The analyzer shall be capable of measuring exhaust concentrations of gases specified in this section at a minimum rate of once per second.

(2) Performance requirements.

(i) Temperature operating range.

The analyzer system and all associated hardware shall operate within the performance specifications described in § 2 of this subpart at ambient air temperatures ranging from 41°F to 110°F. Analyzers shall be designed so that adequate air flow is provided around critical components to prevent

overheating (and automatic shutdown) and to prevent the condensation of water vapor which could reduce the reliability and durability of the analyzer. The analyzer system shall otherwise include necessary features to keep the sampling system within the specified range.

(ii) Humidity operating range.

The analyzer system and all associated hardware shall operate within the performance specifications described in § 2 of this subpart at a minimum of 85% relative humidity throughout the required temperature range.

(iii) Interference effects.

The interference effects for non-interest gases shall not exceed ±4 ppm for hydrocarbons, ±0.02% for carbon monoxide, ±0.20% for carbon dioxide, and ±20 ppm for nitric oxide when using the procedure specified in § 4(d)(6)(iv). Corrections for collision broadening effects of combined high CO and CO_2 concentrations shall be taken into account in developing the factory calibration curves, and are included in the accuracy specifications.

(iv) Barometric pressure compensation.

Barometric pressure compensation shall be provided. Compensation shall be made for elevations up to 6,000 feet (above mean sea level). At any given altitude and ambient conditions specified in (iv) and (v), errors due to barometric pressure changes of ±2 inches of mercury shall not exceed the accuracy limits specified in paragraph (2).

(v) System lockout during warm-up.

Functional operation of the gas sampling unit shall remain disabled through a system lockout preventing the system from performing emission tests until the instrument meets stability and warm-up requirements. The instrument shall be considered ‘‘warmed up’’ when the zero and span readings for HC, CO, NO, and CO_2 have stabilized, within the accuracy values specified in § 3(c)(3) for 5 minutes without adjustment. Turning on the analyzer for a time period of at least 4 times the period of time required to reach stability as demonstrated in the equipment certification (see § 7) shall constitute ‘‘warmed-up.’’

(vi) Zero drift lockout.

If zero or span drift cause the optical bench signal levels to move beyond the adjustment range of the analyzer, the system shall be prevented from performing an emissions test.

(vii) Electromagnetic isolation and interference.

Electromagnetic signals found in an automotive service environment shall not cause malfunctions or changes in the accuracy in the electronics of the analyzer system. The instrument design shall ensure that readings do not vary as a result of electromagnetic radiation and induction devices normally found in the automotive service environment, including high energy vehicle ignition systems, radio frequency transmission radiation sources, and building electrical systems. Certification acceptance test is described in § 7.

(viii) Vibration and shock protection.

System operation shall be unaffected by the vibration and shock encountered under the normal operating conditions encountered in an automotive service environment.

(ix) Propane equivalency factor.

The PEF range shall be between 0.470 and 0.560. For each audit/calibration point, the nominal PEF shall be conveniently displayed for the quality assurance inspector and other authorized personnel, in a manner acceptable to the program. If an optical bench must be replaced in the field, the manufacturer's field service representative (FSR) shall change any external labels to correspond to the nominal PEF of the new bench. The analyzer shall incorporate an algorithm relating PEF to HC concentration. Corrections shall be made automatically.

(x) System response requirements.

The response time from the probe to the display for HC, CO and CO_2 analyzers shall not exceed 8 seconds for 90% of a step change in input. The response time for a step change in O_2 from 20.9% O_2 to 0.1% O_2 shall be no longer than 40 seconds. For no analyzers, the response time shall not exceed 12 seconds for 90% of a step change in input. The response time for a step change in NO from a stabilized reading to 10% of that reading shall be no longer than 12 seconds.

(3) Detection methods, instrument ranges, accuracy and repeatability.

(i) Hydrocarbon analysis.

Hydrocarbon (HC) analysis shall be determined by nondispersive infrared (NDIR) analyzer. The analyzer shall cover at least the range of 0 PPM HC to 2000 PPM HC, where PPM HC is parts per million of hydrocarbon volume as hexane. The accuracy of the instrument between

1400 PPM HC and 2000 PPM HC shall be at least 5.0% of point. The accuracy of the instrument from 0-1400 PPM HC shall be ±4 PPM C6 or 3% of point, whichever is greater. The calibration curve must comply with the quality control specifications in § 4(d)(2) for calibration curve verification.

(ii) Carbon monoxide analysis.

Carbon monoxide (CO) analysis shall be determined by nondispersive infrared (NDIR) analyzer. The analyzer shall cover at least the range of 0.00% CO to 9.99% CO, where % CO is % volume CO. The accuracy of the instrument between 0.01% and 7.00% CO shall be ±3% or 0.02% CO, whichever is greater. The accuracy of the instrument between 7.01% and 10.00% shall be at least 5.0% of point. The calibration curve must comply with the quality control specifications in § 4(d)(2) for calibration curve generation.

(iii) Carbon dioxide analysis.

Carbon dioxide (CO_2) analysis shall be determined by nondispersive infrared (NDIR) analyzer. The analyzer shall cover at least the range of 0.0% CO_2 to 16.0% CO_2. The accuracy of the instrument between 0.01% and 16% CO_2 shall be at least ±0.3% CO_2 or 3% of point which ever is greater. The accuracy of the instrument between 16.01% and 18% shall be at least 5.0% of point. The calibration curve must comply with the quality control specifications in § 4(d)(2) for calibration curve generation.

(iv) Nitric oxide analysis.

The analyzer shall cover at least the range of 0 PPM NO to 5000 PPM NO, where PPM NO is parts per million nitric oxide. The accuracy of the instrument between 0 and 4000 PPM shall be at least ±4.0% of point or 25 PPM NO, whichever is greater. The accuracy of the instrument between 4001 and 5000 PPM shall be ±5.0%. The calibration curve must comply with the quality control specifications in § 4(d)(2) for calibration curve generation.

(v) Oxygen analysis (optional).

If an oxygen analyzer is included, the analyzer shall cover at least the range of 0.0% O_2 to 25.0% O_2. The accuracy of the instrument over this range shall be at least 5% of point or ±0.1% O_2, whichever is greater. The calibration curve must comply with the quality control specifications in § 4(d)(2) for calibration curve generation.

