EMCO

EMISSIONS MEASUREMENT COMPANY

Project GA13-0045

Appendix C: Quality Assurance Data

Analyzer Calibration Error Tests

NO_x Converter Efficiency Test

Analyzer Interference Check (EPA Verification)

Tsubaki Hills
08-62-34-4H

GA13-45
Marathon Oil Company
Tsubaki Hills 08-62-34-4H
6/10/2013

Initial Linearity Gas	Concentration	Value	Initial Response	Error	OK?
O_2	Low	0	0.1	0.47%	Y
	Mid	10.5	10.7	0.95%	Y
	High	21.1	21.1	0.00%	Y
CO_2	Low	0	-0.1	0.52%	Y
	Mid	8.04	7.8	1.26%	Y
	High	19.1	19.1	0.00%	Y
NO_x	Low	0	-1	0.30%	Y
	Mid	145	144	0.30%	Y
	High	332	332	0.00%	Y
CO	Low	0	-1	0.07%	Y
	Mid	776	780	0.26%	Y
	High	1510	1510	0.00%	Y

GA13-45
Marathon Oil Company
Tsubaki Hills 08-62-34-4H
6/10/2013

Analyzer Bias Checks

					Run 1			Run 2			Run 3		
					Start Time	10:10		Start Time	11:20		Start Time	12:30	
					Run Length	60		Run Length	60		Run Length	60	
					Stop Time	11:10		Stop Time	12:20		Stop Time	13:30	
Gas	Concentration	Gas Value	Analyzer Response	Initial Bias	Post Cal	Bias	Drift	Post Cal	Bias	Drift	Post Cal	Bias	Drift
O_2	Low	0	0.1	0.5%	0	0.5%	0.5%	0	0.5%	0.0%	0	0.5%	0.0%
	Span	10.5	10.7	0.9%	10.6	0.5%	0.5%	10.6	0.5%	0.0%	10.5	0.9%	0.5%
CO_2	Low	0	-0.1	0.5%	0.2	1.6%	1.6%	0.1	1.0%	0.5%	0.2	1.6%	0.5%
	Span	8.04	7.8	1.3%	7.9	0.5%	0.5%	8	1.0%	0.5%	7.9	0.5%	0.5%
NO_x	Low	0	-1	0.3%	1	0.6%	0.6%	1.6	0.8%	0.2%	1	0.6%	0.2%
	Span	145	144	0.3%	151	2.1%	2.1%	149	1.5%	0.6%	144	0.0%	1.5%
CO	Low	0	-1	0.1%	0	0.1%	0.1%	4	0.3%	0.3%	2	0.2%	0.1%
	Span	776	780	0.3%	778	0.1%	0.1%	783	0.2%	0.3%	776	0.3%	0.5%
				≤5%		≤5%	≤3%		≤5%	≤3%		≤5%	≤3%

Time	O2	CO2	NOx	CO	
6/10/13 9:18:47	0.1	-0.1	332	-333	Calibration
6/10/13 9:18:57	0.1	-0.1	333	-334	Error Tests
6/10/13 9:19:07	0.1	-0.1	334	-334	
6/10/13 9:19:17	0.1	0.2	334	-11	
6/10/13 9:19:27	1.2	0.5	325	324	
6/10/13 9:19:37	9.9	2.1	219	200	
6/10/13 9:19:47	19.6	3.5	27	5	
6/10/13 9:19:57	20.5	3.5	3	-1	
6/10/13 9:20:07	20.7	10.4	1	-10	
6/10/13 9:20:17	20.8	18.6	1	-11	
6/10/13 9:20:27	20.8	18.7	0	-12	
6/10/13 9:20:37	20.9	18.8	0	-12	
6/10/13 9:20:47	20.9	18.8	0	-12	
6/10/13 9:20:57	21.0	18.8	0	-13	
6/10/13 9:21:07	21.0	18.9	0	-13	
6/10/13 9:21:17	21.1	19.0	0	-14	
6/10/13 9:21:27	21.1	19.1	0	-14	
6/10/13 9:21:37	21.1	19.1	0	-14	
6/10/13 9:21:47	21.1	19.1	0	-13	
6/10/13 9:21:57	21.1	19.2	0	-14	
6/10/13 9:22:07	21.1	19.1	0	-14	
6/10/13 9:22:17	20.2	17.1	2	-11	
6/10/13 9:22:27	13.8	9.0	16	2	
6/10/13 9:22:37	11.2	7.8	0	-1	
6/10/13 9:22:47	11.0	7.7	0	-2	
6/10/13 9:22:57	10.9	7.7	0	-2	
6/10/13 9:23:07	10.8	7.7	0	-3	
6/10/13 9:23:17	10.8	7.7	0	-2	
6/10/13 9:23:27	10.8	7.8	-1	-2	
6/10/13 9:23:37	10.7	7.8	-1	-2	
6/10/13 9:23:47	10.7	7.5	-1	-2	
6/10/13 9:23:57	10.7	3.1	-1	-1	
6/10/13 9:24:07	10.7	5.7	-1	-2	
6/10/13 9:24:17	10.7	3.6	-1	-1	
6/10/13 9:24:27	10.7	7.2	-1	-2	
6/10/13 9:24:37	10.8	3.2	-1	-4	
6/10/13 9:24:47	10.7	1.5	-1	-3	
6/10/13 9:24:57	10.7	-0.2	-1	-1	
6/10/13 9:25:07	10.7	0.1	-1	-1	
6/10/13 9:25:17	10.7	0.0	-1	-1	
6/10/13 9:25:27	10.7	2.1	-1	-1	
6/10/13 9:25:37	10.7	7.8	-1	-1	
6/10/13 9:25:47	10.7	7.8	-1	-1	
6/10/13 9:25:57	10.7	7.8	-1	-2	
6/10/13 9:26:07	10.7	7.8	0	0	
6/10/13 9:26:17	10.7	7.8	0	-1	
6/10/13 9:26:27	7.8	5.1	38	59	
6/10/13 9:26:37	1.4	0.6	277	314	
6/10/13 9:26:47	0.5	0.2	334	325	
6/10/13 9:26:57	0.3	0.2	338	328	
6/10/13 9:27:07	0.3	0.1	340	331	
6/10/13 9:27:17	0.2	0.1	341	334	
6/10/13 9:27:27	0.2	0.1	342	331	
6/10/13 9:27:37	0.1	0.1	343	333	
6/10/13 9:27:47	0.1	0.1	343	333	
6/10/13 9:27:57	0.1	0.1	344	333	
6/10/13 9:28:07	0.1	0.1	341	332	
6/10/13 9:28:17	0.1	0.1	332	333	
6/10/13 9:28:27	0.1	0.1	332	333	
6/10/13 9:28:37	0.1	0.1	332	332	
6/10/13 9:28:47	0.1	0.1	331	332	
6/10/13 9:28:57	0.1	0.1	332	329	
6/10/13 9:29:07	0.1	0.1	332	327	
6/10/13 9:29:17	0.1	0.1	332	329	
6/10/13 9:29:27	0.7	0.3	312	307	
6/10/13 9:29:37	0.6	0.2	182	166	
6/10/13 9:29:47	0.1	0.1	159	162	
6/10/13 9:29:57	0.1	0.1	160	163	
6/10/13 9:30:07	0.1	0.1	161	170	
6/10/13 9:30:17	0.0	0.1	164	175	
6/10/13 9:30:27	0.0	0.1	167	172	
6/10/13 9:30:37	0.0	0.1	164	171	
6/10/13 9:30:47	0.0	0.1	159	167	
6/10/13 9:30:57	0.0	0.1	149	160	
6/10/13 9:31:07	0.0	0.1	145	148	
6/10/13 9:31:17	0.0	0.1	145	150	
6/10/13 9:31:27	0.0	0.1	144	149	
6/10/13 9:31:37	0.0	0.1	144	149	
6/10/13 9:31:47	0.0	0.1	144	148	

Time	O2	CO2	NOx	CO
6/10/13 9:31:57	0.0	0.1	144	148
6/10/13 9:32:07	0.1	0.1	144	148
6/10/13 9:32:17	7.5	0.1	115	107
6/10/13 9:32:27	18.9	0.1	18	9
6/10/13 9:32:37	20.2	0.1	4	8
6/10/13 9:32:47	20.4	0.1	2	7
6/10/13 9:32:57	20.6	0.1	1	7
6/10/13 9:33:07	20.7	0.1	1	2
6/10/13 9:33:17	20.7	0.1	1	5
6/10/13 9:33:27	18.0	1.1	19	384
6/10/13 9:33:37	3.2	8.8	802	1024
6/10/13 9:33:47	-1.3	11.0	1023	1024
6/10/13 9:33:57	-1.3	11.1	766	1024
6/10/13 9:34:07	-1.3	11.1	591	1024
6/10/13 9:34:17	-1.3	11.2	709	1024
6/10/13 9:34:27	-1.3	11.3	775	1024
6/10/13 9:34:37	-1.3	11.3	767	1023
6/10/13 9:34:47	-1.3	11.3	769	1024
6/10/13 9:34:57	-1.3	11.4	770	1024
6/10/13 9:35:07	-1.3	11.4	769	1024
6/10/13 9:35:17	-1.3	11.4	767	1024
6/10/13 9:35:27	-1.3	11.4	773	1024
6/10/13 9:35:37	-1.3	11.4	775	1024
6/10/13 9:35:47	-1.3	11.4	779	1024
6/10/13 9:35:57	-1.3	11.4	783	1024
6/10/13 9:36:07	-1.3	11.4	785	1024
6/10/13 9:36:17	-1.3	11.4	787	1024
6/10/13 9:36:27	-1.3	11.4	794	1024
6/10/13 9:36:37	-1.3	11.4	796	1024
6/10/13 9:36:47	-1.3	11.4	803	1024
6/10/13 9:36:57	-1.3	11.4	798	1024
6/10/13 9:37:07	-1.3	11.4	794	1023
6/10/13 9:37:17	-1.3	11.4	792	1024
6/10/13 9:37:27	-1.3	11.4	786	1024
6/10/13 9:37:37	-1.3	11.4	780	1023
6/10/13 9:37:47	-1.3	11.4	787	1024
6/10/13 9:37:57	-1.3	11.4	805	1024
6/10/13 9:38:07	-1.3	11.5	790	1024
6/10/13 9:38:17	-1.3	11.5	789	1024
6/10/13 9:38:27	-1.3	11.4	795	1024
6/10/13 9:38:37	-1.3	11.2	822	1024
6/10/13 9:38:47	-1.3	11.6	980	1024
6/10/13 9:38:57	-1.3	11.6	994	1023
6/10/13 9:39:07	-1.3	11.6	963	1024
6/10/13 9:39:17	-1.3	11.6	1012	1024
6/10/13 9:39:27	-1.3	11.5	969	1024
6/10/13 9:39:37	-1.3	11.5	946	1023
6/10/13 9:39:47	-1.3	11.6	998	1024
6/10/13 9:39:57	-1.3	11.5	918	1023
6/10/13 9:40:07	-1.3	11.6	975	1024
6/10/13 9:40:17	-1.3	11.1	904	1024
6/10/13 9:40:27	-1.3	11.1	864	1024
6/10/13 9:40:37	-1.3	11.7	970	1023
6/10/13 9:40:47	-1.3	11.7	973	1024
6/10/13 9:40:57	-1.3	11.7	962	1023
6/10/13 9:41:07	-1.3	11.7	946	1024
6/10/13 9:41:17	-1.3	11.7	943	1024
6/10/13 9:41:27	-1.3	11.7	941	1024
6/10/13 9:41:37	-1.3	11.7	941	1024
6/10/13 9:41:47	-1.3	11.7	952	1023
6/10/13 9:41:57	-1.3	11.7	949	1024
6/10/13 9:42:07	-1.3	11.6	953	1024
6/10/13 9:42:17	-0.6	11.6	1005	1024
6/10/13 9:42:27	0.3	11.6	1023	986
6/10/13 9:42:37	1.0	11.4	1023	600
6/10/13 9:42:47	0.9	11.5	1023	656
6/10/13 9:42:57	1.6	11.2	1023	528
6/10/13 9:43:07	1.8	11.1	1010	377
6/10/13 9:43:17	1.5	11.4	1023	392
6/10/13 9:43:27	1.5	11.4	1023	390
6/10/13 9:43:37	1.5	11.4	1023	391
6/10/13 9:43:47	1.5	11.4	1023	382
6/10/13 9:43:57	1.4	11.4	1023	430
6/10/13 9:44:07	1.1	11.3	1023	624
6/10/13 9:44:17	0.7	11.5	1023	763
6/10/13 9:44:27	0.4	11.6	1023	840
6/10/13 9:44:37	0.3	11.6	1023	868
6/10/13 9:44:47	0.3	11.6	1023	895
6/10/13 9:44:57	0.3	11.6	1023	1023

