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RGA-5 Process Gas Analyzer Test Report		ECN No. N/A

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	1	Cog. Mgr.	R. E. Bauer	11/9/94	16-37						
	1	QA	M. L. McElroy	11/9/94	S1-57						
		Safety									
		Env.									

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RELEASE AUTHORIZATION

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7. Abstract This document contains a test report for the RGA-5 dual column gas chromatograph that upgrades the GMS-2 located on the SY tank farm. Testing was performed in the Gas/DACS laboratory located in Building 306E.		
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RGA-5 PROCESS GAS ANALYZER TEST REPORT

Impact Level Q

October 1994

J. L. Weamer
Westinghouse Hanford Company

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RGA-5 PROCESS GAS ANALYZER TEST REPORT

1.0 INTRODUCTION

The gas monitoring system, GMS-2, includes two gas monitors. GC-2 measures high hydrogen concentrations (0.2-10 percent) and GC-3 measures the lower concentration levels (10-100 ppm). Although redundant instruments are in place for accurately measuring the higher hydrogen concentrations, there are no redundant instruments to accurately measure the relatively low baseline hydrogen concentrations. The RGA-5 process gas analyzer is a two-column GC that will replace GC-2 and provide redundancy for GC-3. This upgrade will provide faster response time and reduce tank farm entries for routine operations because the RGA-5 is remotely operable.

Tests were conducted according to WHC-SD-WM-TP-262, "RGA-5 Process Gas Analyzer Test Plan." The first objective was to verify that the vendor-supplied RGA host data acquisition software allowed communication between the RGA-5 and an ISA bus personal computer. Minimum software requirements are shown in Appendix A. The second objective was to determine the capabilities of the RGA-5 process gas analyzer. The tests will do the following:

- With a constant flow rate and pressure, determine the concentration range that each column can accurately and precisely measure.
- Identify any uncorrected interferences from other tank gases such as ammonia, nitrous oxide, or methane.
- Determine the response and decay time.

Appendix B lists these and other functions and requirements.

2.0 DESCRIPTION OF TEST

The system was operated under normal sample flow conditions. To determine that the software met the specifications, the data acquisition functions of the vendor-supplied software were verified. The instrument performance was then evaluated by measuring accuracy, precision, interference, response time, and decay time. All testing was performed according to test procedures of the previously mentioned document. From this information, function parameters (such as individual column concentration range) were determined.

3.0 TEST METHOD AND TEST EQUIPMENT

Normal GC flow and pressure were established. The software verification test was performed per test procedure Appendix C.1. Next, range/accuracy tests for both columns were performed. The Horiba gas divider produced a large variety of concentrations from relatively few bottles of gas. Also, random sampling helped avoid progressive increases in concentration. Interference testing consisted of injecting ammonia, methane, and nitrous oxide. Any reported hydrogen concentration was noted according to Appendix C.3. And finally, response and decay testing was performed according to Appendix C.4. Differences in response/decay times may result if the lower limit is not zero.

4.0 RESULTS

4.1 SOFTWARE VERIFICATION

The communication link between the instrument and the vendor-supplied software were tested according to Appendix C.1. The vendor made changes to the software after minor problems with reporting formats were identified. Four communication ports were required, but only two were available on the computer used for testing. The two available ports were functional. The software met all other functions and requirements.

4.2 ACCURACY

As demonstrated in the following data charts, Column A can provide data accurate within 10 percent error from 10 ppm to 800 ppm. Column B is able to provide accurate data from 720 ppm to 3.06 percent. Each data point is the average of a minimum of two samples. The data is presented graphically following the data chart. Note that the data points fall within the 10 percent error lines. Raw data for each point can be found in Appendix C.2.