(vi) Repeatability.

The repeatability for the HC analyzer in the range of 0-1400 PPM HC shall be 2% of point or 3 PPM HC absolute, whichever is greater. In the range of 1400-2000 PPM HC, the repeatability shall be 3% of point. The repeatability for the CO analyzer in the range of 0-700% CO shall be 2% of point or 0.02% CO absolute, whichever is greater. In the range of 7.00% to 10.00% CO, the repeatability shall be 3% of point. The repeatability for the CO_2 analyzer in the range of 0-10.0% CO_2 shall be 2% of point or 0.1% CO absolute, whichever is greater. In the range of 10.0% to 16.0% CO_2, the repeatability shall be 3% of point. The repeatability of the NO analyzer shall be 3% of point or 20 PPM NO, whichever is greater. The repeatability of the O_2 analyzer shall be 3% of point or 0.1% O_2, whichever is greater.

(4) Ambient conditions.

The current relative humidity, dry-bulb temperature, and barometric pressure shall be measured and recorded prior to the start of every inspection in order to calculate KH (nitric oxide correction factor, see § 1(b)(v)).

(i) Relative humidity.

The relative humidity measurement device shall cover the range from 5% to 95% RH, and 35°F—110°F, with a minimum accuracy of °5% RH. Wet bulb thermometers shall not be used.

(ii) Dry-bulb temperature.

The dry-bulb temperature device shall cover the range from 35°F—110°F-with a minimum accuracy of ±3°F.

(iii) Barometric pressure.

The barometric pressure measurement device shall cover the range from 610 MM HG—810 MM HG, and 35°F—110°F, with a minimum accuracy of ±3% of point.

(d) *Automated test process software and displays.*

(1) Software.

The testing process, data collection and quality control features of the analyzer system shall be automated to the greatest degree possible. The software shall automatically select the emission standards and set the vehicle load based on a Department-provided or approved look-up table. Vehicle identification information may be derived from a database

accessed over a real-time data system to a host computer system. Entry of license plate and all or part of the VIN shall be sufficient to access the vehicle record. Provision shall be made for manual entry of data for vehicles not in the host computer system.

(2) Test and mode timers.

The analyzer shall be capable of simultaneously determining the amount of time elapsed in a test, and in a mode within that test.

(3) Clocks and timers.

The clock used to check the coast-down time shall be accurate to within 0.1% of reading between 0.5 and 100 seconds, with a resolution of 0.001 seconds. The ASM test mode timers used shall be accurate to within 0.1% of reading between 10 and 1,000 seconds with a resolution of 0.1 seconds.

(4) Display refresh rate.

Dynamic information being displayed shall be refreshed at a minimum rate of twice per second.

(5) Minimum analyzer display resolution.

The analyzer electronics shall have sufficient resolution to achieve the following:

HC	1	PPM HC as hexane
NO	1	PPM NO
C	0.01	% CO
CO_2	0.1	% CO_2
O_2	0.1	% O_2
RPM	10	RPM
HC	1	PPM HC as hexane
Speed		0.1 MPH
Wheel Force		0.1 LB
Relative Humidity		1 %RH
Dry bulb temperature		1 °F
Barometric pressure	1	MM HG

(6) Engine speed detection.

The system shall be capable of detecting engine speed in revolutions per minute (RPM) with a 0.5 second response time and an accuracy of ±3% of the true RPM.

(7) Display during testing.

The display during testing shall read ‘‘test in progress’’ and shall digitally display the vehicle’s speed in mph. Emissions values shall not be displayed during official testing.

§ 4. ASM quality control requirements.

(a) *General requirements*

(1) Minimums.

The frequency and standards for quality control specified here are minimum requirements, unless modified as specified in paragraph (2). Greater frequency or tighter standards may be used as needed.

(2) Statistical process control.

Reducing the frequency of the quality control checks, modifying the procedure or specification, or eliminating the quality control checks altogether may be allowed if the Department determines, for the purpose of properly conducting an approved short test, that sufficient statistical process control (SPC) data exist to make a determination, that the SPC data support such action, and that taking such action will not significantly reduce the quality of the emissions measurements. If emission measurement performance or quality deteriorate as a result of allowing such actions, the approval shall be suspended and the frequencies, procedures specifications, or checks specified here or otherwise approved shall be reinstated, pending further determination by the Department.

(b) *Dynamometer*

(1) Coast down check.

(i) Coast down frequency.

The calibration of each dynamometer shall be automatically checked every 72 hours in low volume stations (less than 4,000 tests per year) and daily in high volume stations, when the dynamometer is in active service, by a dynamometer coast-down procedure equivalent to § 86.118-78 (for reference see EOD test procedure TP-302A and TP-202) between the speeds of 30-20 mph and 20-10 mph. All rotating dynamometer

components shall be included in the coast-down check. Speed windows smaller than ±5 mph may be used provided that they show the same calibration capabilities.

(ii) Coast down HP settings.

The base dynamometer inertia (2,000 pounds) shall be checked at two random horsepower settings for each speed range. The two random horsepower settings shall be between 8.0 to 18.0 horsepower. Use of a shunt resistor for a load cell performance check is not permissible because it does not verify the performance of the actual load cell, only the signal processing portion of the system.

(iii) Coast down procedure.

The coast-down procedure shall use a vehicle off-dynamometer type method or equivalent, using a vehicle to bring the dynamometer up to speed and removing the vehicle before the coast-down shall not be permitted. If either the measured 30-20 mph coast-down time or 20-10 mph coast-down time is outside the window bounded by DET (seconds) ±7% then it shall be locked out for official testing purposes until recalibration allows a passing value.

(a) Randomly select an IHP2525 value that is between 8.0 hp and 18.0 hp and set dynamometer PAU to this value.

Coast-down dynamometer from 30-20 mph.

$$DET_{@25mph-yy} = \frac{\left(\frac{0.5 * DIW}{32.2}\right) * (V_{30}^2 - V_{20}^2)}{550 * (IHP2525_{yy} + PLPII_{25-yy})}$$

Where:

DIW = Dynamometer inertia weight, total ''inertia'' weight of all rotating components in dynamometer.

V_{30} = Velocity in feet/sec at 30 mph.