Time	O2	CO2	NOx	CO
6/10/13 9:45:07	0.3	11.6	1023	1024
6/10/13 9:45:17	0.3	11.6	1023	1021
6/10/13 9:45:27	0.2	11.6	1023	1023
6/10/13 9:45:37	0.3	11.6	1023	1023
6/10/13 9:45:47	0.2	11.7	1023	1024
6/10/13 9:45:57	0.2	11.6	1023	1024
6/10/13 9:46:07	1.0	11.3	1023	772
6/10/13 9:46:17	2.1	11.0	997	351
6/10/13 9:46:27	2.2	11.0	970	328
6/10/13 9:46:37	2.3	11.0	974	317
6/10/13 9:46:47	2.3	11.0	989	326
6/10/13 9:46:57	2.3	11.0	979	323
6/10/13 9:47:07	2.4	10.9	971	301
6/10/13 9:47:17	2.4	10.9	970	289
6/10/13 9:47:27	2.4	10.9	969	297
6/10/13 9:47:37	2.4	10.9	963	300
6/10/13 9:47:47	2.3	11.0	965	305
6/10/13 9:47:57	2.3	11.0	972	304
6/10/13 9:48:07	2.3	11.0	983	294
6/10/13 9:48:17	2.3	11.0	984	295
6/10/13 9:48:27	2.3	11.0	994	294
6/10/13 9:48:37	2.3	11.0	989	285
6/10/13 9:48:47	2.4	11.0	995	283
6/10/13 9:48:57	2.4	11.0	982	281
6/10/13 9:49:07	2.8	10.7	921	276
6/10/13 9:49:17	3.9	10.0	677	217
6/10/13 9:49:27	4.1	9.9	610	198
6/10/13 9:49:37	4.1	9.9	602	198
6/10/13 9:49:47	4.1	9.9	588	200
6/10/13 9:49:57	4.2	9.8	572	192
6/10/13 9:50:07	4.2	9.9	575	191
6/10/13 9:50:17	4.2	9.8	578	190
6/10/13 9:50:27	4.2	9.9	583	190
6/10/13 9:50:37	4.2	9.8	576	193
6/10/13 9:50:47	4.2	9.8	576	192
6/10/13 9:50:57	4.3	9.8	572	188
6/10/13 9:51:07	4.3	9.8	573	190
6/10/13 9:51:17	4.3	9.8	573	186
6/10/13 9:51:27	4.2	9.8	571	191
6/10/13 9:51:37	4.2	9.9	577	189
6/10/13 9:51:47	4.2	9.9	584	187
6/10/13 9:51:57	4.2	9.9	586	186
6/10/13 9:52:07	4.2	9.8	569	184
6/10/13 9:52:17	4.2	9.9	574	185
6/10/13 9:52:27	4.2	9.9	588	187
6/10/13 9:52:37	4.1	10.0	479	173
6/10/13 9:52:47	3.9	10.2	100	183
6/10/13 9:52:57	3.9	10.2	61	184
6/10/13 9:53:07	3.9	10.2	58	187
6/10/13 9:53:17	3.8	10.2	57	190
6/10/13 9:53:27	3.8	10.2	56	189
6/10/13 9:53:37	3.9	10.2	54	189
6/10/13 9:53:47	3.9	10.2	53	190
6/10/13 9:53:57	3.9	10.2	52	189
6/10/13 9:54:07	3.9	10.2	52	191
6/10/13 9:54:17	3.9	10.2	52	190
6/10/13 9:54:27	3.9	10.2	50	190
6/10/13 9:54:37	3.9	10.2	50	190
6/10/13 9:54:47	3.8	10.2	50	192
6/10/13 9:54:57	3.8	10.2	50	191
6/10/13 9:55:07	3.8	10.2	50	191
6/10/13 9:55:17	3.8	10.2	49	192
6/10/13 9:55:27	3.4	10.5	56	199
6/10/13 9:55:37	3.0	10.8	71	207
6/10/13 9:55:47	1.8	11.6	89	250
6/10/13 9:55:57	0.7	12.2	115	328
6/10/13 9:56:07	0.8	12.1	122	295
6/10/13 9:56:17	0.7	12.2	126	307
6/10/13 9:56:27	0.6	12.2	124	318
6/10/13 9:56:37	0.6	12.2	126	319
6/10/13 9:56:47	0.6	12.2	184	326
6/10/13 9:56:57	0.5	12.2	321	797
6/10/13 9:57:07	0.5	12.2	321	835
6/10/13 9:57:17	0.5	12.2	319	838
6/10/13 9:57:27	0.4	12.2	307	1000
6/10/13 9:57:37	2.3	11.0	249	703
6/10/13 9:57:47	3.5	10.3	146	537
6/10/13 9:57:57	3.6	10.3	135	508
6/10/13 9:58:07	3.8	10.2	139	489

Time	O2	CO2	NOx	CO
6/10/13 9:58:17	4.3	9.9	143	418
6/10/13 9:58:27	4.4	9.8	127	403
6/10/13 9:58:37	4.5	9.8	120	408
6/10/13 9:58:47	4.5	9.8	119	412
6/10/13 9:58:57	4.5	9.8	119	413
6/10/13 9:59:07	4.5	9.8	120	413
6/10/13 9:59:17	4.5	9.8	120	415
6/10/13 9:59:27	4.5	9.8	121	420
6/10/13 9:59:37	4.5	9.8	121	421
6/10/13 9:59:47	4.5	9.8	122	421
6/10/13 9:59:57	4.6	9.8	133	418
6/10/13 10:00:07	4.6	9.8	130	421
6/10/13 10:00:17	4.6	9.8	126	407
6/10/13 10:00:27	4.6	9.8	126	409
6/10/13 10:00:37	4.6	9.8	127	408
6/10/13 10:00:47	4.6	9.8	127	406
6/10/13 10:00:57	4.6	9.8	125	411
6/10/13 10:01:07	4.6	9.8	130	425
6/10/13 10:01:17	4.6	9.8	129	410
6/10/13 10:01:27	4.6	9.8	126	405
6/10/13 10:01:37	4.6	9.8	125	404
6/10/13 10:01:47	4.6	9.8	126	409
6/10/13 10:01:57	4.6	9.8	127	407
6/10/13 10:02:07	4.6	9.8	127	403
6/10/13 10:02:17	4.6	9.8	126	404
6/10/13 10:02:27	4.6	9.8	128	405
6/10/13 10:02:37	4.6	9.8	128	406
6/10/13 10:02:47	4.6	9.8	128	404
6/10/13 10:02:57	4.5	9.5	86	403
6/10/13 10:03:07	2.3	3.7	233	440
6/10/13 10:03:17	0.3	0.5	8635	1433
6/10/13 10:03:27	0.2	0.3	16164	1489
6/10/13 10:03:37	0.2	0.3	16552	1490
6/10/13 10:03:47	0.1	0.3	15395	1490
6/10/13 10:03:57	0.0	0.2	15012	1489
6/10/13 10:04:07	0.0	0.2	15110	1494
6/10/13 10:04:17	0.0	0.2	15167	1497
6/10/13 10:04:27	0.0	0.2	15240	1499
6/10/13 10:04:37	0.0	0.2	15372	1497
6/10/13 10:04:47	0.0	0.2	15490	1499
6/10/13 10:04:57	0.0	0.2	15604	1499
6/10/13 10:05:07	0.0	0.2	15701	1497
6/10/13 10:05:17	0.0	0.2	15766	1501
6/10/13 10:05:27	0.0	0.2	15813	1497
6/10/13 10:05:37	0.0	0.2	15849	1510
6/10/13 10:05:47	0.0	0.1	15889	1511
6/10/13 10:05:57	0.0	0.1	15907	1510
6/10/13 10:06:07	0.0	0.1	15901	1507
6/10/13 10:06:17	0.0	0.1	10385	1107
6/10/13 10:06:27	0.0	0.1	834	800
6/10/13 10:06:37	0.0	0.1	816	791
6/10/13 10:06:47	0.0	0.1	810	788
6/10/13 10:06:57	0.0	0.1	809	784
6/10/13 10:07:07	0.0	0.1	809	784
6/10/13 10:07:17	0.0	0.1	808	784
6/10/13 10:07:27	0.0	0.1	807	782
6/10/13 10:07:37	0.0	0.1	808	779
6/10/13 10:07:47	0.0	0.1	808	784
6/10/13 10:07:57	0.0	0.1	808	780
6/10/13 10:08:07	0.0	0.1	807	780
6/10/13 10:08:17	0.0	0.1	807	780

Time	O2	CO2	NOx	CO	
6/10/13 11:12:57	0.0	0.2	824	778	R1 PostCal
6/10/13 11:13:07	0.0	0.2	825	778	
6/10/13 11:13:17	0.0	0.3	824	778	
6/10/13 11:13:27	0.6	1.2	738	785	
6/10/13 11:13:37	0.2	0.4	338	320	
6/10/13 11:13:47	0.0	0.2	159	171	
6/10/13 11:13:57	0.0	0.2	154	162	
6/10/13 11:14:07	0.0	0.2	153	159	
6/10/13 11:14:17	0.0	0.2	152	157	
6/10/13 11:14:27	0.0	0.2	152	156	
6/10/13 11:14:37	0.0	0.2	151	155	
6/10/13 11:14:47	0.0	0.2	151	156	
6/10/13 11:14:57	0.0	0.2	150	155	
6/10/13 11:15:07	0.2	0.3	151	155	
6/10/13 11:15:17	5.3	3.8	146	137	
6/10/13 11:15:27	9.8	7.4	20	10	
6/10/13 11:15:37	10.1	7.6	7	9	
6/10/13 11:15:47	10.1	7.7	6	9	
6/10/13 11:15:57	10.2	7.7	6	8	
6/10/13 11:16:07	10.2	7.7	6	7	
6/10/13 11:16:17	10.2	7.7	5	6	
6/10/13 11:16:27	10.2	7.7	5	6	
6/10/13 11:16:37	10.2	7.7	5	8	
6/10/13 11:16:47	10.2	7.7	5	7	
6/10/13 11:16:57	10.2	7.7	6	8	
6/10/13 11:17:07	10.2	7.6	6	7	
6/10/13 11:17:17	10.2	7.6	6	8	
6/10/13 11:17:27	10.2	7.6	6	7	
6/10/13 11:17:37	10.2	7.7	5	8	
6/10/13 11:17:47	10.3	7.7	4	6	
6/10/13 11:17:57	10.5	7.9	2	3	
6/10/13 11:18:07	10.6	7.9	1	2	
6/10/13 11:18:17	10.6	7.9	0	1	
6/10/13 11:18:27	10.6	7.9	1	0	
6/10/13 11:18:37	10.6	7.9	1	-1	
6/10/13 11:18:47	10.6	8.0	1	0	
6/10/13 11:18:57	10.6	7.9	1	0	