APPLICABLE RANGE DETECTOR A

Blend (ppm - H ₂)	Calc. Conc.* (ppm - H ₂)	Standard Dev. (ppm)	% Error
10.2	10.54	0.277	3.33
20.4	21.34	0.515	4.59
30.6	31.29	1.147	2.26
40.8	40.40	0.202	0.97
51	52.04	0.12	2.04
74.4	73.24	0.164	2.57
91.8	93.65	0.308	2.01
100	96.70	0.283	3.3
102	107.11	0.18	5.01
300	307.76	0.694	2.59
500	498.10	1.135	0.38
540	544.50	0.69	0.83
600	581.90	0.578	3.02
700	657.75	0.588	6.04
800	729.01	0.121	9.00

APPLICABLE RANGE DETECTOR B

Blend (ppm - H ₂)	Calc. Conc.* (ppm - H ₂)	Standard Dev. (ppm)	% Error
720	651.62	11.79	9.50
800	724.19	8.88	9.48
900	815.28	6.28	9.41
1010	964.12	7.23	4.54
1800	1723.02	15.65	4.28
3030	3020.77	22.29	0.30
5050	5236.63	9.18	3.70
7070	7465.33	25.14	5.59
9090	9776.90	6.17	7.56
13600	14927.72	286.97	9.76
23800	25916.61	45.10	8.89
30600	28565.74	3627.67	6.65

4.3 INTERFERENCE

Interference testing was performed to discover if the RGA-5 would report hydrogen when injected with either methane, nitrous oxide, or ammonia. The RGA-5 reported nominally zero hydrogen before this test. The instrument was not expected to recognize other gases as hydrogen and the instrument did not disappoint us. No hydrogen was reported in any of these tests.

A feature interference test was performed to find out if methane, nitrous oxide, or ammonia changed the concentration of hydrogen already present. Rather than starting with zero hydrogen, 50 ppm hydrogen was injected along with the previously listed interferents. There was no noticeable effect on the reported concentration. All interference test data are given in Appendix C.3.

4.4 RESPONSE AND DECAY

Response and decay tests were performed to show the instrument's ability to respond to a step input. Hydrogen was injected and disconnected in one quick move. The instrument injects and reports every 3-1/2 minutes.

As shown in the graph below, Column A had a peak response on the first injection and returned to zero on the first injection following gas removal. Only Detector A was required because 10 ppm is within its applicable range.

Both columns were required for the 3.06 percent response and decay test. Note in the graph below, Detector B reported nominally 3.12 percent in the first cycle (3.5 min). The next concentration report was to 41.44 ppm. The applicable range of Detector A is 10 to 800 ppm. Therefore, 41.44 ppm was measured by Detector A. The drop to 9.9 ppm occurred in 34 minutes and the final drop to about 2 ppm took about 2 hours. All data can be found in Appendix C.4.

A feature test was performed to evaluate the instrument's performance using a more realistic event model. The report cycle was reduced to three minutes. The concentrations varied from 100 ppm to 1000 ppm and back to 100 ppm. The instrument responded to both an injection and removal in one report cycle as shown in the graph below.

5.0 CONCLUSION

The software met all of the functions and requirements. The RGA-5 also met all of the functions and requirements and is an adequate instrument for the job.

APPENDIX A

HOST DATA ACQUISITION FUNCTIONS AND REQUIREMENTS CHECKLIST

HOST DATA ACQUISITION FUNCTIONS AND REQUIREMENTS

DESCRIPTION	Y	N	NA	COMMENTS
1. COMMUNICATION SETUP			NA	
a. Supports at least 4 serial ports	flw			
b. Has RS-232 communication port configuration parameters	flw			
2. DISPLAY TREND FOR BOTH DETECTORS				
a. Trend viewer graph	flw			
b. Trend viewer text	flw			
c. Loads file from host	flw			
d. Prints	flw			
3. FILES				
a. Uses date format for file name	flw			
b. Binary file format	flw			
c. Files contain:	flw			
1. Date stamp	flw			
2. Run number	flw			
3. Time stamp	flw			
4. Stream ID	flw			
5. H ₂ Concentration A	flw			
6. H ₂ Concentration B	flw			
d. Continually appends each analysis result to file	flw			
e. Data is added to file at the end of each run	flw			
f. New data file generated every 24 hours	flw			
g. Converts binary data files to ASCII text files	flw			