V_{20} = Velocity in feet/sec at 20 mph.

$IHP2525_{YY}$ = Randomly selected ASM2525 indicated horsepower.

$PLHP_{25\text{-}YY}$ = Parasitic horsepower for specific dynamometer at 25 mph.

(b) Randomly select an IHP5015 value that is between 8.0 hp and 18.0 hp and set dynamometer PAU to this value.

Coast-down dynamometer from 20-10 mph.

Where:

DIW = Dynamometer inertia weight. Total ''inertia'' weight of all rotating components in dynamometer.

V_{20} = Velocity in feet/sec at 20 mph.

V_{10} = Velocity in feet/sec at 10 mph.

$IHP5015_{YY}$ = Randomly selected ASM5015 indicated horsepower.

$PLHP_{15\text{-}YY}$ = Parasitic horsepower for specific dynamometer at 15 mph.

(iv) Parasitic value calculations.

If the coast-down values does not verify in § 2(b)(iii).

$$DET_{@15mph-yy} = \frac{\left(\frac{0.5 * DIW}{32.2}\right) * \left(V_{20}^2 - V_{10}^2\right)}{550 * (IHP5015_{yy} + PLPH_{15-yy})}$$

Parasitic losses shall be calculated using the following equations at 25 and 15 mph. The indicated horsepower shall be set to zero for these tests.

(a) Parasitic losses at 25 mph for a dynamometer with YY diameter rollers.

$$PLHP_{25-yy} = \frac{\left(\frac{0.5 * DIW}{32.2}\right) * \left(V_{30}^2 - V_{20}^2\right)}{550 * (CDT)}$$

Where:

DIW = Dynamometer inertia weight. Total ''inertia'' weight of all rotating components in dynamometer.

V_{30} = Velocity in feet/sec at 30 mph.

V_{20} = Velocity in feet/sec at 20 mph.

CDT = Coast-down time required for dynamometer to coast from 30 to 20 mph.

(b) Parasitic losses at 15 mph for a dynamometer with YY diameter rollers.

$$PLHP_{15-yy} = \frac{\left(\frac{0.5 * DIW}{32.2}\right) * \left(V_{20}^2 - V_{10}^2\right)}{550 * (CDT)}$$

Where:

DIW = Dynamometer inertia weight. Total ''inertia'' weight of all rotating components in dynamometer.

V_{20} = Velocity in feet/sec at 20 mph.

V_{10} = Velocity in feet/sec at 10 mph.

CDT = Coast-down time required for dynamometer to coast from 20 to 10 mph.

(2) Roll speed.

Roll speed and roll counts shall be checked at least once per week by an independent means (for example, photo tachometer). Deviations greater than ±0.2 mph or a comparable tolerance in roll counts shall require corrective action. Alternatively, a redundant roll speed transducer independent of the primary transducer may be used in lieu of the daily comparison. Accuracy of redundant systems shall be checked quarterly.

(c) *Emission sampling system.*

(1) Leak check.

The entire sample system shall be checked for vacuum leaks on a daily basis and for proper flow on a continuous basis. The sample system leak check shall be performed using the manufacturer's recommended procedure. The allowed maximum leak rate and minimum flow rate shall be those determined in the equipment certification procedure (see § 7).

(d) *Analytic instruments.*

(1) General requirements.

The analyzer shall, to the extent possible, maintain accuracy between gas calibrations taking into account all errors, including noise, repeatability, drift, linearity, temperature and barometric pressure.

(i) Calibration method.

(2) Two-point gas calibration.

Analyzers shall automatically require a two point gas calibration for HC, CO, CO_2 and NO. Gas calibration shall be accomplished by introducing span gases that meets the requirements of (d)(3)(iv) in this section into the calibration port. The pressure in the sample cell shall be the same with the calibration gas flowing as with the sample gas flowing during sampling. When a calibration is initiated, the analyzer channels shall be adjusted to the center of the allowable tolerance range.

(ii) Calibration frequency.

Analyzers shall be calibrated within 72 hours before each official test. The Department may adjust the calibration check frequency as necessary based on a statistical process control algorithm approved by the Department. If the system does not calibrate or is not calibrated, the analyzer shall lock out from testing until corrective action is taken.

(iii) Working zero and span gases.

The following gases shall be used for the calibration check.

(a) Zero gas

O2 = 20.9%
HC ‹ 1 PPM THC AS C-1
CO ‹ 1 PPM
CO_2 ‹ 400 PPM
NO ‹ 1 PPM
N2 = Balance 99.99% pure

(b) Working span gas

HC = 3,200 PPM propane
CO = 8%
CO_2 = 12%
NO = 3,000 PPM
N2 = Balance 99.99% pure

(iv) Traceability. The span gases used for the gas calibration and the gas audit shall be traceable to National Institute of Standards and Technology (NIST) standards ±1%, and, in the case of low volume stations shall have a zero blend tolerance.

Alternatively, 5% blend tolerance gases may be used if the system reads the bar-coded calibration gas bottle specifications and adjusts the calibration accordingly.

(3) Five-point gas audit.

(i) Audit frequency.

Analyzers shall successfully pass a five point gas audit for HC, CO, NO and CO_2. Analyzers shall undergo the audit procedure minimally every 6 months. For either type of station, the analyzer shall be adjusted or repaired if the requirements of § 3(c)(2) are not met.

(ii) Audit method.

The gas calibration audit shall be accomplished by introducing span gas that meets the requirements of § (d)(3)(iv). The pressure in the sample cell shall be the same with the calibration audit gas flowing as with the sample gas flowing during sampling.

(iii) Audit gases.

The following gases shall be used for the calibration check. Other calibration gas values may be acceptable when a ‘‘gas blender’’ apparatus is used if approved by the Department.