Time	O2	CO2	NOx	CO	
6/10/13 12:24:37	10.6	8.0	2	4	R2 PostCal
6/10/13 12:24:47	10.6	8.0	2	4	
6/10/13 12:24:57	10.6	8.0	2	4	
6/10/13 12:25:07	10.3	8.2	3	18	
6/10/13 12:25:17	7.2	7.9	61	413	
6/10/13 12:25:27	2.5	2.4	118	225	
6/10/13 12:25:37	0.7	0.8	153	166	
6/10/13 12:25:47	0.7	0.8	154	166	
6/10/13 12:25:57	0.3	0.4	149	156	
6/10/13 12:26:07	0.2	0.3	148	154	
6/10/13 12:26:17	0.1	0.3	148	154	
6/10/13 12:26:27	0.1	0.3	148	154	
6/10/13 12:26:37	0.1	0.3	149	154	
6/10/13 12:26:47	0.1	0.3	149	154	
6/10/13 12:26:57	0.1	0.3	149	155	
6/10/13 12:27:07	0.8	0.6	188	207	
6/10/13 12:27:17	0.5	0.4	596	652	
6/10/13 12:27:27	0.1	0.2	766	737	
6/10/13 12:27:37	0.1	0.2	781	744	
6/10/13 12:27:47	0.0	0.2	799	763	
6/10/13 12:27:57	0.0	0.2	811	772	
6/10/13 12:28:07	0.0	0.2	817	777	
6/10/13 12:28:17	0.0	0.2	820	781	
6/10/13 12:28:27	0.0	0.2	822	783	
6/10/13 12:28:37	0.0	0.1	823	783	
6/10/13 12:28:47	0.0	0.1	824	783	

Time	O2	CO2	NOx	CO	
6/10/13 13:33:27	0.0	0.2	841	776	R3 PostCal
6/10/13 13:33:37	0.0	0.2	841	776	
6/10/13 13:33:47	0.0	0.2	842	776	
6/10/13 13:33:57	0.0	0.2	842	776	
6/10/13 13:34:07	0.1	2.5	933	1196	
6/10/13 13:34:17	0.2	4.6	1023	1811	
6/10/13 13:34:27	0.1	0.6	497	280	
6/10/13 13:34:37	0.0	0.2	179	171	
6/10/13 13:34:47	0.0	0.2	166	166	
6/10/13 13:34:57	0.0	0.2	163	162	
6/10/13 13:35:07	0.0	0.2	150	161	
6/10/13 13:35:17	0.0	0.2	144	159	
6/10/13 13:35:27	0.0	0.2	145	157	
6/10/13 13:35:37	0.0	0.2	145	156	
6/10/13 13:35:47	0.0	0.2	145	156	
6/10/13 13:35:57	0.0	0.2	144	156	
6/10/13 13:36:07	0.0	0.2	144	155	
6/10/13 13:36:17	0.0	0.2	144	155	
6/10/13 13:36:27	0.2	0.3	144	155	
6/10/13 13:36:37	5.1	3.8	125	128	
6/10/13 13:36:47	9.7	7.3	22	12	
6/10/13 13:36:57	10.2	7.7	6	7	
6/10/13 13:37:07	10.3	7.8	5	5	
6/10/13 13:37:17	10.4	7.8	4	4	
6/10/13 13:37:27	10.5	7.9	3	3	
6/10/13 13:37:37	10.5	7.9	3	2	
6/10/13 13:37:47	10.5	7.9	3	2	
6/10/13 13:37:57	10.5	7.9	3	2	
6/10/13 13:38:07	10.6	7.9	3	2	
6/10/13 13:38:17	10.6	7.9	2	2	
6/10/13 13:38:27	13.8	4.8	2	3	
6/10/13 13:38:37	19.6	0.7	1	8	
6/10/13 13:38:47	20.6	0.3	1	8	
6/10/13 13:38:57	20.7	0.2	1	7	

Pawnee Creek
9-57-18-1H

GA13-0045
Marathon Oil Company
Pawnee Creek 9-57-18-1H
6/11/2013

Initial Linearity			Initial		
Gas	Concentration	Value	Response	Error	OK?
O_2	Low	0	0.1	0.47%	Y
	Mid	10.5	10.6	0.47%	Y
	High	21.1	21.1	0.00%	Y
CO_2	Low	0	0	0.00%	Y
	Mid	8.04	7.8	1.26%	Y
	High	19.1	19.1	0.00%	Y
NO_x	Low	0	-0.3	0.04%	Y
	Mid	332	330	0.26%	Y
	High	778	781	0.39%	Y
CO	Low	0	8.5	0.56%	Y
	Mid	776	789	0.86%	Y
	High	1510	1510	0.00%	Y

GA13-0045
Marathon Oil Company
Pawnee Creek 9-57-18-1H
6/11/2013

Analyzer Bias Checks

					Run 1			Run 2			Run 3		
					Start Time	10:15		Start Time	11:25		Start Time	12:33	
					Run Length	60		Run Length	60		Run Length	60	
					Stop Time	11:15		Stop Time	12:25		Stop Time	13:33	
Gas	Concentration	Gas Value	Analyzer Response	Initial Bias	Post Cal	Bias	Drift	Post Cal	Bias	Drift	Post Cal	Bias	Drift
O_2	Low	0	0.1	0.5%	0.1	0.0%	0.5%	0	-0.5%	0.5%	0	-0.5%	0.0%
	Span	10.5	10.5	0.0%	10.5	0.0%	0.0%	10.5	0.0%	0.0%	10.5	0.0%	0.0%
CO_2	Low	0	0.2	1.0%	0.3	0.5%	0.5%	0.3	0.5%	0.0%	0.3	0.5%	0.0%
	Span	8.04	7.8	-1.3%	8.1	1.6%	2.8%	8	1.0%	0.5%	8.1	1.6%	0.5%
NO_x	Low	0	3	0.4%	4	0.1%	0.3%	2	-0.1%	0.3%	9	0.8%	0.9%
	Span	332	331	-0.1%	334	0.4%	0.5%	347	2.1%	1.7%	351	2.6%	0.5%
CO	Low	0	1	0.1%	-1	-0.1%	0.2%	-1	-0.1%	0.0%	-1	-0.1%	0.0%
	Span	776	785	0.6%	761	-1.6%	2.2%	763	-1.5%	0.1%	767	-1.2%	0.3%
				≤5%		≤5%	≤3%		≤5%	≤3%		≤5%	≤3%

Time	O2	CO2	NOx	CO	
6/11/13 9:26:28	21.1	19.1	0	-1	Calibration
6/11/13 9:26:38	21.1	19.1	0	-2	Error Tests
6/11/13 9:26:48	21.1	19.2	0	2	
6/11/13 9:26:58	21.1	19.2	0	0	
6/11/13 9:27:08	21.1	19.1	0	0	
6/11/13 9:27:18	20.9	13.9	0	1	
6/11/13 9:27:28	20.8	4.4	0	6	
6/11/13 9:27:38	20.8	1.1	0	18	
6/11/13 9:27:48	20.9	0.6	0	48	
6/11/13 9:27:58	20.9	0.4	0	44	
6/11/13 9:28:08	20.9	0.4	0	37	
6/11/13 9:28:18	20.9	0.3	0	28	
6/11/13 9:28:28	20.9	0.3	1	78	
6/11/13 9:28:38	20.9	0.2	0	53	
6/11/13 9:28:48	20.9	0.2	0	76	
6/11/13 9:28:58	20.0	1.4	10	118	
6/11/13 9:29:08	9.3	2.3	507	711	
6/11/13 9:29:18	1.7	0.2	1022	1226	
6/11/13 9:29:28	0.8	0.0	1023	1241	
6/11/13 9:29:38	0.6	0.0	1023	1249	
6/11/13 9:29:48	0.5	0.0	1023	1253	
6/11/13 9:29:58	0.4	0.0	1023	1252	
6/11/13 9:30:08	0.3	0.0	1023	1253	
6/11/13 9:30:18	0.2	0.0	1023	1256	
6/11/13 9:30:28	0.2	0.0	1023	1252	
6/11/13 9:30:38	0.2	0.0	1023	1302	
6/11/13 9:30:48	0.2	0.0	1023	1510	
6/11/13 9:30:58	0.2	0.0	1023	1510	
6/11/13 9:31:08	0.1	0.0	1023	1510	
6/11/13 9:31:18	0.1	0.0	1023	1512	
6/11/13 9:31:28	0.1	0.0	1023	1515	
6/11/13 9:31:38	2.5	0.0	1023	1427	
6/11/13 9:31:48	9.0	1.2	729	764	
6/11/13 9:31:58	10.2	5.9	233	199	
6/11/13 9:32:08	10.4	7.3	27	81	
6/11/13 9:32:18	10.4	7.5	11	32	
6/11/13 9:32:28	10.5	7.5	8	19	
6/11/13 9:32:38	10.5	7.6	6	15	
6/11/13 9:32:48	10.5	7.6	5	14	
6/11/13 9:32:58	10.6	7.6	4	13	
6/11/13 9:33:08	10.6	7.6	3	13	
6/11/13 9:33:18	10.6	7.6	3	11	
6/11/13 9:33:28	10.6	7.6	3	11	
6/11/13 9:33:38	10.6	7.8	2	11	
6/11/13 9:33:48	10.6	7.8	2	12	
6/11/13 9:33:58	10.6	7.8	2	14	
6/11/13 9:34:08	10.6	7.8	2	11	
6/11/13 9:34:18	10.6	7.8	2	9	
6/11/13 9:34:28	10.6	7.8	2	9	
6/11/13 9:34:38	10.6	7.8	2	9	
6/11/13 9:34:48	10.6	7.8	1	8	
6/11/13 9:34:58	10.6	7.8	1	9	
6/11/13 9:35:08	10.6	7.8	1	8	
6/11/13 9:35:18	10.6	7.8	1	9	
6/11/13 9:35:28	10.6	7.8	1	9	
6/11/13 9:35:38	10.6	7.9	1	9	
6/11/13 9:35:48	10.6	7.9	1	8	
6/11/13 9:35:58	10.6	7.8	1	8	
6/11/13 9:36:08	12.5	6.1	1	9	
6/11/13 9:36:18	10.8	3.5	81	137	
6/11/13 9:36:28	2.3	0.9	537	707	
6/11/13 9:36:38	0.6	0.3	691	777	
6/11/13 9:36:48	0.4	0.3	704	787	
6/11/13 9:36:58	0.3	0.2	710	790	
6/11/13 9:37:08	0.2	0.2	713	791	
6/11/13 9:37:18	0.2	0.2	715	793	
6/11/13 9:37:28	0.1	0.2	765	789	
6/11/13 9:37:38	0.1	0.2	778	788	
6/11/13 9:37:48	0.1	0.2	779	789	
6/11/13 9:37:58	0.1	0.2	780	789	
6/11/13 9:38:08	0.1	0.2	780	789	