DESCRIPTION	Y	N	NA	COMMENTS
4. CHROMATOGRAM DISPLAY				
a. Displays normally (single chromatogram)	fw			
b. Downloads latest post run from the RGA-5	fw			
c. Retrieves chromatograph from host data files	fw			
d. Prints	fw			
5. CHROMATOGRAM FILES				
a. Uses date and run number format for file name	fw			
b. Any file format is used by display	fw			
c. Saving	fw		NA	
1. Saves every <u>n</u> cycle	fw			
2. <u>n</u> number cycles	fw			
3. Saves on error	fw			
d. For each detector, reports;	fw		NA	
1. Impurity name	fw			
2. Concentration	fw			
3. Peak height	fw			
4. Retention time	fw			
5. Area	fw			
6. Response factor	fw			
7. Detector's status	fw			
5. DATA ACQUISITION				
a. Fully automatic data collection	fw			
b. Continually logs data to host	fw			
6. OUTPUT DATA FOR SYSTEM INTERFACE				

DESCRIPTION	Y	N	NA	COMMENTS
a. Minimum output ASCII data includes	Y			
1. Date	Y			
2. Time	Y			
3. Run number	Y			
4. Stream ID	Y			
5. H ₂ retention time detector A	Y			
6. H ₂ retention time detector B	Y			
5. H ₂ response Factor detector A	Y			
6. H ₂ response Factor Detector B	Y			
7. H ₂ concentration detector A	Y			
8. H ₂ concentration detector B	Y			
7. SOFTWARE				
a. Software is loaded on high density 3-1/2" floppy diskettes	Y			
b. Documentation describing basic software operation is included	Y			

Note: Review this checklist after testing is complete.

APPENDIX B

RGA-5 FUNCTIONS AND REQUIREMENTS

RGA-5 FUNCTIONS AND REQUIREMENTS

Description	Met			Comments
	Y	N	N/A	
The RGA-5 sample stream is capable of being isolated with no other instruments being adversely affected by any aspect of the GC's operation.	<i>JSW</i>			
Flow and pressure characteristics are able to be monitored during initial setup and at periodic intervals.	<i>JSW</i>			
The GC is capable of injecting a sample for analysis once every five minutes.	<i>JSW</i>			
For hydrogen analysis, the RGA-5 shall have a lower detection limit of 10 ppm and an upper limit of 30,000 ppm.	<i>JSW</i>			

APPENDIX C

TEST PROCEDURES AND TEST DATA

APPENDIX C.1

SOFTWARE VERIFICATION PROCEDURE

APPENDIX C.1 SOFTWARE VERIFICATION PROCEDURE

I Communication Port Setup

- a. Establish RGA-5 communication link into com port on the RS232 modem.
- b. Start program "Hanford.exe." Open file, click on "Rga5 settings."
- c. Click on "com port 1", "ok."
- d. Click "Trend Data."

ffw Trend data is visible for com port 1.

- e. Repeat steps a - e for com ports 2, 3, & 4.

ffw Trend data is visible for com port 2.

ffw Trend data is visible for com port 3.

ffw Trend data is visible for com port 4.

II Display, Files, and Printing

Current file

- a. Return communication link to com port 1. Click "Graph."

ffw Trend graph is visible for **current day's** data.

- b. Click "Data."

ffw Trend data is visible for current day's data.

- c. Click "Print Screen."

ffw Screen data is printed.

- d. Click "Print data."

ffw Current day's data is printed including the following:

1. Date
2. Time stamp
3. Run number
4. Stream I.D.
5. H2 concentration A
6. H2 concentration B

Test control copy

Previous day's file

- e. Click "File." Open a previous day's file.
- f. Click "graph."
ffw Trend graph is visible with previous day's data.
- g. Click "data."
ffw Trend text is visible with previous day's data.
- h. Click "Print Screen."
ffw Screen data is printed.
- i. Click "Print data."
ffw Verify printed data includes the following:
 - 1. Date
 - 2. Time stamp
 - 3. Run number
 - 4. Stream I.D.
 - 5. H₂ concentration A
 - 6. H₂ concentration B

