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FEB 13 1997

ENGINEERING DATA TRANSMITTAL

Page 1 of 1

1. EDT

601043

2. To: (Receiving Organization) DISTRIBUTION		3. From: (Originating Organization) REMOTE SENSING AND SAMPLING EQUIPMENT ENGINEERING		4. Related EDT No.: 619113	
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1	HNf-SD-WM-TRP-274	ALL	0	TEST REPORT FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE OF WHITTAKER ELECTROCHEMICAL CELL	SQ	1	1,2	
16. KEY								
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E, S, Q, D or N/A (see WHC-CM-3-5, Sec.12.7)		1. Approval 2. Release 3. Information 4. Review 5. Post-Review 6. Dist. (Receipt Acknow. Required)			1. Approved 2. Approved w/comment 3. Disapproved w/comment 4. Reviewed no/comment 5. Reviewed w/comment 6. Receipt acknowledged			

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1	1	Design Authority G.P. Jap	<i>[Signature]</i>	2/6/97	S7-12	1	1	305 Facility Eng. K. Schindler	<i>[Signature]</i>	2/6/97	S6-13
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18. Signature of ED G.F. Vargo Date 2/6/97		19. J.S. Schofield Authorized Representative Date 2/6/97		20. J.S. Schofield Design Authority/ Cognizant Manager Date 2/6/97		21. DOE APPROVAL (if required) Ctrl. No. ☐ Approved ☐ Approved w/comments ☐ Disapproved w/comments	
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TEST REPORT FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE OF WHITTAKER ELECTROCHEMICAL CELL

G. F. Vargo, Jr.

SGN Eurisys Services Corporation, Richland, WA 99352
U.S. Department of Energy Contract DE-AC06-87RL10930

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Abstract: This document is the test report that summarizes the results of the tests on the Whittaker cells between the temperatures of -20°F and +120°F. These sensors are used on the Rotary Mode Core Sampling (RMCS) flammable gas interlock (FGI), to detect and quantify hydrogen gas. The test consisted of operating five Whittaker electrochemical cells in an environmental chamber that was varied in temperature from -20°F to +120°F. As the rate rise of the voltage from the cells changed, after exposure to a gas concentration of 1% hydrogen at the different temperatures, the voltage was recorded on a computer controlled data acquisition system. Analysis of the data was made to determine if the cells maximum output voltages and rise times were effected by temperature.

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HNF-SD-WM-TRP-274

Rev 0

**TEST REPORT FOR THE MEASUREMENT OF
PERFORMANCE
V.S. TEMPERATURE OF THE WHITTAKER
ELECTROCHEMICAL CELL**

G. F. Vargo, Jr.

SGN Eurisys Services Corporation, Richland, WA 99352

U.S. Department of Energy Contract DE-AC06-87RL10930

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ACRONYMS AND ABBREVIATIONS

CPO	Characterization Project Operations
ETL	Engineering Test Laboratory
FGI	Flammable Gas Interlock
HP	Hewlett Packard
PPM	Parts per Million
WEC	Whittaker Electrochemical Cell

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**TEST REPORT
FOR THE MEASUREMENT OF
PERFORMANCE V.S. TEMPERATURE
OF WHITTAKER
ELECTROCHEMICAL CELL**

1 INTRODUCTION

The purpose of this test report is to summarize the "to date" performance testing, at various temperatures, of the WEC and to select a WEC, for use on the FGI, based on the data to date and this test report. The WEC cell is used on the FGI, for rotary mode core sampling (RMCS), to detect and quantify the presence of hydrogen gas concentration. The test consisted of operating five (5) WECs in an environmental chamber that was varied in temperature from -20° F to 120° F. As the rate rise of the voltage from the WECs changed, after exposure to a calibration gas concentration of 1% hydrogen at the different temperatures, the voltages were recorded on a computer controlled data acquisition system. Analysis of the data was made to determine if the cells maximum voltages and rise times met the criteria as specified in HNF-SD-WM-TP-527.

The manufacturers' recommended operating range is +70° F to +120° F. However, the temperature range for this test was increased from -20° F to +120° F to investigate if the WECs could be operated beyond their specified range.

This testing was performed in the 305 ETL at the Hanford Site, Richland, Washington.

As additional data is gathered this document will be revised to report the new data.

2 REFERENCES

- 2.1 HNF-SD-WM-TP-527, Test Plan for Measurement of Performance v.s. Temperature of Whittaker Electrochemical Cell, Rev. 0, SGN Eurisys Services Corporation, Richland, Washington, 99352, January 1997.
- 2.2 HNF-SD-WM-TC-072, Test Procedure for Measurement of Performance v.s. Temperature of Whittaker Cell, Rev. 0, SGN Eurisys Services Corporation, Richland, Washington, 99352, January 1997.