Time	O2	CO2	NOx	CO	
6/11/13 9:38:18	0.1	0.2	781	794	
6/11/13 9:38:28	0.1	0.2	781	797	
6/11/13 9:38:38	0.1	0.2	781	795	
6/11/13 9:38:48	0.1	0.2	782	795	
6/11/13 9:38:58	0.1	0.2	782	794	
6/11/13 9:39:08	4.7	0.2	688	676	
6/11/13 9:39:18	7.9	0.2	339	340	
6/11/13 9:39:28	1.2	0.2	347	365	
6/11/13 9:39:38	0.2	0.2	332	351	
6/11/13 9:39:48	0.2	0.2	330	348	
6/11/13 9:39:58	0.1	0.2	330	347	
6/11/13 9:40:08	0.1	0.2	330	345	
6/11/13 9:40:18	0.1	0.2	330	349	
6/11/13 9:40:28	0.1	0.2	330	351	
6/11/13 9:40:38	0.1	0.2	330	351	
6/11/13 9:40:48	0.0	0.2	330	350	
6/11/13 9:40:58	0.0	0.2	330	349	
6/11/13 9:41:08	0.0	0.2	330	348	System Bias
6/11/13 9:41:18	0.0	0.2	331	350	
6/11/13 9:41:28	0.0	0.2	330	350	
6/11/13 9:41:38	0.0	0.2	330	350	
6/11/13 9:41:48	2.8	0.2	277	318	
6/11/13 9:41:58	0.9	0.2	568	701	
6/11/13 9:42:08	0.1	0.2	762	800	
6/11/13 9:42:18	0.1	0.2	777	806	
6/11/13 9:42:28	0.1	0.2	779	804	
6/11/13 9:42:38	0.0	0.2	780	810	
6/11/13 9:42:48	0.0	0.2	780	811	
6/11/13 9:42:58	0.0	0.2	783	817	
6/11/13 9:43:08	0.0	0.2	785	821	
6/11/13 9:43:18	0.0	0.2	786	820	
6/11/13 9:43:28	0.0	0.2	786	808	
6/11/13 9:43:38	0.0	0.2	786	785	
6/11/13 9:43:48	0.0	0.2	786	785	
6/11/13 9:43:58	0.0	0.2	785	785	
6/11/13 9:44:08	0.0	0.2	783	785	
6/11/13 9:44:18	0.0	0.2	783	782	
6/11/13 9:44:28	0.0	0.2	783	784	
6/11/13 9:44:38	0.0	0.2	782	785	
6/11/13 9:44:48	0.0	0.2	783	788	
6/11/13 9:44:58	0.0	0.2	783	785	
6/11/13 9:45:08	0.0	0.2	783	784	
6/11/13 9:45:18	0.2	0.2	782	785	
6/11/13 9:45:28	6.3	0.3	637	564	
6/11/13 9:45:38	9.1	3.9	316	283	
6/11/13 9:45:48	10.0	7.3	68	37	
6/11/13 9:45:58	10.3	7.7	14	20	
6/11/13 9:46:08	10.4	7.7	9	11	
6/11/13 9:46:18	10.4	7.8	7	10	
6/11/13 9:46:28	10.5	7.8	6	11	
6/11/13 9:46:38	10.5	7.8	5	8	
6/11/13 9:46:48	10.5	7.8	5	9	
6/11/13 9:46:58	10.5	7.8	5	9	
6/11/13 9:47:08	10.5	7.8	3	-1	
6/11/13 9:47:18	10.5	7.8	3	1	
6/11/13 9:47:28	10.5	7.8	3	2	
6/11/13 9:47:38	10.5	7.8	4	0	
6/11/13 9:47:48	10.5	7.9	3	0	
6/11/13 9:47:58	10.5	7.9	3	1	
6/11/13 9:48:08	10.5	7.9	3	1	

Time	O2	CO2	NOx	CO	
6/11/13 11:17:58	10.5	8.1	4	-1	R1 PostCal
6/11/13 11:18:08	10.5	8.1	4	-1	
6/11/13 11:18:18	10.5	8.1	4	-1	
6/11/13 11:18:28	10.5	8.1	3	-1	
6/11/13 11:18:38	10.5	8.1	3	-1	
6/11/13 11:18:48	9.3	8.7	22	10	
6/11/13 11:18:58	6.7	8.1	169	58	
6/11/13 11:19:08	2.8	2.2	226	101	
6/11/13 11:19:18	0.5	0.6	323	131	
6/11/13 11:19:28	0.3	0.4	333	131	
6/11/13 11:19:38	0.2	0.4	335	132	
6/11/13 11:19:48	0.2	0.4	336	131	
6/11/13 11:19:58	0.1	0.4	336	131	
6/11/13 11:20:08	0.1	0.4	336	131	
6/11/13 11:20:18	0.1	0.3	334	246	
6/11/13 11:20:28	0.1	0.3	334	330	
6/11/13 11:20:38	0.1	0.3	333	330	
6/11/13 11:20:48	0.1	0.3	334	331	
6/11/13 11:20:58	0.0	0.3	335	331	
6/11/13 11:21:08	0.0	0.3	335	330	
6/11/13 11:21:18	0.0	0.3	335	329	
6/11/13 11:21:28	0.0	0.3	336	331	
6/11/13 11:21:38	0.0	0.3	336	330	
6/11/13 11:21:48	0.4	1.5	334	329	
6/11/13 11:21:58	0.8	2.6	385	383	
6/11/13 11:22:08	0.2	0.5	688	717	
6/11/13 11:22:18	0.0	0.3	795	758	
6/11/13 11:22:28	0.0	0.3	802	759	
6/11/13 11:22:38	0.0	0.3	804	760	
6/11/13 11:22:48	0.0	0.3	806	760	
6/11/13 11:22:58	0.0	0.3	807	760	
6/11/13 11:23:08	0.0	0.3	807	760	
6/11/13 11:23:18	0.0	0.3	808	761	
6/11/13 11:23:28	0.0	0.3	808	761	

Time	O2	CO2	NOx	CO	
6/11/13 12:27:18	0.0	0.4	826	**763**	R2 PostCal
6/11/13 12:27:28	0.0	0.4	879	**763**	
6/11/13 12:27:38	0.0	0.4	894	764	
6/11/13 12:27:48	0.3	0.8	663	571	
6/11/13 12:27:58	0.1	0.4	385	396	
6/11/13 12:28:08	0.0	0.4	350	336	
6/11/13 12:28:18	0.0	0.4	348	335	
6/11/13 12:28:28	0.0	0.4	347	334	
6/11/13 12:28:38	0.0	0.3	347	332	
6/11/13 12:28:48	0.0	0.3	346	331	
6/11/13 12:28:58	0.0	0.3	347	332	
6/11/13 12:29:08	**0.0**	**0.3**	**347**	331	
6/11/13 12:29:18	**0.0**	**0.3**	**347**	331	
6/11/13 12:29:28	0.0	0.3	347	331	
6/11/13 12:29:38	0.0	0.3	346	331	
6/11/13 12:29:48	0.0	0.3	346	330	
6/11/13 12:29:58	0.2	1.1	347	333	
6/11/13 12:30:08	1.9	5.5	386	334	
6/11/13 12:30:18	7.2	6.8	169	106	
6/11/13 12:30:28	9.9	7.9	17	6	
6/11/13 12:30:38	10.2	8.0	6	2	
6/11/13 12:30:48	10.3	8.0	5	1	
6/11/13 12:30:58	10.4	8.0	4	0	
6/11/13 12:31:08	10.4	8.0	4	0	
6/11/13 12:31:18	10.5	8.0	3	-1	
6/11/13 12:31:28	**10.5**	**8.0**	3	**-1**	
6/11/13 12:31:38	**10.5**	**8.0**	3	**-1**	
6/11/13 12:31:48	10.5	8.0	**2**	-1	
6/11/13 12:31:58	10.5	8.1	**2**	-1	

Time	O2	CO2	NOx	CO	
6/11/13 13:36:08	10.5	8.1	9	-1	R3 PostCal
6/11/13 13:36:18	10.5	8.1	9	-1	
6/11/13 13:36:28	10.5	8.1	8	-1	
6/11/13 13:36:38	10.5	8.1	8	-1	
6/11/13 13:36:48	10.1	8.4	13	7	
6/11/13 13:36:58	7.0	8.7	181	158	
6/11/13 13:37:08	3.3	2.7	259	252	
6/11/13 13:37:18	0.6	0.6	334	326	
6/11/13 13:37:28	0.3	0.5	346	329	
6/11/13 13:37:38	0.2	0.4	348	329	
6/11/13 13:37:48	0.2	0.4	349	330	
6/11/13 13:37:58	0.1	0.4	350	330	
6/11/13 13:38:08	0.1	0.4	350	330	
6/11/13 13:38:18	0.1	0.4	351	331	
6/11/13 13:38:28	0.1	0.4	351	331	
6/11/13 13:38:38	0.1	0.6	351	332	
6/11/13 13:38:48	0.5	2.1	385	373	
6/11/13 13:38:58	0.3	0.6	610	646	
6/11/13 13:39:08	0.1	0.4	807	759	
6/11/13 13:39:18	0.0	0.3	822	763	
6/11/13 13:39:28	0.0	0.3	824	763	
6/11/13 13:39:38	0.0	0.3	826	765	
6/11/13 13:39:48	0.0	0.3	827	767	
6/11/13 13:39:58	0.0	0.3	827	767	

Crow Valley
7-62-32-1H

GA13-0045
Marathon Oil Company
Crow Valley 7-62-32-1H
6/14/2013

Initial Linearity

Gas	Concentration	Value	Initial Response	Error	OK?
O_2	Low	0	0	0.00%	Y
	Mid	10.5	10.3	0.95%	Y
	High	21.1	21.1	0.00%	Y
CO_2	Low	0	-0.1	0.52%	Y
	Mid	8.04	7.7	1.78%	Y
	High	19.1	19.1	0.00%	Y
NO_x	Low	0	-0.2	0.03%	Y
	Mid	332	337	0.64%	Y
	High	778	782	0.51%	Y
CO	Low	0	2	0.13%	Y
	Mid	776	772	0.26%	Y
	High	1510	1506	0.26%	Y

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Analyzer Bias Checks

					Run 1			Run 2			Run 3		
					Start Time	8:27		Start Time	9:38		Start Time	10:49	
					Run Length	60		Run Length	60		Run Length	60	
					Stop Time	9:27		Stop Time	10:38		Stop Time	11:49	
Gas	Concentration	Gas Value	Analyzer Response	Initial Bias	Post Cal	Bias	Drift	Post Cal	Bias	Drift	Post Cal	Bias	Drift
O_2	Low	0	0	0.0%	-0.1	-0.5%	0.5%	-0.1	-0.5%	0.0%	-0.2	-0.9%	0.5%
	Span	10.5	10.3	-0.9%	10.2	-0.5%	0.5%	10.2	-0.5%	0.0%	10.2	-0.5%	0.0%
CO_2	Low	0	-0.1	-0.5%	0	0.5%	1.0%	0.1	1.0%	0.5%	0.1	1.0%	0.0%
	Span	8.04	7.7	-1.8%	7.9	1.0%	2.8%	8.1	2.1%	1.0%	8.1	2.1%	0.0%
NO_x	Low	0	1.2	0.2%	3	0.2%	0.1%	9	1.0%	0.8%	7	0.7%	0.3%
	Span	332	341	1.2%	328	-1.7%	2.8%	340	-0.1%	1.5%	333	-1.0%	0.9%
CO	Low	0	-3	-0.2%	1.4	0.3%	0.5%	3	0.4%	0.1%	1	0.3%	0.1%
	Span	776	787	0.7%	784	-0.2%	0.9%	799	0.8%	1.0%	808	1.4%	0.6%
				≤5%		≤5%	≤3%		≤5%	≤3%		≤5%	≤3%