III Chromatograms

- a. Set computer clock to 11:55 p.m.
ffw At 12:00 a.m. a new data file is generated
- b. Click "Conditions," "Collect chromatogram after 1 run."
- c. Inject 1000 ppm concentration H₂ and wait four cycles.
- d. Repeat steps a-c collecting chromatograms every 2 runs.
ffw Verify chromatograms for both columns are available only at requested intervals.
- e. Click "Conditions," "Collect chromatogram after 0 runs + concentration error." Set GC instrument alarm to 900 ppm.
- f. Inject 1000 ppm H₂ in nitrogen.
ffw Verify chromatogram is available only at 1000 ppm H₂ levels. Chromatogram is saved on error.

ffw

Verify chromatogram uses date and run number format for file name.

IV Information

- a. Click "Information."

ffw

The following chromatograph information is available for each column:

1. Impurity name
2. Concentration
3. Peak height
4. Retention time
5. Area
6. Response factor
7. Detector's status

V Data acquisition

ffw
ffw

Data collection is fully automatic.

Data is continually logged to host.

VI Output data for system interface.

- a. Open data file in ASCII format in an external program.

ffw

The following output ASCII data is included:

1. Date
2. Time
3. Run number
4. Stream ID
5. H₂ retention time for both detectors A and B
6. H₂ response factor for both detectors A and B
7. H₂ concentration for both detectors A and B

VII Software

ffw
ffw

The software is loaded on high density 3-1/2 floppy disks.

Documentation describing basic software operation is included.

VIII Checklist

ffw

Review checklist Appendix A.

APPENDIX C.2

RANGE AND ACCURACY

RANGE AND ACCURACY TEST DATA

DETECTOR A RF = 4643.8					
BLEND (ppm)	AREA A	CALC CONC. (ppm)	AVERAGE CALC. CONC. (ppm)	STD DEV. (ppm)	% ERROR
10.2	50668	10.911			
10.2	48763	10.501			
10.2	47241	10.173			
10.2	49621	10.686			
10.2	48433	10.430	10.540	0.277	3.33
20.4	101557	21.870			
20.4	99805	21.492			
20.4	95845	20.640			
20.4	99123	21.345	21.337	0.515	4.59
30.6	148541	31.987			
30.6	148230	31.920			
30.6	139161	29.967	31.292	1.147	2.26
40.8	186543	40.171			
40.8	188244	40.537			
40.8	188070	40.500	40.402	0.202	0.97
51.0	242059	52.126			
51.0	241268	51.955	52.041	0.120	2.04
71.4	340807	73.390			
71.4	340185	73.257			
71.4	339291	73.064	73.237	0.164	2.57
91.8	435890	93.866			
91.8	433869	93.431	93.648	0.308	2.01
100.0	447941	96.461			
100.0	450259	96.960			
100.0	448951	96.679			
100.0	447237	96.309	96.700	0.283	3.30
102.0	497684	107.173			
102.0	496871	106.998			
102.0	498421	107.332			
102.0	496562	106.931	107.108	0.180	5.01
300.0	1431551	308.275			
300.0	1430443	308.036			
300.0	1425499	306.971	307.761	0.694	2.59
500.0	2307043	496.806			
500.0	2316872	498.922			
500.0	2315262	498.576	498.101	1.135	0.38
540.0	2524812	543.701			
540.0	2530468	544.919			
540.0	2530257	544.873	544.498	0.690	0.83
600.0	2699307	581.277			
600.0	2701960	581.849			
600.0	2701719	581.797			
600.0	2705795	582.674	581.899	0.578	3.02
700.0	3058499	658.627			
700.0	3052768	657.393			
700.0	3052963	657.435			
700.0	3053468	657.543	657.749	0.588	6.04
800.0	3381102	728.097			
800.0	3380866	728.046			
800.0	3380947	728.064			
800.0	3379869	727.832	728.010	0.121	9.00
900.0	3668529	789.993			
900.0	3670555	790.429			
900.0	3665918	789.430			
900.0	3671232	790.575	790.107	0.514	12.21
1000.0	3916821	843.461			
1000.0	3915757	843.231			
1000.0	3920263	844.202	843.631	0.507	15.64