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- 2.3 HNF-N-3-1, Testing and System Development Notes for 305 Engineering Testing Laboratory, Hanford Nuclear Facility. Issued to K. S. Witwer, 1/8/97.
- 2.4 WHC-SD-WM-SAD-035, A Safety Assessment of Rotary Mode Core Sampling in Flammable Gas Single Shell Tanks, Rev 0A, Los Alamos National Laboratory, Los Alamos, New Mexico, August 1996.

3 TEST SUMMARY

The format of the test plan allowed for flexibility in the performance of the test. Therefore, under recommendations from the Whittaker factory, initial testing was performed at +40° F, on all five(5) test WECs. Based on the factory conversations, a starting point was established that if any WEC failed any of the tests, the temperature was to be increased and the cells retested using the 100% calibration rate test as an initial "pass/fail" criteria (Reference HNF-SD-WM-TP-527 and HNF-SD-TC-072). All the WECs would have to pass all the tests for the temperature to be lowered. For the purpose of this report the definition of "pass/fail by" in microvolts (ppm), is the amount the 90% of the final WEC under test voltage value is "greater than"(pass), or "less than" (fail), the 2 minute WEC under test voltage value. The definition of the "final WEC under test voltage value" is the voltage value the WEC has attained after 15 minutes from injection of the calibration gas concentration (opening of solenoid valve from gas header to the WEC under test).

The results of the testing at + 40° F is as follows:

- all WECs, except for WEC 1, failed at least one(1) of the tests;
- in addition to WEC 5 failing the criteria, it was noted to be excessively noisy, i.e., +/- 10 micro volt signal variation as compared to +/- 2 microvolts for WECs 1-4. One(1) micro volt equates to nominally 10 ppm. A typical WEC output voltage response would be from 0.0 microvolts (0.0 ppm) at 0% hydrogen to 1000 microvolts (10,000 ppm) at 1% hydrogen.

Since at least one(1) failure was noted, the temperature was increased to +50° F. WECs 2 and 4 were tested at the 100% calibration rate test. WECs 2 and 4 were a randomly selected sample for this test.

The results of the testing at +50° F is as follows:

- WEC 2 (HP data file WEC 252) failed by 7.9 microvolts (79 ppm);
- WEC 4 (HP data file WEC 452) passed by 27.5 microvolts (275 ppm).

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Since WEC 2 failed, the temperature was increased to +60° F and all WECs were tested at the 100% calibration rate test with the following results:

- WEC 1 (HP data file WEC 162) passed by 17.6 microvolts (176 ppm);
- WEC 2 (HP data file WEC 262) passed by 42.7 microvolts (427 ppm);
- WEC 3 (HP data file WEC 362) failed by 9 microvolts (90 ppm);
- WEC 4 (HP data file WEC 462) passed 57 microvolts (570 ppm);
- WEC 5 (HP data file WEC 562) failed by 79.6 microvolts (796 ppm).

At this time the 305 ETL team called for a consultation meeting with T.C. Schneider, in regards to the performance of WEC 5. After a reverification that the data acquisition system was functioning correctly, and after an examination of WEC 5 and it's configuration in the test setup, Schneider could not determine if anything was wrong with WEC 5. He stated that the polyamide membrane, used in the WECs as a diffusion barrier, could be slightly thicker on that particular WEC. This could be the cause for the slow response time. However, the excessive noise could not be readily explained. Additional testing of WEC 5 is recommended. WEC 5 has failed all tests to date.

Since WEC 3 had failed at +60° F, the temperature was increased to +65° F and WEC 3 was tested with the following results:

- WEC 3 (HP data file 363) failed by 1 microvolt (10 ppm);
- WEC 3 (HP data file 364) passed by 7.3 microvolts (73 ppm).

Two(2) tests were performed because the first test failed by the small margin of 1 microvolt. The second test passed. However, the initial starting value was higher (9 microvolts versus 3 microvolts).

NOTE 1:	When testing first commenced the testing team discovered that the configuration of the test setup caused calibration gas from an online WEC to contaminate an offline WEC through the common exhaust header. This cause a high initial offset voltage (100 - 500 microvolts). However, this was corrected. Future testing, after the correction to the vents was implemented, showed the initial starting voltages repeatedly approached a consistent value after consecutive testing.
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The temperature was increased to +70° F. All WECs were tested with the following results:

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- WEC 1 (HP data file 172) passed by 17.6 microvolts (176 ppm);
- WEC 2 (HP data file 272) passed by 51 microvolts (510 ppm);
- WEC 3 (HP data file 372) passed by 18.9 microvolts (189);
- WEC 4 (HP data file 472) passed by 70.4 microvolts (704 ppm);
- WEC 5 (HP data file 572) failed by 49.6 microvolts (496 ppm).

The temperature was increased to +80° F. The results are listed below:

- WEC 1 (HP data file 182) failed by 7 microvolts (70 ppm);
- WEC 1 (HP data file 183) passed by 6.6 microvolts (66 ppm);
- WEC 1 (HP data file 184) failed by 10.3 microvolts (103 ppm);
- WEC 2 (HP data file 282) passed 58.3 microvolts (583 ppm);
- WEC 4 (HP data file 482) passed 74 microvolts (740 ppm).