(a) Zero gas

O2 = 20.9% (if O_2 span is desired)
HC ‹ 1.0 PPM THC
CO ‹ 1.0 PPM
CO_2 ‹ 1 PPM
NO ‹ 1.0 PPM
N2 = Balance 99.99% pure

(b) Low range calibration gas

HC = 200 PPM propane
CO = 0.5%
CO_2 = 6.0%

NO = 300 PPM
N2 = Balance 99.99% pure

(c) Low-middle range calibration gas

HC = 960 PPM propane
CO = 2.4%
CO_2 = 3.6%
NO = 900 PPM
N2 = Balance 99.99% pure

(d) High-middle range calibration gas

HC = 1920 PPM propane
CO = 4.8%
CO_2 = 7.2%
NO = 1800 PPM
N2 = Balance 99.99% pure

(e) High range calibration gas

HC = 3200 PPM propane
CO = 8.0%
CO_2 = 12.0%
NO = 3000 PPM
N2 = Balance 99.99% pure

(iv) Traceability. The span gases used for the gas calibration and the gas audit shall be traceable to National Institute of Standards and Technology (NIST) standards ±1% and, in the case of low volume stations shall have a zero blend tolerance. Alternatively, 5% blend tolerance gases may be used if the system reads the bar-coded calibration gas bottle specifications and adjusts the calibration accordingly.

(v) Audit specifications. The analytical system shall read the audit gas within 5% of labeled value. The analyzer shall be adjusted or repaired if the accuracy specifications are not met.

(4) Service and repair calibration.

(i) In-field calibration.

Each time an analyzer's emissions measurement system, sensor or other electronic components are repaired or replaced, a minimum of a five-point gas audit such as (d)(3) shall be performed prior to returning the unit to service.

(ii) Leak check

Each time the sample line integrity is broken, a leak check shall be performed prior to testing.

§ 5. ASM test record information.

(a) *General requirements*

(1) Test data.

In addition to the information required to uniquely identify the testing station, technician and vehicle, the following data shall also be recorded.

(i) General records

a. Test record number

b. Inspection station and inspector numbers

c. Test system number

d. Dynamometer site

e. Date of test

f. Emission test start time and the time the final emission scores are determined

g. Vehicle identification number

h. License plate number

i. Test certificate number

j. Vehicle model year, make and type

k. Number of cylinders or engine displacement

l. Transmission type

m. Odometer reading

n. Type of test performed (that is, initial test, first retest or subsequent retest)

(ii) Ambient test conditions

a. Relative humidity (%)

b. Dry-bulb temperature (°F)

c. Atmospheric pressure (MM HG)

d. No correction factor

e. System response time for each instrument (Transport +T90)

(iii) ASM5015 mode

a. ASM5015 final HC running average (AVGHC) (PPM).

b. ASM5015 final CO running average (AVGCO) (%).

c. ASM5015 final NO running average (AVGNO) (PPM).

d. Total ASM5015 horsepower used to set the DYNE (THP5015) (HP).

e. Engine RPM running average corresponding to the final test score.

f. Dilution correction factor (DCF).

(iv) Diagnostic/quality assurance information.

a. Test time (SEC).

b. Mode time (SEC).

c. Vehicle speed (MPH) for each second of the test.

d. Engine RPM running average.

e. Dynamometer load (pounds) for each second of the test.

f. HC concentration (PPM) for each second of the test.

g. CO concentration (%) for each second of the test.

h. No concentration (PPM) for each second of the test.

i. CO_2 concentration (%) for each second of the test.

j. O2 concentration (%) for each second of the test (optional).

§ 6. ASM terms and definitions.

$HPXXXX_{YY}$ = The ASM actual horsepower value contained in the look up table for a vehicle being tested (using the ASM5015 or 2525) on a dynamometer with YY inch diameter rollers. The actual horsepower is the sum of the indicated horsepower and the parasitic losses ($PLHP_{ZZ\text{-}YY}$).

$IHPXXXX_{YY}$ = The ‘‘indicated’’ ASM horsepower value set on the dynamometer.

THPXXXX = The ‘‘total’’ horsepower for an ASM test includes indicated, tire losses and parasitics. This value is independent of roll size.

ETW = Equivalent test weight. Weight class of vehicle for testing, defined as curb weight plus 300 pounds. For ASM testing, it is rounded to the nearest 125 pound increment.

$GTRL_{@ZZ\ MPH\text{-}YY}$ = Generic tire-roll interface horsepower losses at ZZ mph on a dynamometer with YY inch diameter rollers.

$PLHP_{ZZ\text{-}YY}$ = Parasitic losses (horsepower) due to internal dynamometer friction. A value is specific to each individual dynamometer and speed.

A_T = 1st curve coefficient used to characterize tire/roll losses. Different values depending on dynamometer roller diameter.

B_T = 2nd curve coefficient used to characterize tire/roll losses. Different values depending on dynamometer roller diameter.

C_T = 3rd curve coefficient used to characterize tire/roll losses. Different values depending on dynamometer roller diameter.

XXXX = Place holder for ASM test mode, ASM5015 or ASM 2525.

YY = Place holder for dynamometer roll diameter. Usually 8.6 or 20 inches.

ZZ = Place holder for dynamometer speed. Usually 15 mph or 25 mph.

§ 7. Equipment certification procedures.

I. *Dynamometer.*

A. *Load cell verification (if equipped).*

This test confirms the proper operation of the dynamometer load cell and associated systems. Weights in the proper range shall be supplied by the system supplier. Weights shall be NIST traceable to 0.1% of point.

(1) Calibrate the load cell according to the manufacturer's direction.

(2) Using a dead weight method, load the test cell to 20%, 40%, 60% and 80% (in ascending order) of the range used for ASM testing. Record the readings for each weight.

(3) Remove the weights in the same steps (descending order) and record the results.

(4) Perform steps A through B two more times (total of three).

(5) Calculate the average value for each weight.

(6) Multiply the average weight from E by the length of the torque arm.

Acceptance criteria: The difference for each reading from the weight shall not exceed 0.1% of full scale.

B. *Speedometer verification.*

This test confirms the accuracy of the dynamometer's speedometer.

(1) Set dynamometer speed to 15 MPH.

(2) Independently measure and record dynamometer speed.

(3) Repeat at 25 mph.

Acceptance criteria: The difference for each reading from set dynamometer speed shall not exceed 0.2 mph.

C. *Parasitic verification.*

Parasitic losses shall be calculated using the following equations at 25 and 15 mph. The indicated horsepower ($IHPXXXX_{YY}$) shall be set to zero for these tests. Using time versus speed data from the system, calculate $PLHP_{YY}$ for 15 mph and 25 mph.