Time	O2	CO2	NOx	CO	
6/14/13 7:59:27	21.1	19.1	0	-1	Calibration
6/14/13 7:59:37	21.1	19.1	0	0	Error Tests
6/14/13 7:59:47	21.1	19.1	0	0	
6/14/13 7:59:57	21.1	19.1	0	0	
6/14/13 8:00:07	21.1	19.2	0	2	
6/14/13 8:00:17	21.1	19.2	0	3	
6/14/13 8:00:27	21.1	19.2	0	2	
6/14/13 8:00:37	21.1	19.2	0	1	
6/14/13 8:00:47	21.1	19.2	0	1	
6/14/13 8:00:57	21.1	19.2	0	3	
6/14/13 8:01:07	21.0	17.4	0	2	
6/14/13 8:01:17	17.7	11.6	300	20	
6/14/13 8:01:27	4.9	2.9	1023	367	
6/14/13 8:01:37	1.0	0.3	1023	485	
6/14/13 8:01:47	0.6	0.1	1023	493	
6/14/13 8:01:57	0.4	0.0	1023	496	
6/14/13 8:02:07	0.4	0.0	1023	498	
6/14/13 8:02:17	0.3	0.0	1023	498	
6/14/13 8:02:27	0.2	0.0	1023	498	
6/14/13 8:02:37	0.2	-0.1	1023	498	
6/14/13 8:02:47	0.1	-0.1	1023	501	
6/14/13 8:02:57	0.2	-0.1	1023	726	
6/14/13 8:03:07	0.2	0.0	1023	1406	
6/14/13 8:03:17	0.2	-0.1	1023	1374	
6/14/13 8:03:27	0.2	-0.1	1023	1368	
6/14/13 8:03:37	0.3	-0.1	1023	1360	
6/14/13 8:03:47	0.3	-0.1	1023	1361	
6/14/13 8:03:57	0.3	-0.1	1023	1367	
6/14/13 8:04:07	0.3	-0.1	1023	1368	
6/14/13 8:04:17	0.3	-0.1	1023	1368	
6/14/13 8:04:27	0.3	-0.1	1023	1370	
6/14/13 8:04:37	0.3	-0.1	1023	1369	
6/14/13 8:04:47	0.3	-0.1	1023	1374	
6/14/13 8:04:57	0.3	-0.1	1023	1378	
6/14/13 8:05:07	0.3	-0.1	1023	1377	
6/14/13 8:05:17	0.3	-0.1	1023	1373	
6/14/13 8:05:27	0.1	-0.1	1023	1482	
6/14/13 8:05:37	0.0	-0.1	1023	1507	
6/14/13 8:05:47	0.0	-0.1	1023	1504	
6/14/13 8:05:57	0.0	-0.1	1023	1503	
6/14/13 8:06:07	0.0	-0.1	1023	1506	
6/14/13 8:06:17	0.0	-0.1	1023	1510	
6/14/13 8:06:27	0.0	-0.1	1023	1508	
6/14/13 8:06:37	1.0	-0.1	1023	1475	
6/14/13 8:06:47	7.7	-0.1	751	880	
6/14/13 8:06:57	3.7	-0.1	497	782	
6/14/13 8:07:07	0.5	-0.1	566	784	
6/14/13 8:07:17	0.1	-0.1	579	782	
6/14/13 8:07:27	0.1	-0.1	577	777	
6/14/13 8:07:37	0.0	-0.1	575	774	
6/14/13 8:07:47	0.0	-0.1	573	772	
6/14/13 8:07:57	0.0	-0.1	573	772	
6/14/13 8:08:07	0.0	-0.1	573	772	
6/14/13 8:08:17	0.0	-0.1	573	772	
6/14/13 8:08:27	0.0	-0.1	575	772	
6/14/13 8:08:37	0.0	-0.1	697	774	
6/14/13 8:08:47	0.0	-0.1	777	773	
6/14/13 8:08:57	0.0	-0.1	778	775	
6/14/13 8:09:07	0.0	-0.1	781	775	
6/14/13 8:09:17	0.0	-0.1	782	776	
6/14/13 8:09:27	0.0	-0.1	781	776	
6/14/13 8:09:37	0.0	-0.1	780	774	
6/14/13 8:09:47	0.0	-0.1	781	775	
6/14/13 8:09:57	0.0	-0.1	786	777	
6/14/13 8:10:07	0.0	-0.1	787	779	
6/14/13 8:10:17	0.1	-0.1	783	774	
6/14/13 8:10:27	4.0	-0.1	685	607	
6/14/13 8:10:37	2.9	-0.1	429	423	
6/14/13 8:10:47	0.4	-0.1	353	345	
6/14/13 8:10:57	0.1	-0.1	337	340	

Time	O2	CO2	NOx	CO	
6/14/13 8:11:07	0.0	-0.1	338	338	
6/14/13 8:11:17	0.0	-0.1	337	336	
6/14/13 8:11:27	0.0	-0.1	338	335	
6/14/13 8:11:37	0.0	-0.1	339	335	
6/14/13 8:11:47	0.0	-0.1	337	336	
6/14/13 8:11:57	0.0	-0.1	339	339	
6/14/13 8:12:07	0.0	-0.1	339	337	
6/14/13 8:12:17	0.0	-0.1	339	337	
6/14/13 8:12:27	0.2	-0.1	334	334	
6/14/13 8:12:37	5.7	0.0	274	240	
6/14/13 8:12:47	9.5	2.9	132	116	
6/14/13 8:12:57	10.0	6.5	35	14	
6/14/13 8:13:07	10.1	7.1	9	-2	
6/14/13 8:13:17	10.1	7.2	6	-4	
6/14/13 8:13:27	10.2	7.2	5	-4	
6/14/13 8:13:37	10.2	7.2	4	-6	
6/14/13 8:13:47	10.2	7.3	4	-7	
6/14/13 8:13:57	10.3	7.3	3	-8	
6/14/13 8:14:07	10.3	7.4	3	-8	
6/14/13 8:14:17	10.3	7.7	3	-8	
6/14/13 8:14:27	10.3	7.7	3	-8	
6/14/13 8:14:37	10.3	7.7	4	-7	
6/14/13 8:14:47	10.3	7.7	7	-7	
6/14/13 8:14:57	10.3	7.7	7	-8	
6/14/13 8:15:07	10.3	7.7	6	-7	
6/14/13 8:15:17	10.3	7.7	6	-12	
6/14/13 8:15:27	10.3	7.7	6	-9	System
6/14/13 8:15:37	10.3	7.7	6	-8	Bias
6/14/13 8:15:47	10.3	7.7	6	-10	
6/14/13 8:15:57	10.3	7.7	6	-8	
6/14/13 8:16:07	10.3	7.7	6	-9	
6/14/13 8:16:17	10.3	7.7	6	-11	
6/14/13 8:16:27	10.3	7.7	6	-12	
6/14/13 8:16:37	10.3	7.7	6	-12	
6/14/13 8:16:47	10.3	7.8	2	-11	
6/14/13 8:16:57	10.3	7.8	2	-9	
6/14/13 8:17:07	10.3	7.8	1	-3	
6/14/13 8:17:17	10.3	7.8	1	-3	
6/14/13 8:17:27	10.3	7.8	1	-2	
6/14/13 8:17:37	10.3	7.8	1	-2	
6/14/13 8:17:47	10.3	7.8	1	-3	
6/14/13 8:17:57	10.3	7.8	1	-3	
6/14/13 8:18:07	10.3	7.7	1	-4	
6/14/13 8:18:17	11.3	6.3	2	-4	
6/14/13 8:18:27	7.2	2.5	87	68	
6/14/13 8:18:37	1.5	0.4	283	306	
6/14/13 8:18:47	0.4	0.1	332	329	
6/14/13 8:18:57	0.2	0.0	338	336	
6/14/13 8:19:07	0.2	0.0	339	338	
6/14/13 8:19:17	0.1	0.0	341	337	
6/14/13 8:19:27	0.1	0.0	342	338	
6/14/13 8:19:37	0.0	0.0	341	338	
6/14/13 8:19:47	0.0	-0.1	343	338	
6/14/13 8:19:57	0.0	-0.1	342	338	
6/14/13 8:20:07	0.0	-0.1	341	339	
6/14/13 8:20:17	0.0	-0.1	341	338	
6/14/13 8:20:27	0.0	-0.1	341	337	
6/14/13 8:20:37	0.0	-0.1	336	336	
6/14/13 8:20:47	3.2	-0.1	316	303	
6/14/13 8:20:57	6.3	-0.1	258	312	
6/14/13 8:21:07	1.3	-0.1	618	727	
6/14/13 8:21:17	0.2	-0.1	781	776	
6/14/13 8:21:27	0.1	-0.1	798	784	
6/14/13 8:21:37	0.0	-0.1	803	785	
6/14/13 8:21:47	0.0	-0.1	803	782	
6/14/13 8:21:57	0.0	-0.1	803	781	
6/14/13 8:22:07	0.0	-0.1	802	783	
6/14/13 8:22:17	0.0	-0.1	800	785	
6/14/13 8:22:27	0.0	-0.1	803	787	
6/14/13 8:22:37	0.0	-0.1	803	789	
6/14/13 8:22:47	0.0	-0.1	803	788	
6/14/13 8:22:57	0.0	-0.1	803	786	

Time	O2	CO2	NOx	CO	
6/14/13 9:30:37	-0.1	0.0	790	784	R1 PostCal
6/14/13 9:30:47	-0.1	0.0	789	784	
6/14/13 9:30:57	-0.1	0.0	793	782	
6/14/13 9:31:07	-0.1	0.0	793	782	
6/14/13 9:31:17	-0.1	0.0	785	780	
6/14/13 9:31:27	-0.1	0.2	784	780	
6/14/13 9:31:37	0.4	2.8	715	781	
6/14/13 9:31:47	0.2	1.1	526	688	
6/14/13 9:31:57	-0.1	0.1	357	356	
6/14/13 9:32:07	-0.1	0.1	337	346	
6/14/13 9:32:17	-0.1	0.0	334	344	
6/14/13 9:32:27	-0.1	0.0	330	341	
6/14/13 9:32:37	-0.1	0.0	327	341	
6/14/13 9:32:47	-0.1	0.0	326	340	
6/14/13 9:32:57	-0.1	0.0	326	340	
6/14/13 9:33:07	-0.1	0.0	327	341	
6/14/13 9:33:17	-0.1	0.0	328	341	
6/14/13 9:33:27	-0.1	0.0	327	342	
6/14/13 9:33:37	-0.1	0.0	327	339	
6/14/13 9:33:47	-0.1	0.0	328	337	
6/14/13 9:33:57	-0.1	0.0	328	339	
6/14/13 9:34:07	-0.1	0.2	325	346	
6/14/13 9:34:17	1.0	3.7	333	670	
6/14/13 9:34:27	5.9	6.2	185	399	
6/14/13 9:34:37	9.4	7.6	29	36	
6/14/13 9:34:47	9.9	7.8	9	11	
6/14/13 9:34:57	10.0	7.8	6	8	
6/14/13 9:35:07	10.1	7.9	5	5	
6/14/13 9:35:17	10.1	7.9	5	5	
6/14/13 9:35:27	10.2	7.9	4	3	
6/14/13 9:35:37	10.2	7.9	4	3	
6/14/13 9:35:47	10.2	7.9	4	2	
6/14/13 9:35:57	10.2	7.9	4	1	
6/14/13 9:36:07	10.2	7.9	3	2	
6/14/13 9:36:17	10.2	7.9	3	1	
6/14/13 9:36:27	10.2	7.9	3	1	