The temperature was increased to +100° F. The results are listed below:

- WEC 2 (HP data file 212) passed by 48.5 microvolts (485 ppm);
- WEC 4 (HP data file 412) passed 97.3 microvolts (973 ppm).

The temperature was increased to +120° F. The results are listed below:

- WEC 2 (HP data file 222) passed 64.3 microvolts (643 ppm);
- WEC 4 (HP data file 422) passed 64.7 microvolts (647 ppm).

WECs 2 or 4 can be used on the FGI as per the criteria stated in WHC-SD-WM-SAD-035. The WECs should be calibrated at a temperature of 100° F and operated between 80° F and 100° F. Alternately the WECs could be calibrated at 70° F or 80° F and operated from the calibration temperature down to 10° F below the calibration temperature. The WECs may be operated at temperatures less than the values stated above, however the SAD-035 limit of $\leq 1,000$ ppm prior to sampling will likely not be achievable. The WECs must be kept above 60° to maintain the 90% response in two minutes requirement of SAD-035. (REF: APPENDIX, "ANALYSIS OF TEMPERATURE EFFECTS ON WHITTAKER CELL CALIBRATION".)

4 TEST METHOD

4.1 TEST EXCEPTIONS

4.1.1 EXCEPTION #1

Before the testing began the testing team decided, after discussions with T. C. Schneider

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from the gas characterization team, to modify the wiring configuration of the test setup to include an isolation relay between the Stahl intrinsic isolating voltage repeater(s) and the WEC(s). This would allow voltage measurements to be made on the WEC(s) isolated from any interfacing device.

This configuration was implemented by the addition of a +24 Vdc relay that was obtained from 305 ETL electronics laboratory. The contacts of the relay were inspected and found to be of gold for low contact resistance. Furthermore, the relay was tested, using the Fluke documenting calibrator (Fluke Manufacturing Inc. Test instrument), by injecting and reading a microvolt signal across the energized closed relay contacts. A control switch was installed on the test control panel that deenergized (disconnected the WEC(s) from the barrier(s)) or energize (connect the WEC(s) to the barrier(s)). Reference page 12 of ETL note book HNF-N-3-1 and Appendix C of HNF-SD-WM-TC-072.

This exception was resolved by implementation and approved by the test director, 305 ETL testing engineer, and the RMCS exhaust engineer as authorized by *HNF-SD-WM-TP-527, Sections 3.1.1.2.*

4.1.2 EXCEPTION #2

Before testing began CPO had sent an engineer to the Whittaker factory, in Simi Valley, California, to talk to the Whittaker engineering team first hand. These discussions led to a recommendation from Whittaker that the temperature testing be started at +40°. And if all the WECs passed the criteria then the temperature could be decreased. However, if any of the WECs failed the criteria then the temperature would be increased and the WECs retested.

This exception was resolved by changing the initial temperature to +40° in step 7.4 of the test procedure HNF-SD-WM-TC-072, and approved by the test director, 305 ETL testing engineer, and the RMCS exhaust engineer as authorized by *HNF-SD-WM-TP-527, Sections 3.1.1.2.*

4.1.3 EXCEPTION #3

Before the testing began the testing team decided, after discussions with T. C. Schneider from the gas characterization team, that it would be a better test if the transit time of the gas from the gas divider to the input of the WECs was minimized. This change allows the gas header supply line, up to the solenoids to the WECs, to be charged with the specific concentration of calibration gas (30%, 60%, 90%) before allowing the gas to enter the WECs. Reference page 13 of ETL note book HNF-N-3-1 and Appendix C of HNF-SD-WM-TC-072.

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This exception was resolved by changing the order in steps 7.19-7.22 of the test procedure HNF-SD-WM-TC-072, and approved by the test director, 305 ETL testing engineer, and the RMCS exhaustor engineer as authorized by *HNF-SD-WM-TP-527, Sections 3.1.1.2*.

4.1.4 EXCEPTION #4

After discussing methods to reduce the test time with T.C. Schneider and after measuring the transit time of the gas from the gas divider to the WEC (approximately 25 seconds), the test team decided to change the purge time of the gas header from 15 minutes to 2 minutes. This reduces the overall test time by 13 minutes. Reference page 13 of ETL note book HNF-N-3-1 and Appendix C of HNF-SD-WM-TC-072.

This exception was resolved by changing the purge time from 15 to 2 minutes, in step 7.32 of the test procedure HNF-SD-WM-TC-072, and approved by the test director, 305 ETL testing engineer, and the RMCS exhaustor engineer as authorized by *HNF-SD-WM-TP-527, Sections 3.1.1.2*

4.1.5 EXCEPTION #5

During the initial testing of WECs 1-5 at +40° F, a problem was observed of the WECs not returning to the initial voltage values after a test (See Note 1). After analysis of the test piping configuration it was decided to change the vents from all the WECs to individual lines instead of all WECs being connected to a common header. The analysis and observation indicated that calibration gas from an online WEC was contaminating an offline WEC. The calibration gas of the WEC under test was remaining trapped in offline WECs. Reference page 16 of ETL note book HNF-N-3-1 and Appendix C of HNF-SD-WM-TC-072.