(1) Parasitic losses at 25 mph for a dynamometer with YY diameter rollers.

$$PLHP_{25-yy} = \frac{\left(\frac{0.5 * DIW}{32.2}\right) * (V_{30}^2 - V_{20}^2)}{550 * (CDT)}$$

Where:

DIW = Dynamometer inertia weight. Total ''inertia'' weight of all rotating components in dynamometer.

V_{30} = Velocity in feet/sec at 30 mph.

V_{20} = Velocity in feet/sec at 20 mph.

CDT = Coast-down time required for dynamometer to coast from 30 to 20 mph.

(2) Parasitic losses at 15 mph for a dynamometer with YY diameter rollers.

$$PLHP_{15-yy} = \frac{\left(\frac{0.5 * DIW}{32.2}\right) * (V_{20}^2 - V_{10}^2)}{550 * (CDT)}$$

Where:

DIW = Dynamometer inertia weight. Total ''inertia'' weight of all rotating components in dynamometer.

V_{20} = Velocity in feet/sec at 20 mph.

V_{10} = Velocity in feet/sec at 10 mph.

CDT = Coast-down time required for dynamometer to coast from 20 to 10 mph.

Acceptance criteria: The difference between the external calculated value and the machine calculated value shall not exceed 0.25 HP (or 6.25 lb. wheel force a 15 MPH and 3.75 lb. wheel force at 25 mph).

D. *Verify coast-down.*

The coast-down procedure shall use a vehicle off-dynamometer type method or equivalent. Using a vehicle to bring the dynamometer up to

speed and removing the vehicle before the coast-down shall not be permitted.

(1) Randomly select an IHP2525 value that is between 8.0 hp and 18.0 hp and set dynamometer PAU to this value.

Coast-down dynamometer from 30-20 mph.

$$DET_{@25mph-yy} = \frac{\left(\frac{0.5 * DIW}{32.2}\right) * (V_{30}^2 - V_{20}^2)}{550 * (IHP2525_{yy} + PLHH_{25-yy})}$$

Where:

DIW = Dynamometer inertia weight. Total ''inertia'' weight of all rotating components in dynamometer.

V_{30} = Velocity in feet/sec at 30 mph.

V_{20} = Velocity in feet/sec at 20 mph.

$IHP2525_{YY}$ = Randomly selected ASM2525 indicated horsepower.

$PLHP_{25\text{-}YY}$ = Parasitic horsepower for specific dynamometer at 25 mph.

(2) Randomly select an IHP5015 value that is between 8.0 hp and 18.0 hp and set dynamometer PAU to this value.

Coast-down dynamometer from 20-10 mph.

$$DET_{@15mph\ yy} = \frac{\left(\frac{0.5 * DIW}{32.2}\right) * (V_{20}^2 - V_{10}^2)}{550 * (IHP5015_{yy} + PLHP_{15\ yy})}$$

Where:

DIW = Dynamometer inertia weight. Total ''inertia'' weight of all rotating components in dynamometer.

V_{20} = Velocity in feet/sec at 20 mph.

V_{10} = Velocity in feet/sect at 10 mph.

$IHP5015_{YY}$ = Randomly selected ASM5015 indicated horsepower.

$PLHP_{15\text{-}YY}$ = Parasitic horsepower for specific dynamometer at 15 mph.

Acceptance criteria: The measured 30-20 mph coast-down time and the 20-10 mph coast-down time must be inside the window bounded by DET (seconds ±7%.

II. *Analyzer system:*

A. *Analyzer warm-up.*

The analyzer shall be turned off and at a room temperature not greater than 41°F for a time period of at least 4 hours.

Analyzer warm-up acceptance criteria. The analyzer shall reach stability in less than 30 minutes at 41°F from start-up. If an analyzer does not achieve stability within the allotted time frame, it shall be locked out from testing. The instrument shall be considered ''warmed up'' when the zero and span readings for HC, CO, NO and CO_2 have stabilized, within the accuracy values specified in § 3(c)(2) for 5 minutes without adjustment.

B. *Leak rate.*

A needle valve teed into the line upstream of the sample pump inlet shall be used to induce a leak which reduces the readings by 3%. Perform a leak check using the manufacturer's recommended procedures. The unit under test shall fail the leak check and prevent further testing until corrective action is performed.

Leak rate acceptance criteria. The analyzer shall not allow a deviation of more than 3% of the readings obtained using the mid-range span gas described in paragraph (d)(3)(iii)(c) of § 4.

C. *Flow restrictions.*

(1) Using the mid-range span gas described in Paragraph (d)(3)(iii)(c) of § 4 entering the sample probe at atmospheric pressure, take a base reading with no restriction in the line. Insert a throttling valve in the vacuum side of the sampling system. With the gas flowing (still at atmospheric pressure), restrict the sample flow until: (1) the low flow indication is activated, (2) the response time of the slowest NDIR channel exceeds 11 seconds to 90% of the base reading, or (3) the actual gas reading differs

from the base reading on any channel by more than 3% of the base reading.

Acceptance criteria: The low flow indication is activated and the response times of all NDIR channels are 13 seconds or less to 90% of the base readings, and the actual gas readings differ from the base readings by 3% of the base readings or less.

(2) If the low flow sensor is activated by pressure (or vacuum), insert A 0-10 PSIG (0-30 in. HG) gauge between the throttling valve and the inlet O the low flow sensor. Use the throttling valve to activate and deactivate the low flow indication. Measure the pressure (or vacuum) at which activation and deactivation occur. Perform this test three times.

Acceptance criteria: The difference between the activation point and deactivation point shall be no greater than 3% of the activation point pressure (or vacuum).

D. *Dilution.*

The procedure for measuring flow rate dilution shall be as follows:

(1) Set vehicle with 1.6 liter maximum engine displacement at factory-recommended idle speed. OEM configuration exhaust system, transmission in neutral, hood up (a fan to cool the engine may be used if needed). Set idle speed not to exceed 920 RPM. (Set for 900 RPM with a tolerance ± 20 RPM.)

(2) With a laboratory grade analyzer system, sample the exhaust at 40 centimeters depth with a flow sample rate below 320 liters per hour. Allow sufficient time for this test. Record all HC, CO, NO, CO_2 and O_2 readings. A chart recorder or electronically stored data may be used to detect the point of stable readings.