RANGE AND ACCURACY TEST DATA

DETECTOR B
RF = 76.8

BLEND (ppm)	AREA B	CALC CONC. (ppm)	AVERAGE CALC.CONC. (ppm)	STD DEV. (ppm)	% ERROR
300	18087	235.61			
300	18202	237.11			
300	17976	234.16	235.63	1.47	21.46
500	34303	446.84			
500	34488	449.25			
500	33576	437.37	444.49	6.28	11.10
540	36886	480.49			
540	38305	498.98			
540	37428	487.55	489.01	9.33	9.44
600	40874	532.44			
600	39950	520.40			
600	42485	553.43			
600	41205	536.75	535.76	13.66	10.71
720	49383	643.28			
720	50663	659.96	651.62	11.79	9.50
800	55667	725.14			
800	54817	714.07			
800	56464	735.52			
800	55427	722.01	724.19	8.88	9.48
900	62905	819.43			
900	62177	809.94			
900	63093	821.87			
900	62173	809.89	815.28	6.28	9.41
1010	73261	954.33			
1010	74572	971.40			
1010	73598	958.72			
1010	74386	968.98			
1010	74533	970.90			
1010	73726	960.38	964.12	7.23	4.54
1800	132407	1724.79			
1800	131008	1706.56			
1800	133400	1737.72	1723.02	15.65	4.28
3030	230050	2996.72			
3030	232209	3024.85			
3030	233429	3040.74	3020.77	22.29	0.30
5050	402078	5237.62			
5050	401262	5227.00			
5050	402665	5245.27	5236.63	9.18	3.70
7070	570869	7436.36			
7070	574332	7481.47			
7070	574077	7478.15	7465.33	25.14	5.59
9090	750245	9772.98			
9090	750300	9773.70			
9090	751091	9784.00	9776.90	6.17	7.56
13600	1120597	14597.33			
13600	1156954	15070.93			
13600	1160329	15114.90	14927.72	286.97	9.76
23800	1986253	25873.71			
23800	1989231	25912.50			
23800	1993156	25963.63	25916.61	45.10	8.89
30600	2495756	32510.69			
30600	2500170	32568.19	28565.74	3627.67	6.65

APPENDIX C.3

INTERFERENCE

INTERFERENCE TEST DATA

		Detector A			Detector B	
	Time	Run #	Reported Conc. (ppm)	Area	Reported Conc. (ppm)	Area
Blank	13:17	17	2.21	10254	0	0
	13:28	18	2.08	9676	0	0
	13:33	19	1.86	8646	0	0
	13:36	20	1.78	8287	2.799	168
Methane ID # A019312						
	13:40	21	1.72	7995	0	0
	13:44	22	1.84	8525	0	0
	13:49	23	1.77	8212	0	0
	13:53	24	1.84	8539	0	0
	13:57	25	1.74	8070	0	0
Nitrous Oxide ID # 1A021591						
	14:09	28	0.23	1074	0	0
	14:14	29	0.26	1212	0	0
	14:18	30	0.26	1226	0	0
	14:33	31	0.17	794	0	0
Ammonia ID # AAU3460						
	15:04	36	0.26	1192	0	0
	15:11	37	0.00	0	0	0
	15:17	38	0.08	370	0	0
	15:30	39	0.06	268	0	0

FEATURE INTERFERENCE TEST DATA

50 ppm hydrogen						
	13:17	59	59.11	274506	35.66	2739
	13:20	60	56.37	261770	47.79	3670
	13:23	61	58.48	271586	37.43	2875
	13:26	62	58.11	269861	39.30	3018
	13:29	63	57.96	269133	36.88	2832
50 ppm hydrogen / 50 ppm ammonia						
	11:26	22	58.29	270701	48.82	2929
	11:29	23	55.31	256845	42.25	2535
	11:32	24	57.93	268997	56.27	3376
	11:35	25	57.96	269147	43.77	2626
	11:38	26	57.97	269221	47.10	2826
50 ppm hydrogen / 249.9 ppm methane						
	11:56	32	59.58	276661	44.47	2668
	11:59	33	58.45	271417	54.08	3245
	12:02	34	58.71	272657	45.37	2722
	12:05	35	58.42	271277	46.65	2799
	12:08	36	58.23	270425	45.25	2715
50 ppm hydrogen/50 ppm nitrous oxide						
	12:50	50	56.36	281809	49.57	2974
	12:53	51	55.93	279638	55.90	3354
	12:56	52	55.31	276539	50.17	3010
	12:59	53	52.90	264485	50.28	3017
	13:02	54	54.25	271237	51.50	3090
	13:05	55	54.09	270461	51.45	3087