Time	O2	CO2	NOx	CO
6/14/13 10:42:27	10.2	8.1	9	3
6/14/13 10:42:37	10.2	8.1	9	3
6/14/13 10:42:47	10.2	8.1	8	2
6/14/13 10:42:57	10.3	8.1	8	2
6/14/13 10:43:07	10.2	8.1	8	5
6/14/13 10:43:17	8.2	8.5	68	223
6/14/13 10:43:27	3.8	3.9	235	327
6/14/13 10:43:37	0.8	0.7	314	340
6/14/13 10:43:47	0.2	0.3	335	343
6/14/13 10:43:57	0.1	0.2	337	347
6/14/13 10:44:07	0.1	0.2	338	344
6/14/13 10:44:17	0.0	0.1	339	346
6/14/13 10:44:27	0.0	0.1	340	346
6/14/13 10:44:37	0.0	0.1	340	341
6/14/13 10:44:47	0.0	0.1	340	344
6/14/13 10:44:57	0.0	0.1	341	345
6/14/13 10:45:07	-0.1	0.1	341	345
6/14/13 10:45:17	-0.1	0.1	341	345
6/14/13 10:45:27	-0.1	0.1	344	348
6/14/13 10:45:37	-0.1	0.2	341	347
6/14/13 10:45:47	0.3	3.9	355	819
6/14/13 10:45:57	0.3	3.7	450	868
6/14/13 10:46:07	0.0	0.5	685	773
6/14/13 10:46:17	-0.1	0.1	796	793
6/14/13 10:46:27	-0.1	0.1	808	797
6/14/13 10:46:37	-0.1	0.1	810	793
6/14/13 10:46:47	-0.1	0.1	811	791
6/14/13 10:46:57	-0.1	0.1	811	791
6/14/13 10:47:07	-0.1	0.1	813	795
6/14/13 10:47:17	-0.1	0.1	814	792
6/14/13 10:47:27	-0.1	0.1	815	795
6/14/13 10:47:37	-0.1	0.1	815	793
6/14/13 10:47:47	-0.1	0.1	816	795
6/14/13 10:47:57	-0.1	0.1	817	799
6/14/13 10:48:07	-0.1	0.1	823	798
6/14/13 10:48:17	-0.1	0.0	822	800

R2 PostCal

Time	O2	CO2	NOx	CO	
6/14/13 11:52:17	-0.2	0.1	771	809	R3 PostCal
6/14/13 11:52:27	-0.2	0.1	769	807	
6/14/13 11:52:37	-0.2	0.1	767	809	
6/14/13 11:52:47	-0.1	0.1	767	808	
6/14/13 11:52:57	-0.1	0.1	767	807	
6/14/13 11:53:07	-0.1	0.1	770	807	
6/14/13 11:53:17	-0.1	0.1	774	808	
6/14/13 11:53:27	-0.1	0.1	774	808	
6/14/13 11:53:37	-0.1	0.1	771	808	
6/14/13 11:53:47	-0.1	0.6	767	811	
6/14/13 11:53:57	0.2	3.1	683	1236	
6/14/13 11:54:07	0.0	0.8	455	647	
6/14/13 11:54:17	-0.1	0.2	346	379	
6/14/13 11:54:27	-0.2	0.1	336	359	
6/14/13 11:54:37	-0.2	0.1	338	359	
6/14/13 11:54:47	-0.2	0.1	338	357	
6/14/13 11:54:57	-0.2	0.1	336	354	
6/14/13 11:55:07	-0.2	0.1	336	355	
6/14/13 11:55:17	-0.2	0.1	333	354	
6/14/13 11:55:27	-0.2	0.1	333	356	
6/14/13 11:55:37	-0.1	0.1	333	352	
6/14/13 11:55:47	-0.2	0.1	333	351	
6/14/13 11:55:57	-0.2	0.1	333	352	
6/14/13 11:56:07	-0.1	0.2	331	353	
6/14/13 11:56:17	0.7	3.4	354	520	
6/14/13 11:56:27	5.4	6.2	266	329	
6/14/13 11:56:37	9.3	7.7	46	24	
6/14/13 11:56:47	9.9	7.9	15	9	
6/14/13 11:56:57	10.0	8.0	11	7	
6/14/13 11:57:07	10.1	8.0	10	4	
6/14/13 11:57:17	10.1	8.0	9	3	
6/14/13 11:57:27	10.2	8.1	9	3	
6/14/13 11:57:37	10.2	8.1	8	3	
6/14/13 11:57:47	10.2	8.1	8	4	
6/14/13 11:57:57	10.2	8.1	8	1	
6/14/13 11:58:07	10.2	8.1	7	2	
6/14/13 11:58:17	10.2	8.1	7	2	
6/14/13 11:58:27	10.2	8.1	7	1	
6/14/13 11:58:37	10.2	8.1	7	2	
6/14/13 11:58:47	10.3	8.1	7	1	
6/14/13 11:58:57	10.3	8.1	6	1	

THE ENVIRONMENTAL TECHNOLOGY VERIFICATION PROGRAM

File Contains Data for PostScript Printers Only

U.S. Environmental Protection Agency

Battelle

. . . Putting Technology To Work

ETV Joint Verification Statement

TECHNOLOGY TYPE:	PORTABLE EMISSION ANALYZER		
APPLICATION:	DETERMINING NITROGEN OXIDES EMISSIONS		
TECHNOLOGY NAME:	PG-250 Portable Gas Analyzer		
COMPANY:	Horiba Instruments, Inc.		
ADDRESS:	17671 Armstrong Avenue Irvine, California 92614	PHONE: FAX:	714-250-4811 714-250-0924
WEB SITE:	Http://www.horiba.com		
E-MAIL:	Info@horiba.com		

The U.S. Environmental Protection Agency (EPA) has created the Environmental Technology Verification (ETV) Program to facilitate the deployment of innovative or improved environmental technologies through performance verification and dissemination of information. The goal of the ETV Program is to further environmental protection by substantially accelerating the acceptance and use of improved and cost-effective technologies. ETV seeks to achieve this goal by providing high quality, peer reviewed data on technology performance to those involved in the design, distribution, financing, permitting, purchase, and use of environmental technologies.

ETV works in partnership with recognized standards and testing organizations; stakeholder groups which consist of buyers, vendor organizations, and permitters; and with the full participation of individual technology developers. The program evaluates the performance of innovative technologies by developing test plans that are responsive to the needs of stakeholders, conducting field or laboratory tests (as appropriate), collecting and analyzing data, and preparing peer reviewed reports. All evaluations are conducted in accordance with rigorous quality assurance protocols to ensure that data of known and adequate quality are generated and that the results are defensible.

The Advanced Monitoring Systems (AMS) program, one of 12 technology areas under ETV, is operated by Battelle in cooperation with EPA's National Exposure Research Laboratory. AMS has recently evaluated the performance of portable nitrogen oxides monitors used to determine emissions from combustion sources. This verification statement provides a summary of the test results for the Horiba PG-250 Portable Emission Analyzer.

VERIFICATION TEST DESCRIPTION

The verification test described in this report was one of a series of tests conducted in early 1999 on commercial portable nitrogen oxides analyzers at Battelle's facilities in Columbus, Ohio. Verification testing of the analyzers

involved (1) a series of laboratory tests in which certified NO and NO_2 standards were used to challenge the analyzers over a wide concentration range and (2) tests using realistic combustion sources, in which data from the portable analyzers undergoing testing were compared to simultaneous NO and NO_x measurements obtained with two chemiluminescent analyzers.

Verification testing lasted three to four days, of which two days were required for laboratory testing and the remainder for source emissions testing. To assess inter-unit variability, two identical analyzers were tested simultaneously in all tests, and results from the two analyzers were kept separate. The analyzers were operated at all times by a representative of Horiba and supervised at all times by Battelle staff.

Verification testing focused on measurement of NO and NO_2, the sum of which is denoted as NO_x. Laboratory testing included a linearity test over the entire nominal ranges of the analyzers for both NO and NO_2; estimation of detection limits and response times; interference testing; assessment of sample pressure and ambient temperature effects on analyzer response; and evaluation of zero and span drift during the various laboratory tests. Tests with combustion sources assessed the accuracy of NO, NO_2, and NO_x measurements, relative to the chemiluminescent NO/NO_x approach that is the basis of EPA Method 7E. Sources used in the testing were a gas-fired rangetop burner, a gas-fired water heater, and a diesel-powered electrical generator operated at both idle and at high RPM. These sources produced NO_x emissions ranging from less than 10 to over 400 ppm. Zero and span drift resulting from exposure to source emissions were assessed, and analyzer stability was monitored during one hour of uninterrupted sampling of diesel emissions.

Quality assurance (QA) oversight of verification testing was provided by both Battelle and U.S. EPA. Battelle QA staff conducted a technical systems audit, a performance evaluation audit, and a data quality audit of 10 percent of the test data. EPA QA staff conducted an independent on-site technical system audit.

TECHNOLOGY DESCRIPTION

The Horiba Model PG-250 multi-gas portable analyzer is 10.2 inches high, 10.2 inches wide, and 20.1 inches deep and weighs 37 pounds. The PG-250 provides the user with simultaneous analyses of CO, CO_2, O_2, NO_x, and SO_2 in flue gas samples. Each gas constituent can be monitored over multiple ranges. The PG-250 employs non-dispersive infrared detection of SO_2, CO, and CO_2; chemiluminescence detection of NO and NO_x; and an electrochemical cell for O_2 measurement. Only the NO/NO_x measurement capabilities were verified in this test. Measurements of NO_x are achieved with a low temperature converter that reduces NO_2 to NO for detection. Although the PG-250 offers NO/NO_x measurement ranges up to 2,500 ppm, the applicability of the NO_2 converter is limited to concentrations below 6 ppm. Converter lifetime is shortened by sampling NO_2 above 6 ppm. The PG-250 incorporates a built-in sample conditioner consisting of a dual-stage moisture removal system that includes a gravity drain separator and thermal-electric cooler. Other sample conditioning components can include acid mist eliminators, filters, sample pump, condensate drain pump, and a sample flow monitor. Sampling is accomplished with a 316 stainless steel unheated sample probe equipped with an external primary filter. Data may be output from the instrument via 4 to 20 mA analog signals or from the instrument's RS-232C serial communication port. A large liquid crystal display screen also displays in real time the gas parameters being measured, in addition to the selected measurement ranges for each gas and the sample flow through the analyzer.

VERIFICATION OF PERFORMANCE

Linearity: The Horiba PG-250 analyzers provided linear response to NO over the full 0 to 2,500 ppm range tested. Response to NO_2 over a range of 0 to 500 ppm was approximately linear, but exhibited a slope much less than one (i.e., about 0.7) on both analyzers. This behavior is attributed to the limited capacity of the NO_2 converters in the analyzers.

Detection Limit: For analyzers A and B, respectively, detection limits determined from the linearity test data were 6 and 7 ppm on the 0 to 2,500 ppm range for NO, and 16 and 9 ppm on the 0 to 500 ppm range for NO_2. Lower detection limits can be achieved using lower measurement ranges, as is indicated by the relative accuracy results obtained with a range of emission sources.

Response Time: Response times of both analyzers for NO were 40 seconds; for NO_2, analyzer A had a response time of about 90 seconds, and analyzer B had a response time of 130 seconds.

Zero/Span Drift: Zero drift during laboratory tests was 6 ppm or less. Span drift in those tests was equivalent to about 1 to 3 percent of the corresponding span concentration. Shutting the analyzers down overnight produced no additional effect on zero or span drift.