This exception was resolved by adding individual vent lines from each WEC and removing the common vent header, and approved by the test director, 305 ETL testing engineer, and the RMCS exhaustor engineer as authorized by *HNF-SD-WM-TP-527, Sections 3.1.1.2*

5 TEST OBSERVATIONS

1. The system data acquisition signal path loops, for every channel, were verified for accuracy before starting of the procedure. On every channel, each WEC was disconnected and a precision voltage was injected, as generated by a Fluke documenting calibrator, and was read by the Fluke and the HP data acquisition system. All channels were verified and recorded. Reference page 11 of ETL note book HNF-N-3-1.

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2. The time for the WEC to reach it's final voltage value, for the purpose of this testing, was defined at 15 minutes, a conservative time.. The criteria is based on the WEC voltage reaching 90% of the final voltage in 2 minutes. The longer the wait to reach the final voltage the faster the rate-of-rise must be within the 2 minutes. The Whittaker factory uses 10 minutes as a time to final value. If the TABLE 1 - TEST RESULTS SUMMARY is analyzed for a pass/fail criteria, using 10 minutes as a time to final value, the majority of the tests that failed for WECs 1-4 would have passed.

6 CONCLUSIONS

1. The results of the testing, that has been completed to date, has shown that WECs 2 or 4 can be used on the FGI for RMCS of single shell tanks as per WHC-SD-WM-SAD-035. The range of operation must be held between +60° F and +120° F.
2. The test results indicate that WECs 2 and 4 can be operated below the manufacturers' recommended temperature range of +70° F to +120° F.
3. All WECs used on the FGI must be qualification tested to verify operation in the expected temperature range. Furthermore, the WEC must be maintained in the tested temperature range during field operation.
4. An analysis of the data has shown that generally, for a given WEC test output voltage, as the temperature increases the difference between the final value at 15 minutes and the starting initial value, decreases (Reference Attachment 2). This concludes that the calibration for the FGI WECs should be performed at a higher temperature to be on the conservative side.

For the FGI application, the WECs should be calibrated at +80° F and operated between +60° F and +120° F (Reference ATTACHMENT 5: SUPPORTING DOCUMENTATION, "*ANALYSIS OF FGI WHITTAKER CELL CALIBRATION AND OPERATING TEMPERATURES*").

5. The testing has shown that all WECs do not respond the same. For example, out of the five WECs selected at random, WEC #5, has not passed any of the test "to date". Furthermore, WEC #1 passed all the tests and WEC #3 failed all the tests at +40° F.
6. Some of the WECs tested do not meet the manufacturers' specifications, i.e., WEC 5 not passing in the temperature range of +70° F to +120° F.

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7 **RECOMMENDATIONS**

1. It will be necessary to "hand select", through qualification testing, WECs for a given application.
2. Additional selective retesting could be performed, to verify the current +40° F data is valid, after exception #5 was implemented.
3. Additional testing should be performed to characterize the behavior of the initial offset voltage, i.e. changes with temperature, effects from intrinsic voltage repeating barrier, etc. A simple test would be to isolate the intrinsic barriers from the WECs and observe and record the WEC output voltage as the temperature is varied from +40° F to +120° F.
4. Additional selective testing could be performed to characterize the temperature behavior and response time when disconnected, via the isolating relay, from the intrinsic voltage isolating repeater. The information gathered from 3 and 4 will be useful for future flammable gas monitoring activities, i.e., yields more knowledge on the behavior of the WEC, used in the Hanford Site base technology, in flammable gas monitoring.
5. Additional selective testing could be performed to characterize the temperature behavior of the WECs for all temperature not previously tested, that may be experienced in the field.
6. Additional testing/analysis is recommended for WEC 5 to investigate the excessive noise, noted on the cell output voltage, as compared to the other cells, i.e., consult factory.

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HNF-SD-WM-TRP-274

Rev 0

8 ATTACHMENTS

- 8.1 ATTACHMENT 1: TABLE 1 - TEST RESULTS SUMMARY
- 8.2 ATTACHMENT 2: WHITTAKER CELLS #2 & #4 WITH 100% CALIBRATION GAS
- 8.3 ATTACHMENT 3: HNF-N-3-1 LOG BOOK PAGES
- 8.4 ATTACHMENT 4: HNF-SD-WM-TC-072, Rev 0
- 8.5 ATTACHMENT 5: SUPPORTING DOCUMENTATION

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HNF-SD-WM-TRP-274, REV 0

8.1 ATTACHMENT 1: TABLE 1 - TEST RESULTS SUMMARY

Cell 1						
Temperature (°F)	30%	60%	90%	100% (1st)	100% (2nd)	100% (3rd)
40	P 1/25/97	P 1/25/97	P 1/25/97	P 1/25/97	P 1/25/97	P 1/25/97
50						
60				P 1/29/97		
65						
70				P 1/29/97		
80				F * 1/30/97	P 1/30/97	F * 1/30/97
100						
120						

The asterisk “*” next to some of the failures (F) in this table indicates tests that would have passed if the final value time had been 10 minutes (instead of 15 minutes) - which happens to be the time Whittaker uses for their qualification testing at their factory.