Test control copy

APPENDIX C.3
INTERFERENCE

C.3.a

Data File Name 94C914.DAT

Method File P5 - Detector A & B

Certified standard concentration - ~~987~~ ppm ammonia in nitrogen
1000 ppm ID# AAL13460

1. Verify that flow is nominally 34 mlm and pressure is nominally 15 psi.
2. Establish method file in RGA-5 software and begin testing.

a. ^{Initial} Reported hydrogen concentration nominally zero

Column A same as above

Column B "

Record observations and attach printout to test logbook.

Test control copy

C.3.b

Data File Name 940914 DAT

Method File P5-Detector A & B

Certified standard concentration - 499.8 ppm methane in nitrogen

Number of cycles 5

1. Verify that flow is nominally 34 mlm and pressure is nominally 15 psi.
2. Establish method file in RGA-5 software and begin testing.

- a. ^{Initial} Reported hydrogen concentration Normally zero
Column A Same as above
Column B "

Record observations and attach printout to test logbook.

Test control copy

C.3.c

Data File Name 940914.DAT

Method File P5 Detects, A & B

Certified standard concentration - 984 ppm nitrous oxide in nitrogen
- ID# A019302

Number of cycles 5

-
1. Verify that flow is nominally 34 mlm and pressure is nominally 15 psi.
 2. Establish method file in RGA-5 software and begin testing.

a. ^{Initial} Reported hydrogen concentration nominally zero

Column A same as above

Column B "

Record observations and attach printout to test logbook.

APPENDIX C.4

RESPONSE AND DECAY

Response and Decay 10 ppm Detector A		
Time (hrs:min)	Reported Area	Reported Conc.* (ppm)
0:00	496	0.107
0:03	1014	0.22
0:07	881	0.19
0:10	53874	11.711
0:14	50824	11.048
0:17	50965	11.079
0:20	0	0
0:24	98	0
0:27	0	0

* Based on average RF = 4643.8

Response and Decay 30600 ppm Detectors A and B				
Time (hrs:min)	Reported Area - A	Reported Conc.- A* (ppm)	Reported Area -B	Reported Conc.- B * (ppm)
0:00	5108	1.1		
0:03			2397542	31217.99
0:06	192445	41.44		
0:10	91194	19.64		
0:13	74166	15.97		
0:17	67627	14.56		
0:20	62608	13.48		
0:24	57392	12.36		
0:27	53482	11.52		
0:31	48357	10.41		
0:34	45973	9.9		
0:38	42389	9.13		
0:41	41166	8.86		
0:45	38472	8.28		
0:48	37336	8.04		
0:52	34031	7.33		
0:55	32136	6.92		
0:59	29033	6.25		
1:02	28170	6.07		
1:06	24755	5.33		
1:09	23606	5.08		
1:13	22722	4.89		
1:16	19875	4.28		
1:20	20672	4.45		
1:23	18899	4.07		
1:27	16832	3.62		
1:30	18708	4.03		
1:34	16359	3.52		
1:37	14043	3.02		
1:41	14941	3.22		
1:44	12899	2.78		
1:48	13770	2.97		
1:51	11338	2.44		
1:55	10394	2.24		
1:58	9967	2.15		
2:02	14029	3.02		
2:05	8233	1.77		
2:09	16323	3.52		
2:12	14001	3.01		
2:16	12631	2.72		
2:19	10664	2.3		
2:23	12343	2.66		
2:26	9486	2.04		
2:30	12984	2.8		
2:33	9184	1.98		

* Detector A - Based on average RF = 4643.8
* Detector B - Based on average RF = 76.8