Interferences: No interference was found from elevated concentrations of SO_2, CO, CO_2, NH_3, or hydrocarbons, but a reduction of about 13 percent in response to 381 ppm NO was seen when SO_2 was also present at about 450 ppm.

Pressure Sensitivity: Over the range of +10 to -10 inches of water (relative to the ambient pressure), the sample gas pressure had no significant effect on zero or span response to NO or NO_2.

Ambient Temperature: Ambient temperature over the range of 45° to 105°F had a significant effect only on response to NO. The effect was about a 5 percent increase in NO response at reduced temperature, and about a 6 percent decrease in response to NO at elevated temperature, relative to response at room temperature.

Relative Accuracy: Accuracy for NO ranged from 1.9 to 8.5 percent relative to the reference method, in emission measurements on a range of sources. Accuracy for NO_2 from those same sources ranged from about 35 to 50 percent, because of the limited capacity of the NO_2 converters. The sources tested emitted predominantly NO, so the overall accuracy for NO_x determination ranged from 5 to 19 percent at NO_x levels from less than 10 to over 400 ppm.

Inter-Unit Repeatibility: Comparison of results from the two PG-250 analyzers shows that they performed essentially identically in the verification tests. Unit-to-unit agreement of the two Horiba analyzers was within 4.8 percent, on combustion sources emitting from 8 ppm to 400 ppm NO_x, and was usually better than the unit-to-unit agreement of the reference analyzers.

Gabor J. Kovacs Vice President Environmental Sector Battelle	Date
Gary J. Foley Director National Exposure Research Laboratory Office of Research and Development U.S. Environmental Protection Agency	Date

NOTICE: EPA verifications are based on an evaluation of technology performance under specific, predetermined criteria and the appropriate quality assurance procedures. EPA and Battelle make no expressed or implied warranties as to the performance of the technology and do not certify that a technology will always operate as verified. The end user is solely responsible for complying with any and all applicable federal, state, and local requirements. Mention of commercial product names does not imply endorsement.

EPA Method 7E §16.2.2
NO_2 to NO Converter Efficiency Test

Time	NO_x ppm
6/7/13 8:31	404.9
8:32	406.5
8:33	406.5
8:34	409.8
8:35	409.8
8:36	411.6
8:37	411.6
8:38	414.1
8:39	415.8
8:40	417.0
8:41	418.3
8:42	418.3
8:43	420.5
8:44	420.5
8:45	423.3
8:46	423.3
8:47	426.0
8:48	426.6
8:49	426.8
8:50	427.7
8:51	427.7
8:52	429.3
8:53	429.3
8:54	429.9
8:55	429.9
8:56	430.0
8:57	431.0
8:58	432.4
8:59	433.3
9:00	433.3
$NO_{x\ PEAK}$	**433.3**
$NO_{x\ FINAL}$	**433.3**
% Difference	**0.0%**
Limit	**2%**

"Fill a Tedlar bag approximately half full with either ambient air, pure oxygen, or an oxygen standard gas with at least 19.5 percent by volume oxygen content. Fill the remainder of the bag with mid-level NO in nitrogen calibration gas.
(1) Immediately attach the bag to the inlet of the NOx analyzer. Measure the NOx concentration for a period of 30 minutes. If the NOx concentration drops more than 2% from the peak value observed, then the NO2 converter has failed to meet the criteria of this test."

EMCO

EMISSIONS MEASUREMENT COMPANY

Project GA13-0045

Appendix D: Calibration Information

EPA Protocol 1 Gas Certificates

AIR LIQUIDE Air Liquide America Specialty Gases LLC Scott

RATA CLASS

Dual-Analyzed Calibration Standard

500 WEAVER PARK RD, LONGMONT, CO 80501 Phone: 888-253-1635 Fax: 303-772-7673

CERTIFICATE OF ACCURACY: Interference Free™ Multi-Component EPA Protocol Gas

Assay Laboratory - PGVP Vendor ID: A42013

AIR LIQUIDE AMERICA SPECIALTY GASES LLC
500 WEAVER PARK RD
LONGMONT, CO 80501

P.O. No.: MATTHEW PARKS
Document # : 49699478-002

Customer
EMISSIONS MEASURMENT COMPANY LLC

5160 PARFET STREET
UNIT A3
WHEAT RIDGE CO 80033
US

ANALYTICAL INFORMATION Gas Type : CO2,O2,BALN

This certification was performed according to EPA Traceability Protocol For Assay & Certification of Gaseous Calibration Standards; Procedure G-1; September, 1997.

Cylinder Number: ALM013897 **Certification Date:** 27Feb2013 **Exp. Date:** 28Feb2021
Cylinder Pressure*:** 2015 PSIG **Batch No:** LGM0080281

COMPONENT	CERTIFIED CONCENTRATION (Moles)		ACCURACY**	TRACEABILITY
OXYGEN	10.5	%	+/- 1%	
CARBON DIOXIDE	8.04	%	+/- 1%	Direct NIST and VSL
NITROGEN		BALANCE		

*** Do not use when cylinder pressure is below 150 psig.
** Analytical accuracy is based on the requirements of EPA Protocol Procedure G1, September 1997.

REFERENCE STANDARD

TYPE/SRM NO.	EXPIRATION DATE	CYLINDER NUMBER	CONCENTRATION	COMPONENT
NTRM 2658	01Feb2016	K012175	10.03 %	OXYGEN
NTRM 1675	05Jan2018	K015237	13.94 %	CARBON DIOXIDE

INSTRUMENTATION

INSTRUMENT/MODEL/SERIAL#	DATE LAST CALIBRATED	ANALYTICAL PRINCIPLE
OXYMAT/6E/W5-951	04Feb2013	PARAMAGNETIC
FTIR//0929062	15Feb2013	FTIR

ANALYZER READINGS

(Z=Zero Gas R=Reference Gas T=Test Gas r=Correlation Coefficient)

First Triad Analysis **Second Triad Analysis** **Calibration Curve**

OXYGEN
Date: 27Feb2013 Response Unit:VOLTS
Z1=0.00000 R1=10.04000 T1=10.55000
R2=10.04000 Z2=0.00000 T2=10.54000
Z3=0.00000 T3=10.55000 R3=10.04000
Avg. Concentration: 10.53 %

Concentration=A+Bx+Cx2+Dx3+Ex4
r=0.999999
Constants: A=0.01095568
B=0.999285181 C=
D= E=

CARBON DIOXIDE
Date: 26Feb2013 Response Unit:%
Z1=-0.00255 R1=13.90004 T1=8.01822
R2=13.90344 Z2=0.00009 T2=8.02371
Z3=0.00293 T3=8.02648 R3=13.90428
Avg. Concentration: 8.044 %

Concentration=A+Bx+Cx2+Dx3+Ex4
r=9.99996E-1
Constants: A=0.00000E+0
B=6.43489E-1 C=4.64700E-3
D=5.00000E-6 E=0.00000E+0

APPROVED BY: ADAM HANLEY

AIR LIQUIDE Air Liquide America Specialty Gases LLC Scott™

RATA CLASS

Dual-Analyzed Calibration Standard

500 WEAVER PARK RD, LONGMONT, CO 80501 Phone: 888-253-1635 Fax: 303-772-7673

CERTIFICATE OF ACCURACY: Interference Free™ Multi-Component EPA Protocol Gas

Assay Laboratory - PGVP Vendor ID: A42013

AIR LIQUIDE AMERICA SPECIALTY GASES LLC
500 WEAVER PARK RD
LONGMONT, CO 80501

P.O. No.: MATTHEW PARKS
Document # : 50220560-001

Customer
EMISSIONS MEASURMENT COMPANY LLC

5160 PARFET STREET
UNIT A3
WHEAT RIDGE CO 80033
US

ANALYTICAL INFORMATION Gas Type : CO2,O2,BALN

This certification was performed according to EPA Traceability Protocol For Assay & Certification of Gaseous Calibration Standards; Procedure G-1; September, 1997.

Cylinder Number: ALM005309 **Certification Date:** 10Apr2013 **Exp. Date:** 11Apr2021
Cylinder Pressure*:** 2008 PSIG **Batch No:** LGM0084671

COMPONENT	CERTIFIED CONCENTRATION (Moles)		ACCURACY**	TRACEABILITY
OXYGEN	21.1	%	+/- 1%	
CARBON DIOXIDE	19.1	%	+/- 1%	Direct NIST and VSL
NITROGEN		BALANCE		

*** Do not use when cylinder pressure is below 150 psig.
** Analytical accuracy is based on the requirements of EPA Protocol Procedure G1, September 1997.

REFERENCE STANDARD

TYPE/SRM NO.	EXPIRATION DATE	CYLINDER NUMBER	CONCENTRATION	COMPONENT
NTRM 2657	28Aug2015	K026139	2.003 %	OXYGEN
NTRM 1800	01Mar2019	K022438	17.87 %	CARBON DIOXIDE

INSTRUMENTATION

INSTRUMENT/MODEL/SERIAL#	DATE LAST CALIBRATED	ANALYTICAL PRINCIPLE
OXYMAT/6E/W5-951	11Mar2013	PARAMAGNETIC
FTIR//0929062	28Mar2013	FTIR

ANALYZER READINGS

(Z=Zero Gas R=Reference Gas T=Test Gas r=Correlation Coefficient)

First Triad Analysis **Second Triad Analysis** **Calibration Curve**

OXYGEN
Date: 10Apr2013 Response Unit:VOLTS
Z1=0.00000 R1=1.98000 T1=21.03000
R2=1.98100 Z2=0.00000 T2=21.03000
Z3=0.00000 T3=21.03000 R3=1.98200
Avg. Concentration: 21.14 %

Concentration=A+Bx+Cx2+Dx3+Ex4
r=0.999999
Constants: A=0.01274156
B=0.999165608 C=
D= E=

CARBON DIOXIDE
Date: 09Apr2013 Response Unit:%
Z1=0.00047 R1=17.83883 T1=19.08697
R2=17.83936 Z2=0.00347 T2=19.11312
Z3=0.00361 T3=19.11461 R3=17.86795
Avg. Concentration: 19.13 %

Concentration=A+Bx+Cx2+Dx3+Ex4
r=9.99997E-1
Constants: A=0.00000E+0
B=5.98458E-1 C=3.97100E-3
D=3.00000E-6 E=0.00000E+0

APPROVED BY: ADAM HANLEY

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500 WEAVER PARK RD, LONGMONT, CO 80501 Phone: 888-253-1635 Fax. 303-772-7673

RATA CLASS

Dual-Analyzed Calibration Standard

CERTIFICATE OF ACCURACY: Interference Free™ Multi-Component EPA Protocol Gas

Assay Laboratory - PGVP Vendor ID: A42011
AIR LIQUIDE AMERICA SPECIALTY GASES LLC
500 WEAVER PARK RD
LONGMONT, CO 80501

P.O. No.: MATT PARKS
Document # : 44385599-001

Customer
EMISSIONS MEASURMENT COMPANY LLC
5160 PARFET STREET
UNIT A3
WHEAT RIDGE CO 80033
US

ANALYTICAL INFORMATION Gas Type : NC

This certification was performed according to EPA Traceability Protocol For Assay & Certification of Gaseous Calibration Standards; Procedure G-1; September, 1997.