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HNF-SD-WM-TRP-274, REV 0

TABLE 1 - TEST RESULTS SUMMARY - CONT

Cell 2						
Temperature (°F)	30%	60%	90%	100% (1st)	100% (2nd)	100% (3rd)
40	P 1/27/97	P 1/27/97	P 1/27/97	P 1/27/97	F * 1/27/97	F * 1/27/97
50				F * 1/28/97		
60	P (2/3/97)	P (2/3/97)	P (2/3/97)	P 1/29/97		
65						
70	P 2/4/97	P 2/4/97	P 2/4/97	P 1/29/97		
80				P 1/31/97		
100				P 1/31/97		
120				P 2/1/97		

Cell 3						
Temperature (°F)	30%	60%	90%	100% (1st)	100% (2nd)	100% (3rd)
40	F 1/27/97	F 1/27/97	F 1/27/97	F 1/27/97	F 1/27/97	F 1/27/97
50						
60				F * 1/29/97		
65				F * 1/29/97	P 1/29/97	
70				P 1/29/97		
80						
100						
120						

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HNF-SD-WM-TRP-274, REV 0

TABLE 1 - TEST RESULTS SUMMARY - CONT.

Cell 4						
Temperature (°F)	30%	60%	90%	100% (1st)	100% (2nd)	100% (3rd)
40	P 1/28/97	F * 1/28/97	F 1/28/97	F 1/28/97	F 1/28/97	F 1/28/97
50	P 2/4/97	P 2/4/97	P 2/4/97	P 1/28/97		
60	P 2/3/97	P 2/3/97	P 2/3/97	P 1/29/97		
65						
70	P 2/3/97	P 2/3/97	P 2/4/97	P 1/29/97		
80	P 2/4/97	P 2/4/97	P 2/4/97	P 1/31/97		
100				P 1/31/97		
120				P 1/31/97		

Cell 5						
Temperature (°F)	30%	60%	90%	100% (1st)	100% (2nd)	100% (3rd)
40	F 1/28/97	F 1/28/97	F 1/28/97	F 1/28/97	F 1/28/97	F 1/28/97
50				F 1/29/97		
60				F 1/29/97		
65						
70				F 1/29/97		
80						
100						
120						

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HNF-SD-WM-TRP-274

Rev 0

8.2 ATTACHMENT 2: WHITTAKER CELL #2 WITH 100% CALIBRATION GAS

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8.2.1 ATTACHMENT 2: WHITTAKER CELL #4 WITH 100% CALIBRATION GAS

Whittaker Cell # 4 With 100% Calibration Gas

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HNF-SD-WM-TRP-274
Rev 0

8.3 ATTACHMENT 3: HNF -N-3-1 LOG BOOK PAGES

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NOTEBOOK/LOGBOOK UNCLASSIFIED COVERSHEET				
SECTION I RECORD COPY Not for Circulation		Notebook No. <u>HNF-N-3 1</u>		
		Date of Issue <u>1-8-97</u>	Copy <u>1</u>	
		Title <u>Testing & System Development</u> <u>Notes from 305 Engineering</u> <u>Testing Laboratory</u>		
		Author <u>Keith S. Witwer</u> If continued from another notebook give the notebook number _____		
This is a Controlled Notebook. The assigned custodian is responsible for this book. When the book is completed, contact your Records Management Specialist for a Retention Schedule. Complete Section II of this form and return the Notebook to Unclassified Document Control, A3-95.				
Responsible Custodian		Payroll No.	MSIN	Date Assigned
<u>KS Witwer</u>		<u>0043871</u>	<u>46-13</u>	<u>12 8 1997</u>
_____		_____	_____	_____
_____		_____	_____	_____
_____		_____	_____	_____
SECTION II Complete this section prior to returning notebook to Unclassified Document Control, A3-95 Abstract: (Give brief description of notebook contents) <u>used for various prototype development</u> <u>projects in the 305 Building.</u>				
Period Covered: (Inclusive dates - Month/Day/Year) <u>1/4/97 -</u>				
Certification Statement: This notebook does ☐ does not ☐ contain any Quality Assurance Record Material (as described in Section 9.0 of WHC-CM-3-5) and has been verified to be a complete and legible record.				
_____ Custodian's Signature and Date				
Retention Schedule:	Specialist Concurrence Name	Custodian's Manager's Name		

BD-6001-256 (10/95)