Response and Decay Feature Test 100 ppm to 1000 ppm				
Time (hrs:min)	Reported Area - A	Reported Conc. A* (ppm)	Reported Area - B	Reported Conc. B* (ppm)
0:00	494451	106		
0:03	478945	103		
0:06	472327	102		
0:09			166357	1008
0:12			163897	993
0:15			164030	994
0:18			162073	982
0:21	463396	100		
0:24	455719	98		
* Detector A - Based on average RF = 4643.8				
* Detector B - Based on average RF = 165				

Test Control copy

C.4.a

Data File Name 941003.DAT

Method File P5 - Detector A & B

Certified standard concentration - 50 ppm hydrogen in nitrogen

Number of cycles _____

1. Verify that flow is nominally 34 mlm and pressure is nominally 15 psi.
2. Using the SGD-710C gas divider, reduce the concentration of the certified standard gas to 10 ppm by setting the divider to 20. ($0.20 \times 50 \text{ ppm} = 10 \text{ ppm}$) Use nitrogen as the carrier gas and the certified standard as the component gas.
3. Establish method file in EZChrom system software and begin testing.
4. Response

- a. Range/accuracy test reported concentration ± 2 standard deviations.

Range High 11.094
Low 9.986

- b. Inject H_2 . Record time A.

Time A C

- c. When concentration falls within Range, record time B.

Time B 3 min

- d. Record number of cycles required for concentration to fall within range.

of cycles 1

- e. Record time between injections.

Cycle time 3.5
3.5 min

- f. Response Time = Time B - Time A

Response Time 3 min

Test control copy

5. Decay

- a. Record reported average concentration.

Average concentration 11.28

- b. Remove H₂. Record time C.

Time C 0

- c. Record time D when concentration reaches nominally zero.

Time D # 3 min

- d. Record number of cycles required for concentration to reach nominally zero.

of cycles 1

- e. Record time between injections.

Cycle time ^{3.5}
3 min

- f. Decay time = Time D - Time C

Decay time 3 min

Record observations. Attach data reports to test logbook.

Test control copy

C.4.b

Data File Name 941003.DAT

Method File P5-Detector A & B

Instrument sensitivity _____

Certified standard concentration - 3.4 percent hydrogen in nitrogen
- ID# 1A015056

Number of cycles _____

-
1. Establish flow as stated in Appendix B.
 2. Using the SGD-710C Horiba gas divider, reduce the concentration of the certified standard gas to 3.06 percent by setting the divider to 90. ($0.90 \times 3.4 \text{ percent} = 3.06 \text{ percent}$). Use nitrogen as the carrier gas and the certified standard as the component gas.
 3. Establish method file in EZChrom system software and begin testing.
 4. Response
 - a. Range/accuracy test reported concentration ± 2 standard deviations.
Range High 3502.08
Low 21310.4
 - b. Inject H_2 . Record time A.
Time A 0
 - c. When concentration falls within Range, record time B.
Time B 3 min
 - d. Record number of cycles required for concentration to fall within range.
of cycles 1
 - e. Record time between injections.
Cycle time 3.5 min

Test control copy

f. Response Time = Time B - Time A

Response Time 3 min

5. Decay

a. Record reported average concentration.

Average concentration 31217.99

b. Remove H₂. Record time C.

Time C 0

c. Record time D when concentration reaches nominally zero.

Time D 2 hrs 30 min

d. Record number of cycles required for concentration to reach nominally zero.

of cycles 43

e. Record time between injections.

Cycle time 3.5 min

f. Decay time = Time D - Time C

Decay time 2 hrs 30 min

Record observations. Attach data reports to test logbook.

APPENDIX D

TEST EXCEPTION LOG

TEST EXCEPTION LOG

TE No.	DATE	DESCRIPTION	DISPOSITION	DATE CLOSED
1		Gases used for all tests were not those designated in the test plan.	Appropriate substitutions were made.	
2		Not all of the gases required for the Accuracy and Range tests were used.	The gases that were tested covered the cross-over range and provided adequate data for the upper and lower ranges as well.	