Cylinder Number: ALM047091
Cylinder Pressure*:** 2000 PSIG

Certification Date: 30Dec2011

Exp. Date: 31Dec2019
Batch No: LGM0044375

COMPONENT	CERTIFIED CONCENTRATION (Moles)	ACCURACY**	TRACEABILITY
CARBON MONOXIDE	146 PPM	+/- 1%	Direct NIST and VSL
NITRIC OXIDE	144 PPM	+/- 1%	Direct NIST and VSL
NITROGEN - OXYGEN FREE	BALANCE		
TOTAL OXIDES OF NITROGEN	145. PPM		Reference Value Only

*** Do not use when cylinder pressure is below 150 psig.
** Analytical accuracy is based on the requirements of EPA Protocol Procedure G1, September 1997.

REFERENCE STANDARD

TYPE/SRM NO.	EXPIRATION DATE	CYLINDER NUMBER	CONCENTRATION	COMPONENT
NTRM 2636	02Oct2012	ALM058337	248.5 PPM	CARBON MONOXIDE
NTRM 1685	19May2016	KAL004105	243.0 PPM	NITRIC OXIDE

INSTRUMENTATION

INSTRUMENT/MODEL/SERIAL#	DATE LAST CALIBRATED	ANALYTICAL PRINCIPLE
FTIR//0929062	07Dec2011	FTIR
FTIR//0929062	04Dec2011	FTIR

ANALYZER READINGS

(Z=Zero Gas R=Reference Gas T=Test Gas r=Correlation Coefficient)

First Triad Analysis	Second Triad Analysis	Calibration Curve
CARBON MONOXIDE		
Date: 23Dec2011 Response Unit: PPM Z1=-0.00568 R1=248.6335 T1=145.7365 R2=248.8576 Z2=0.02752 T2=145.9253 Z3=0.03477 T3=146.0454 R3=249.2862 Avg. Concentration: 145.6 PPM	Date: 30Dec2011 Response Unit: PPM Z1=-0.02990 R1=249.2110 T1=145.9185 R2=249.6441 Z2=0.00252 T2=146.3338 Z3=0.05063 T3=146.5495 R3=249.9954 Avg. Concentration: 145.6 PPM	Concentration=A+Bx+Cx2+Dx3+Ex4 r=9.99998E-1 Constants: A=0.00000E+0 B=9.69352E-1 C=6.96000E-4 D=1.00000E-6 E=0.00000E+0
NITRIC OXIDE		
Date: 23Dec2011 Response Unit: PPM Z1=0.03493 R1=247.9629 T1=144.7037 R2=248.2568 Z2=0.07228 T2=144.7574 Z3=0.26852 T3=144.7673 R3=248.5460 Avg. Concentration: 143.4 PPM	Date: 30Dec2011 Response Unit: PPM Z1=-0.26796 R1=243.6062 T1=145.0164 R2=243.6325 Z2=-0.02884 T2=145.0361 Z3=0.03914 T3=145.0581 R3=243.7725 Avg. Concentration: 144.7 PPM	Concentration=A+Bx+Cx2+Dx3+Ex4 r=9.99997E-1 Constants: A=0.00000E+0 B=9.51195E-1 C=1.88000E-4 D=0.00000E+0 E=0.00000E+0

Special Notes:
The expiration date has been extended without re-assay per EPA 600/R23-23/542.

QUALITY ASSURANCE

APPROVED BY: SARAH HERBERT
(signature on file)

AIR LIQUIDE Air Liquide America Specialty Gases LLC Scott

RATA CLASS

Dual-Analyzed Calibration Standard

500 WEAVER PARK RD, LONGMONT, CO 80501 Phone: 888-253-1635 Fax: 303-772-7673

CERTIFICATE OF ACCURACY: Interference Free™ Multi-Component EPA Protocol Gas

Assay Laboratory - PGVP Vendor ID: A42013

AIR LIQUIDE AMERICA SPECIALTY GASES LLC
500 WEAVER PARK RD
LONGMONT, CO 80501

P.O. No.: MATTHEW PARKS
Document # : 50061662-003

Customer
EMISSIONS MEASURMENT COMPANY LLC

5160 PARFET STREET
UNIT A3
WHEAT RIDGE CO 80033
US

ANALYTICAL INFORMATION Gas Type : CO,NO,BALN

This certification was performed according to EPA Traceability Protocol For Assay & Certification of Gaseous Calibration Standards; Procedure G-1; September, 1997.

Cylinder Number: BLM004034 **Certification Date:** 08Apr2013 **Exp. Date:** 09Apr2021
Cylinder Pressure*:** 1820 PSIG **Batch No:** LGM0083349

COMPONENT	CERTIFIED CONCENTRATION (Moles)		ACCURACY**	TRACEABILITY
NITRIC OXIDE	331	PPM	+/- 1%	Direct NIST and VSL
CARBON MONOXIDE	333	PPM	+/- 1%	Direct NIST and VSL
NITROGEN - OXYGEN FREE		BALANCE		
TOTAL OXIDES OF NITROGEN	332.	PPM		Reference Value Only

*** Do not use when cylinder pressure is below 150 psig.
** Analytical accuracy is based on the requirements of EPA Protocol Procedure G1, September 1997.

REFERENCE STANDARD

TYPE/SRM NO.	EXPIRATION DATE	CYLINDER NUMBER	CONCENTRATION	COMPONENT
NTRM 1685	04Jan2018	KAL004390	242.0 PPM	NITRIC OXIDE
NTRM 2636	03Nov2017	KAL003931	240.8 PPM	CARBON MONOXIDE

INSTRUMENTATION

INSTRUMENT/MODEL/SERIAL#	DATE LAST CALIBRATED	ANALYTICAL PRINCIPLE
FTIR//0929062	21Mar2013	FTIR
FTIR//0929062	22Mar2013	FTIR

ANALYZER READINGS

(Z=Zero Gas R=Reference Gas T=Test Gas r=Correlation Coefficient)

First Triad Analysis **Second Triad Analysis** **Calibration Curve**

NITRIC OXIDE

Date: 01Apr2013 Response Unit:PPM
Z1=-0.16027 R1=242.7831 T1=332.0075
R2=242.8019 Z2=-0.06617 T2=332.0580
Z3=-0.01169 T3=332.1086 R3=242.8360
Avg. Concentration: 330.9 PPM

Date: 08Apr2013 Response Unit: PPM
Z1=-0.26267 R1=241.4587 T1=330.7043
R2=241.7570 Z2=-0.24681 T2=331.2147
Z3=0.03043 T3=331.3894 R3=241.7650
Avg. Concentration: 331.5 PPM

Concentration=A+Bx+Cx2+Dx3+Ex4
r=9.99987E-1
Constants: A=0.00000E+0
B=9.56731E-1 C=1.75000E-4
D=0.00000E+0 E=0.00000E+0

CARBON MONOXIDE

Date: 01Apr2013 Response Unit:PPM
Z1=-0.06487 R1=241.8764 T1=334.6819
R2=241.9570 Z2=-0.05924 T2=334.7655
Z3=-0.01322 T3=335.1262 R3=242.0897
Avg. Concentration: 333.2 PPM

Date: 08Apr2013 Response Unit: PPM
Z1=-0.05968 R1=241.3205 T1=333.6388
R2=241.5636 Z2=0.12761 T2=333.8577
Z3=0.15132 T3=334.0260 R3=241.7819
Avg. Concentration: 332.8 PPM

Concentration=A+Bx+Cx2+Dx3+Ex4
r=9.99999E-1
Constants: A=0.00000E+0
B=5.55204E-1 C=3.77000E-4
D=0.00000E+0 E=0.00000E+0

APPROVED BY: Jon Witzak

AIR LIQUIDE Air Liquide America Specialty Gases LLC Scott

RATA CLASS

Dual-Analyzed Calibration Standard

500 WEAVER PARK RD, LONGMONT, CO 80501 Phone: 888-253-1635 Fax: 303-772-7673

CERTIFICATE OF ACCURACY: Interference Free™ Multi-Component EPA Protocol Gas

Assay Laboratory - PGVP Vendor ID: A42013

AIR LIQUIDE AMERICA SPECIALTY GASES LLC
500 WEAVER PARK RD
LONGMONT, CO 80501

P.O. No.: MATTHEW PARKS
Document # : 49391884-007

Customer
EMISSIONS MEASURMENT COMPANY LLC

5160 PARFET STREET
UNIT A3
WHEAT RIDGE CO 80033
US

ANALYTICAL INFORMATION Gas Type : CO,NO,BALN

This certification was performed according to EPA Traceability Protocol For Assay & Certification of Gaseous Calibration Standards; Procedure G-1; September, 1997.

Cylinder Number: BAL5148 **Certification Date:** 11Feb2013 **Exp. Date:** 12Feb2021
Cylinder Pressure*:** 1880 PSIG **Batch No:** LGM0078443

COMPONENT	CERTIFIED CONCENTRATION (Moles)		ACCURACY**	TRACEABILITY
NITRIC OXIDE	1,530	PPM	+/- 1%	Direct NIST and VSL
CARBON MONOXIDE	1,510	PPM	+/- 1%	Direct NIST and VSL
NITROGEN - OXYGEN FREE		BALANCE		
TOTAL OXIDES OF NITROGEN	1,531.	PPM		Reference Value Only

*** Do not use when cylinder pressure is below 150 psig.
** Analytical accuracy is based on the requirements of EPA Protocol Procedure G1, September 1997.

REFERENCE STANDARD

TYPE/SRM NO.	EXPIRATION DATE	CYLINDER NUMBER	CONCENTRATION	COMPONENT
NTRM 1687	18Apr2018	KAL003938	970.9 PPM	NITRIC OXIDE
NTRM 1681	15Jun2015	KAL004699	970.0 PPM	CARBON MONOXIDE

INSTRUMENTATION

INSTRUMENT/MODEL/SERIAL#	DATE LAST CALIBRATED	ANALYTICAL PRINCIPLE
FTIR//0929062	01Feb2013	FTIR
FTIR//0929062	01Feb2013	FTIR

ANALYZER READINGS

(Z=Zero Gas R=Reference Gas T=Test Gas r=Correlation Coefficient)

First Triad Analysis **Second Triad Analysis** **Calibration Curve**

NITRIC OXIDE

Date: 04Feb2013 Response Unit:PPM
Z1=-0.14576 R1=969.4085 T1=1520.922
R2=969.4584 Z2=0.17457 T2=1521.700
Z3=0.25386 T3=1522.426 R3=969.8149
Avg. Concentration: 1524. PPM

Date: 11Feb2013 Response Unit: PPM
Z1=-0.14138 R1=956.6927 T1=1508.367
R2=957.9800 Z2=0.02197 T2=1508.961
Z3=0.08178 T3=1513.818 R3=956.5638
Avg. Concentration: 1532. PPM

Concentration=A+Bx+Cx2+Dx3+Ex4
r=9.99987E-1
Constants: A=0.00000E+0
B=9.49783E-1 C=1.77000E-4
D=0.00000E+0 E=0.00000E+0

CARBON MONOXIDE

Date: 04Feb2013 Response Unit:PPM
Z1=-0.06665 R1=972.2577 T1=1513.091
R2=973.0768 Z2=-0.01192 T2=1516.098
Z3=0.11497 T3=1516.206 R3=973.6532
Avg. Concentration: 1510. PPM

Date: 11Feb2013 Response Unit: PPM
Z1=-0.02812 R1=954.9485 T1=1486.741
R2=959.6529 Z2=0.01898 T2=1497.702
Z3=0.06850 T3=1505.144 R3=966.6137
Avg. Concentration: 1511. PPM

Concentration=A+Bx+Cx2+Dx3+Ex4
r=9.99999E-1
Constants: A=0.00000E+0
B=2.20993E-1 C=1.77000E-4
D=0.00000E+0 E=0.00000E+0

APPROVED BY: JW
Jon Witzak