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INSTRUCTIONS FOR USING NOTEBOOKS/LOGBOOKS

Please Read Before Making Entries

1. Original records are to be legibly written in reproducible black ink.
2. Notebook/Logbook pages are to be used consecutively. If for any reason a page is skipped, a diagonal line shall be drawn from the top to the bottom of the page. If the entries on a given subject do not completely fill a page, a diagonal line shall be drawn from the last entry to the bottom of the page. These line-outs should be initialed and dated. If the entries on a given subject extend over several pages which are not consecutive, proper cross-references should be inserted.
3. Notebooks/Logbooks are to be preserved intact. In no case should any pages or part of a page be removed. All extra unused pages shall be left intact and be firmly secured.
4. No erasures are to occur in the record. Any corrections or changes should be made by drawing one line, leaving the original entry legible. Date and initial. Do not obliterate deletions in any manner.
5. All entries should be dated, including the year. If a given entry extends over more than one page, the date should appear on each page.
6. The person making each entry should sign his/her name at the end of the entry.
7. Entries relating to new ideas, proposals for future experiments, or completed experiments, should receive particular attention. They should be understandable to others, not a mere reminder to the maker. These entries should be reviewed and witnessed by an independent technically qualified person who shall date and sign each page of the entry. Additional entries or corrections necessary to clarify the entries to the reviewer shall be made prior to their signing.
8. Classified information shall not be entered into this notebook.
9. Notebook/Logbook procedures are found in WHC-CM-3-5, Section 12.8.
10. When Notebooks/Logbooks are completed or no longer needed, complete section II of the Notebook/Logbook Unclassified Cover Sheet. Contact the records specialist assigned to your organization to obtain concurrence on the record retention schedule.

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Logbook

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Completed, contact
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(1-3-5) and has

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D-8001-256 (10/95)

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John S. Wither
1/16/97

*Measurement of Performance vs Temperature
of Whittaker Electrochemical Cell.*

HNF-SD-WM-TP-527
Rev 0

TEST PLAN
FOR MEASUREMENT OF
PERFORMANCE VS TEMPERATURE
OF WHITTAKER
ELECTROCHEMICAL CELL

1.0 INTRODUCTION

The purpose of this test plan is to define the methodology used to test the performance of the WEC with changes in temperature. This cell is used on the FGI, for RMCS, to detect and quantify the presence of hydrogen gas concentration. Since, the WEC on the FGI is not mounted in a protected enclosure, recent calibration of the WEC has been degraded due to the cold weather.

This test will be performed using the guidelines as defined in EP-4.2, Section 2.2.1, "Development testing". The main purpose of the test is to resolve the engineering issues regarding the performance of the Whittaker cell through the range of temperatures that may be experienced during Hanford Site tank farm deployment. This test will not resolve issues of flow through the WEC. The parameters for the test will be the recommended parameters gained from the experience by the gas characterization team (GCT) while developing the GCSS. The WECs configuration, inlet pressure, and flow rates will not be the same as used during actual use in the FGI system. The test parameters used are best suited to test the response of the WECs to the calibration gas at the test temperatures.

This test, as described above, will be under the test direction of George Vargo. Keith Wither will be Cog Engineer in charge of facility, particulars. Supporting Technicians are Steve Jordan and Norm Leech - both at the Engineering Testing Laboratory - 305 Bldg.

All electronic and otherwise measuring equipment directly involved with the performance of the Whittaker cell will have calibration/verification showing actual performance of the item.

The test Procedure used for this test is HNF-SD-WM-TP-072 Test Procedure for Measurement of Performance vs. Temperature of Whittaker Electrochemical Cell.

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Below is a list of Portland measuring equipment along with calibration # and due date.

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John L. Lutter
1/16/97 3

A Hewlett Packard 9000 series computer with an HP 3497 Acquisition Central Unit will monitor and record the temperature inputs (also possibly the milliwatt outputs from the Intrinsic Isolators. An Omega CL-505A Temperature Calibrator will be used to verify displayed & recorded temperatures to the computer. Below is the cal sheet for the calibrator. The HP unit will record outputs from both the WEC's & intrinsic isolators.