(3) While operating the candidate analyzer system in a mode which has the same flow rate as the official test mode. Record the levels of HC, CO, NO, CO_2 and O_2. Ensure that the probe is installed correctly.

(4) Repeat step (II).

Acceptance criteria: The flow rate on the analyzer shall not cause more than 10% dilution during sampling of exhaust of a 1.6 liter engine a normal idle. Ten percent dilution is defined as a sample of 90% exhaust and 10% ambient air. If the difference of the readings between (ii) and (iv) exceed 5% of the average of (ii) and (iv), repeat (ii), (iii), and (iv); otherwise average (ii) and (iv) and compare with (iii). If (iii) is within 10%

of the average of (ii) and (iv), then the equipment meets the dilution specification.

E. *Analyzer accuracy.*

This test confirms the ability of the candidate instruments to read various concentrations of gases within the tolerances required by this specification. The test compares the response of the candidate instrument with that of standard instruments, and also estimates the uncertainty of the readings.

The analyzer shall be zeroed and span gas calibrated using the working gases. The instrument shall be tested using propane, carbon monoxide, carbon dioxide and nitric oxide in nitrogen, with a certified accuracy of ±1%, in the following concentrations: 0%, 10%, 20%, 30%, 40%, 50%, 60%, 70%, 80%, 90% of full scale for the analyzers. Full scale is defined in § 3(c)(3).

(1) Introduce the gases in ascending order of concentrations, through the probe, beginning with the zero gas. Record the readings of the standard and candidate instruments to each concentration value.

(2) After the highest concentration has been introduced and recorded, introduce the same gases to the standard and candidate analyzers in descending order, including the zero gas. Record the reading of analyzers to each gas, including negatives (if any).

(3) Repeat steps A and B for the candidate only, four more times (total of five times).

(4) Calculations:

a. Calculate the average value of each concentration for the readings of the standard instruments.

b. Calculate the mean and standard deviation of each candidate's readings for each concentration. Include both upscale and down scale readings for the same gas concentration. (All calculations may not be possible for zero concentrations.)

c. For each concentration, calculate the difference between the candidate mean and the standard average.

d. For each concentration, compute the following:

(i) $Y1 = X + K_{SD}$

(ii) $Y2 = X - K_{SD}$

Where:

K_{SD} = STD DEV * 3.5 for zero and the highest concentration value.

K_{SD} = STD DEV * 2.5 for all other concentration values, and

X = Mean (arithmetic average) of the set of candidate readings.

e. Compute the uncertainty (U) of the calibration curve for each concentration as follows:

(i) U_1 = Concentration value - Y_1

(ii) U_2 = Concentration value - Y_2

Acceptance criteria: (1) for each concentration, the differences calculated in Step 3 shall be no greater than the accuracy tolerances specified in § 3(c)(3). (2) for each concentration, the uncertainties, (U_1 and U_2) shall be no greater than the accuracy tolerances required in § 3(c)(3).

F. *Analyzer system repeatability.*

This test characterizes the ability of the instrument to give consistent readings when repeatedly sampling the same gas concentration.

(1) Using an 80% full scale gas, introduce the gas through the sample probe. Record the readings.

(2) Purge with ambient air for at least 30 seconds but no more than 60 seconds.

(3) Repeat steps (1) and (2) above four more times.

(4) Repeat steps (1), (2) and (3), introducing the gas through the sample probe.

Acceptance criteria: The differences between the highest and lowest readings from both ports shall not exceed the value specified in § 3(c)(3).

G. *Analyzer system response time.*

This test determines the speed of response of the candidate instrument when a sample is introduced at the sample probe.

(1) Gas calibrate the candidate instrument per the manufacturer's instructions.

(2) Using a solenoid valve or equivalent selector system, remotely introduce an 80% full scale gas to the probe. The gas pressure at the entrance to the probe shall be equal to room ambient.

(3) Measure the elapsed time required for the instrument display to read 90% of the final stabilized reading for HC, CO, CO_2 and NO. (Optional: also, measure the time required for the O_2 analyzer to read 0.1% O_2). Alternatively, the bench outputs may be recorded against a time base to determine the response time. Record all times in seconds.

(4) Switch the solenoid valve to purge with zero air for at least 40 seconds but no more than 60 seconds.

(5) Measure the elapsed time required for the NO instrument display to read 10% of the stabilized reading in Step (3).

(6) Repeat steps (1), (2) and (3), two more times (total three times).

Acceptance criteria: The response (drop time for O_2 and NO. Rise time for HC, CO, CO_2 and NO) time shall meet the requirement specified in § 3(c)(2)(X). The response time shall also be within ± 1 second of the nominal response time supplied by the equipment supplier for use in § 5(1)(a)(i)(e).

H. *Analyzer interference effects.*

The following acceptance test procedure shall be performed at 45°F, 75°F and 105°F conditions, except as noted.

(1) Zero and span the instrument.

(2) Sample the following gases for at least 1 minute. Record the response of each channel to the presence of these gases.

a. 16% carbon dioxide in nitrogen.

b. 1600 PPM hexane in nitrogen.

c. 10% carbon monoxide in nitrogen.

d. 3000 PPM nitric oxide in nitrogen.

e. 75 PPM sulfur dioxide (SO2) in nitrogen.

f. 75 PPM hydrogen sulfide (H2S) in nitrogen.

(3) Water-saturated hot air. The water-saturated hot air shall be drawn through the probe from the top of a sealed vessel partially filled with water through which ambient air will be bubbled. The water shall be maintained at a temperature of 122°F ±9°F. This test shall be performed at only the 75°F, and 105°F conditions.

Acceptance criteria: The interference effects shall not exceed the limits specified in § 3(c)(2)(iii).

I. *Electromagnetic isolation and interference.*

This test shall measure the ability of the candidate instrument to withstand electromagnetic fields which could exist in vehicle testing and repair facilities. For all tests described below, sample ‘‘low-middle calibration gas’’ specified in § 4(d)(3)(iii)(c), at atmospheric pressure, through the sample probe. Record analyzer reading during test periods.

(1) Radio frequency interference test.

a. Use a test vehicle with an engine having a high energy ignition system (or equivalent), a solid core coil wire and a 3/8" air gap. Leave engine off.

b. Locate the candidate instrument within 5 feet of the ignition coil. Gas calibrate the candidate instrument.

c. Sample gas specified above. Wait 20 seconds, and record analyzer readings.

d. Start engine. With the hood open, cycle the engine from idle through 2500 RPM. With the gas flowing record the analyzer readings.

e. Relocate the instrument to within 6 inches of one side of the vehicle near the engine compartment. Repeat Step 4.

f. Relocate the instrument to within 6 inches of the other side of the vehicle near the engine compartment. Repeat Step 4.

Acceptance criteria: The analyzer readings shall deviate no more than 0.5% full scale.

(2) Induction field test. Use a variable speed (commutator type) hand drill having a plastic housing and rated at 3 amps or more. While the analyzer is sampling the gas, vary the drill speed from zero to maximum

while moving from the front to the sides of the instrument at various heights.

Acceptance criteria: The analyzer readings shall deviate no more than 0.5% full scale.

(3) Line interference test. Plug the drill used in Part B above into one outlet of A #16-3 wire extension cord approximately 20 feet long. Connect the instrument into the other outlet of the extension cord. Repeat Part B above.

Acceptance criteria: The analyzer readings shall deviate no more than 0.5% full scale.

(4) VHF band frequency interference test. Locate both a citizens ban radio (CB), with output equivalent to FCC legal maximum, and a highway patrol transmitter (or equivalent) within 50 feet of the instrument. While the analyzer is sampling the gas, press and release transmit button of both radios several times.

Acceptance criteria: The analyzer readings shall deviate no more than 0.5% full scale.

(5) Ambient conditions instruments. Upon installation and every 6 months, the performance of the ambient conditions instruments shall be cross checked against a master weather station.

Acceptance criteria: The individual instruments shall be within the tolerance specified in § 3(c)(4).

§ 8. Software specifications and emission inspection waiver procedure.

(a). *Software specifications.*

(1) General.

(i) The software shall prompt the test personnel to restrain the vehicle. The test system does not need to have a feedback to detect the presence of the restrain system. (Shop requirement).

(ii) At each calibration called for in § 4(d)(2)(i), the system shall automatically record the date, time, the gas readings for HC, CO, NO and CO_2 prior to adjustment to the labeled gas values of the calibration gases, and the gas readings after adjustment. This data shall be readily accessible for purposes of statistical process control analysis.

(iii) Software shall be developed and provided to permit statistical process control procedures to be utilized to determine calibration lengths and intervals and other procedures as specified in § 4(a) and as otherwise determined by the Commonwealth.

(2) Software shall be developed and provided to permit the use of the enhanced waiver procedure described in subsection 8(b) of this appendix.

(3) Emission inspection equipment software for the Pennsylvania emission inspection program shall be approved by the Department or its designee prior to installation and use in emission inspection equipment installed at certified emission inspection stations.

(4) An emission inspection test report, meeting the requirements of § 177.252(b), shall be generated by the analyzer. A sample is attached as Exhibit A.

(b) *Emission inspection waiver procedure.*

(1) After failing initial I/M test, vehicle will receive vehicle repair form.

(i) This form must be completed by person repairing vehicle.

(ii) Completed form will include repairs done and cost of such repairs.

(2) When repairs are completed, vehicle shall be returned to a certified emission inspection.

(3) When retest is begun, repairs made and cost of repairs will be entered into the inspection equipment.

(i) If vehicle fails retest, screen will prompt inspector ‘‘Do you wish waiver?’’

(ii) If no, retest will be aborted.

(iii) If yes, inspector will be presented with waiver screen.

(iv) This screen will ask for certified repair technician number (it may be read by bar code reader or manually entered).

(4) The vehicle inspection information data base (VIID) will be queried and the repair data, including cost, will be examined.

(5) The VIID will review the transmitted data.

(i) The repairs will be compared with the cause of the failure to ensure that they were appropriate to the failure.

(ii) the cost of the repairs will be examined to ensure that cost meets minimum requirements for a waiver.

(6) If the VIID determines that the waiver requirements as specified in § 177.281 and § 177.282 have not been satisfied, the VIID will return a ''NO'' to request for waiver.

(7) If all waiver requirements under § 177.281 and § 177.282 are met, the VIID will transmit a unique waiver transaction approval number to the certified repair technician approving the waiver.

(8) The waiver sticker may then be placed on the vehicle.

(9) Copies of all repair receipts must be kept by the inspection station issuing waiver.

(i) All waiver repair receipts will be examined by quality assurance officers during normal record audits.

(ii) Waiver repair receipts may also be examined at any time by quality assurance officers or other qualified Commonwealth employees.

§ 9. Hardware specifications.

(a) *General.*

(1) Tamper control

—Keys allowed Yes

—Solenoid required Optional

—Switches required Yes

—Secure user floppy No

—Allow DOS access No

—Gas analyzer Yes

—Detect power off Yes

(2) Computer requirements

Processor (minimum): Pentium

OS system: Latest version of commercially available OS

RAM required (minimum): 16 MB

Minimum RAM upgrade capability 32 MB

Secured floppy drive (3.5"): 1

Hard drive size (minimum): 1.2 GB

2nd HD expansion required: Yes

2nd 3.5" expansion required: Yes

CD required (4X minimum): Optional

16 BIT sound card (minimum) Optional

Modem speed (minimum): 28.8

Free slots required: 2

Mouse upgrade: Optional

(3) Ports/connectors:

—Parallel (minimum): 2

—Serial (free port) 1

(BAUD 300-115.2) 111 MAX

(DB25 connector): Yes

—Special serial port:* 1

(4) Special COMM PORTS CPC

—12V switched power Yes

—12V protected Yes

* An additional RS232 serial port shall be provided specifically to conduct either a gas cap test or a tank integrity test (pressure test) and a purge test when the appropriate test(s) or alternate tests are developed and approved by the Federal Environmental Protection Agency (EPA).

(5) Bar code scanner 2D

—User replaceable Yes

(6) Printer (Laser): 1

—User replaceable: Yes

(7) Keyboard: 101

—User replaceable Yes

(8) Video CRT: 14"

—User replaceable Yes

—Memory (minimum): 1 MB

—Resolution: SVGA

(9) Other devices required:

—Opacity Future

—OBD II Port Future upgrade

—Gas cap tester Yes

—Tachometer number 3

—Conventional 1

—Non-intrusive 1

—OBD II 1, when available

Notes:

A. Operating system (OS) must be upgradable to Windows 95, if required by Department at a later date.

B. Manufacturer must demonstrate a working unit to the Department of Transportation or designee. Unit must provide minimum capabilities listed with costing for all options, including future upgrades.