WESTINGHOUSE STANDARDS LABORATORY PHYSICAL AND ELECTRICAL REPORT

DELIVERY/ADDRESS SQUIER DM I.E.-13		ORDER NO. 12-11-55-002		DATE 10-26-56		REFERENCE NUMBER 40366	
INSTRUMENT T-C CALIBRATOR OMEGA CL-505A		SERIAL NUMBER 3324 5567		PURCHASER NUMBER N/A		TEST TYPE 1. GENERAL TESTS 2. SPECIAL TESTS 3. REPAIRS 4. RECALIBRATION 1	
MODEL CL-505A		TEST DATE 10-26-56		TEST TIME 1:30 PM		TEST LOCATION WESTINGHOUSE	
ORDER NO. 12-11-55-002		PURCHASER NUMBER 4		TEST TYPE 1. GENERAL TESTS 2. SPECIAL TESTS 3. REPAIRS 4. RECALIBRATION 1		TEST TIME 1:30 PM	
TEST DATE 10-26-56		TEST TIME 1:30 PM		TEST LOCATION WESTINGHOUSE		REFERENCE NUMBER 40366	
INSTRUMENT IDENTIFICATION WIK 6-3019		SERIAL NUMBER 4-1 (YES) 2011V CL8300 1473		TEST TYPE 1. GENERAL TESTS 2. SPECIAL TESTS 3. REPAIRS 4. RECALIBRATION 1		TEST TIME 1:30 PM	
INSTRUMENT IDENTIFICATION 50mV 250V OUT OF SPEC - JSC ALDET		SERIAL NUMBER 4-1 (YES) 2011V CL8300 1473		TEST TYPE 1. GENERAL TESTS 2. SPECIAL TESTS 3. REPAIRS 4. RECALIBRATION 1		TEST TIME 1:30 PM	
INSTRUMENT IDENTIFICATION 50mV 250V OUT OF SPEC - JSC ALDET		SERIAL NUMBER 4-1 (YES) 2011V CL8300 1473		TEST TYPE 1. GENERAL TESTS 2. SPECIAL TESTS 3. REPAIRS 4. RECALIBRATION 1		TEST TIME 1:30 PM	
INSTRUMENT IDENTIFICATION 50mV 250V OUT OF SPEC - JSC ALDET		SERIAL NUMBER 4-1 (YES) 2011V CL8300 1473		TEST TYPE 1. GENERAL TESTS 2. SPECIAL TESTS 3. REPAIRS 4. RECALIBRATION 1		TEST TIME 1:30 PM	
INSTRUMENT IDENTIFICATION 50mV 250V OUT OF SPEC - JSC ALDET		SERIAL NUMBER 4-1 (YES) 2011V CL8300 1473		TEST TYPE 1. GENERAL TESTS 2. SPECIAL TESTS 3. REPAIRS 4. RECALIBRATION 1		TEST TIME 1:30 PM	
INSTRUMENT IDENTIFICATION 50mV 250V OUT OF SPEC - JSC ALDET		SERIAL NUMBER 4-1 (YES) 2011V CL8300 1473		TEST TYPE 1. GENERAL TESTS 2. SPECIAL TESTS 3. REPAIRS 4. RECALIBRATION 1		TEST TIME 1:30 PM	
INSTRUMENT IDENTIFICATION 50mV 250V OUT OF SPEC - JSC ALDET		SERIAL NUMBER 4-1 (YES) 2011V CL8300 1473		TEST TYPE 1. GENERAL TESTS 2. SPECIAL TESTS 3. REPAIRS 4. RECALIBRATION 1		TEST TIME 1:30 PM	
INSTRUMENT IDENTIFICATION 50mV 250V OUT OF SPEC - JSC ALDET		SERIAL NUMBER 4-1 (YES) 2011V CL8300 1473		TEST TYPE 1. GENERAL TESTS 2. SPECIAL TESTS 3. REPAIRS 4. RECALIBRATION 1		TEST TIME 1:30 PM	
INSTRUMENT IDENTIFICATION 50mV 250V OUT OF SPEC - JSC ALDET		SERIAL NUMBER 4-1 (YES) 2011V CL8300 1473		TEST TYPE 1. GENERAL TESTS 2. SPECIAL TESTS 3. REPAIRS 4. RECALIBRATION 1		TEST TIME 1:30 PM	
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INSTRUMENT IDENTIFICATION 50mV 250V OUT OF SPEC - JSC ALDET		SERIAL NUMBER 4-1 (YES) 2011V CL8300 1473		TEST TYPE 1. GENERAL TESTS 2. SPECIAL TESTS 3. REPAIRS 4. RECALIBRATION 1		TEST TIME 1:30 PM	
INSTRUMENT IDENTIFICATION 50mV 250V OUT OF SPEC - JSC ALDET		SERIAL NUMBER 4-1 (YES) 2011V CL8300 1473		TEST TYPE 1. GENERAL TESTS 2. SPECIAL TESTS 3. REPAIRS 4. RECALIBRATION 1		TEST TIME 1:30 PM	
INSTRUMENT IDENTIFICATION 50mV 250V OUT OF SPEC - JSC ALDET		SERIAL NUMBER 4-1 (YES) 2011V CL8300 1473		TEST TYPE 1. GENERAL TESTS 2. SPECIAL TESTS 3. REPAIRS 4. RECALIBRATION 1		TEST TIME 1:30 PM	
INSTRUMENT IDENTIFICATION 50mV 250V OUT OF SPEC - JSC ALDET		SERIAL NUMBER 4-1 (YES) 2011V CL8300 1473		TEST TYPE 1. GENERAL TESTS 2. SPECIAL TESTS 3. REPAIRS 4. RECALIBRATION 1		TEST TIME 1:30 PM	

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Omega CL-505A cal sheet - cont.