(b) Gas analyzers.

(1) Bench performance (minimum): Pennsylvania (East Coast)

Specification

—Measured gases (standard): 4

—NO Standard

—Humidity compensated Standard

—PEF range (.XX format) 47-56

—Warm up time 15 minutes

—Ranges

HC PPM 0-10,000

CO% 0-14.0

CO2% 0-18.0

NO PPM 0-5,000

O2% 0-25.0

—Zero set two point Yes

(2) Sample system

—Dual probes required: Yes

—25' sample hose required: Yes

(3) Calibration system

—Zero gas required Yes

—Calibration frequency 3 days

—Calibration Single

—Second gas Optional

—Third gas Open

—Calibration gas specifications

Accuracy +/- 1%

Blend tolerance +/- 5%

Type, blend TRI/QUAD*

Values

CO% 3.5%

HC propane 2,000

CO2 14.0

NO 2,000

(4) 3 ports shall be provided for calibration gas: 1 port shall be for zero gas, 1 port shall be used for calibration gas and 1 port shall be for a spare. Hardware shall be included to activate the third port.

(5) Vented storage required N/S

(6) ASM areas will use QUAD blend, idle test areas will use tri blend

(c) *ASM dynamometer*

(1) Base specification Pennsylvania

—Upgrade Standard

(2) Identification Plate N/S

(3) MAX vehicle test weight 9000 GVWR

(4) Absorber accuracy +/- 2%

(5) Base inertia 2000 +/- 40

Inertia simulation range 2-6

—Mechanical increments 500

—Electrical increments 1

(6) Roll diameter 8.5-21

(7) Testable track width 30-100

(8) Coast down CK 3 day

(9) Vehicle weight measurement No

(10) Vehicle restraint monitor No

(11) Aximum allowed incline 5%

(12) Automatic lift Yes

—Power failure backup No

(13) Remote control N/S

(14) Fan required No

—Remote control N/S

(15) Augmented braking No

(16) 12V PC controlled power switched

Notes:

The fan in the Pennsylvania/East Coast specification is a shop requirement.

EXHIBIT A

SAMPLE

COMMONWEALTH OF PENNSYLVANIA

VEHICLE EMISSIONS INSPECTION REPORT

Test Date/Time: 01/22/1997 @ 08:50

VEHICLE INFORMATION

Year:	1986	Make:	XXXX	Model:	XXXXXXXXXXXX
VIN:	A12346789012345	Engine Size:	6.0 L	Cylinders:	XXXX
Odometer:	100000	GVWR:	6600	Estimated Test:	E
License:	XXX1234	Inspection Type:	INITIAL	Weight:	4600
County:	PRINCE WILLIAM			Record Number:	123456

EMISSIONS CONTROL SYSTEMS VISUAL/FUNCTIONAL INSPECTION

Air Pump System:	PASS	Catalytic Converter:	PASS	Gas Cap Integrity:	PASS
EGR System:	PASS	Evaporative Control System:	PASS	Evaporative Pressure:	N/A
PCV System:	PASS			Evaporative Purge:	N/A
Fuel Inlet Restrictor	PASS				

TAILPIPE EMISSIONS INSPECTION

MODE	CO %			HC ppm			RPM		DILUTION	
2 Speed Idle	Limit	Reading	Result	Limit	Reading	Result	Reading	Result	Reading	Result
IDLE	1.20	2.23	FAIL	220	360	FAIL	800	VALID	13.5%	VALID
2500 RPM	1.20	2.35	FAIL	220	120	PASS	2499	VALID	14.3%	VALID

OVERALL TEST RESULTS: **FAILED**

Emissions Control Systems Visual/Functional Inspection: **PASS** Transaction Identification Number: **123456789**

Tailpipe Emissions Inspection: **FAIL**

BAR CODE HERE

RETAIN THIS DOCUMENT FOR USE ON REINSPECTION.
RETURN THE VEHICLE TO THE SAME STATION WITHIN THIRTY (30) DAYS FOR ONE (1) FREE RETEST.

This vehicle has failed the emissions inspection. **REPAIRS SHOULD BE MADE TO EITHER PASS REINSPECTION OR QUALIFY FOR A WAIVER.** All emissions related repairs performed must be documented by the inspection station. This inspection report and **copies of the repair receipts** must be made available to the inspection station at the time of reinspection.

Vehicles that fail the inspection may be eligible for warranty coverage for the required repairs. Vehicle manufacturers are required by Federal law to provide EMISSIONS WARRANTIES FOR AT LEAST FIVE (5) YEARS OR FIFTY THOUSAND (50,000) MILES. Warranty coverage may vary depending on vehicle make and model year. For further information, refer to the EMISSIONS WARRANTY section of the vehicle's owner manual.

In order for a vehicle to receive a "WAIVER" when tailpipe emissions levels of CO, HC, and NO (if applicable) are still failing to meet the standards at the time of reinspection, the following requirements must be met.

1. **REPAIR WORK MUST BE APPROVED BY A CERTIFIED REPAIR TECHNICIAN.**
2. Emissions related repair expenditures must have been at least $XXX.XX.
3. Copies of the repair receipts for emissions related repairs must be provided to the inspection station.
4. Repairs were performed no earlier than 60 days prior to the initial inspection.

Vehicle tested in accordance with 40 CFR, Part 51 and Pa. Title 67, Chapter 177.

EMISSIONS INSPECTION STATION

STATION #:	12345	INSPECTOR NAME:	JOHN T. SMITH
STATION NAME:	I/M Quality Inspection	INSPECTOR ID:	12345
ADDRESS:	13901 CROWN COURT, ANYTOWN 12345	ANALYZER #	Z12345
PHONE:	216- 123-4567	SOFTWARE VERSION	1.00

VEHICLE EMISSIONS INSPECTION QUESTIONS: If the station cannot answer your questions, please contact the Department of Transportation, Vehicle Inspection Division at (717) 783-5842.

Inspector's Signature _____

John T. Smith