John S. Date
1/16/97

Belton

PROCEDURE NAME - 353 MHC-4-OMA-CL505A REV.D	STANDARDS CODE NUMBER 750-12-55-002	REFERENCE NUMBER 401661
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DATA SHEET

Expires 6/25/97

TC TYPE	°C	EQUIVALENT MV	OUT INDICATION		MANUFACTURER TOLERANCE
			AS FOUND	FINAL	
J SIMULATED	-140	-6.359	-139.7	6202	±.3°C
	0	0	0.1		"
	400	21.846	400.0		"
	800	45.498	800.2		±.5°C
	1198	69.422	1198.1		"
J MEASURE	-140	-6.359	-140.3		±.3°C
	0	0	-0.1		"
	400	21.846	400.1		"
	800	45.498	800.0		±.5°C
	1198	69.422	1198.5		"
	2188.4°F	"	2190		±1°F
K SIMULATED	-140	-4.669	-139.7		±.3°C
	0	0	0.1		±.3°C
	600	24.902	599.7		±.5°C
	1368	54.739	1368.4		"
K MEASURE	-140	-4.648	-140.3		±.3°C
	0	0	-0.2		"
	600	24.902	600.5		±.5°C
	1368	54.739	1369.5		"
T SIMULATED	-150	-4.648	-149.7		±.5°C
	0	0	0.0		"
	200	9.286	200.0		±.6°C
	400	20.869	399.9		"

APPROVED AT 08/17/96	CALIBRATED BY [Signature]	PAGE 2 of 5
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Below is the cal sheet for the gas flow indicator

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[Signature]
1/24/97

Inputs
being
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9000
be us
shows
source

2001

Calibration Gases & Equipment

Date: March 4, 1996

Norco Order Number: 720091-00

Lot #: 6-062-100

Postnet Fax Note	7671	DATE 1-20-97	1
To: KENN Kentland		From: R. BYRN	
Co: Dept.		Co:	
Phone #		Phone #	
Fax # 7671 - 3473		Fax # 7671 - 4695	

The carrier gas is pure N_2 and does not require / or is supplied with any certification information

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1/24/97

1/24/97

in at

Inputs from the test chamber for each cell & isolator being tested (Temperature, MV output, chamber temp) will be fed first to a terminal strip (except T.C.'s) and then to an HP 9000 data acquisition system. As can be seen inputs can be resolved down to 1 μ V resolution. Although the calibration shows a tolerance of $\pm 18 \mu$ V. Typical indicated values varied from the source by a maximum of 2 μ V.

WESTINGHOUSE STANDARDS LABORATORY PHYSICAL AND ELECTRICAL REPORT

CUSTOMER/ADDRESS JORDAN SR L6-13		STANDARD CODE NUMBER 752-67-11-004		REFERENCE NUMBER 406499	
ITEM/DESCRIPTION DATA ACQUSN SYSTEM H-P 3497A CONTROL UNIT		SERIAL NUMBER 2511A02694		MATERIALS N/A	
ROOM N/A		BUILDING 305		SERVICE DEPARTMENT 4	
K WITHDER 6-3019 TEMPERATURE DETECTOR SEE TOLERANCE COLUMN		PROBES N/A		RECAL STATUS RECALIBRATED DATE RECEIVED 1/20/97	
STANDARD(S) USED IN CALIBRATION REFERENCE TO NATIONAL BUREAU OF STANDARDS AND TECHNOLOGY OR NATIONALLY RECOGNIZED STANDARDS A1 B4120 Y 82 Y 13		EXPIRATION DATE 002-14-01-036 7/25/97 002-73-06-036 3/16/97 002-45-08-059 9/25/97		EXPIRATION DATE 1/16/97 1/16/98	
PROCEDURE WORKS WHC-67-11-3497A (12-82)		TRAINING HOURS 1.0		CALIBRATION HOURS 3.0	
		REPAIR HOURS		OTHER HOURS	
		ENG/ADMIN HOURS		MATERIALS	
		TOTAL CHANGE DATE CALIBRATED DATE DUE 1/16/97 1/16/98		AMBIENT TEMPERATURE - 24.4	

INFORMATION ONLY

RUSH

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		42	Hanford Operations and Engineering Contractor (for the United States Department of Energy)	1 OF 3

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1/24/97

PROCEDURE NAME - 1A WHC-67-11-3497A(12-82)	STANDARD CODE NUMBER 752-67-11-004	REFERENCE NUMBER 406439
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DATA SHEET

DMM RANGE AND DISPLAY	STANDARD READING	DMM READING		ONE YEAR TOLERANCE
		AS FOUND	FINAL	
.1V 5 1/2 DIGIT	.100000	.100001	SAME	± 18 μ V
1.0V	1.00000	1.00005		± 160 μ V
10.0V	1.11111	1.11116		± .3 mV
	2.22222	2.2222		± .4 mV
	3.33333	3.33334		± .6 mV
	4.44444	4.4445		± .8 mV
	5.55555	5.55557		± .9 mV
	6.66666	6.66668		± 1.1 mV
	7.77777	7.7779		± 1.3 mV
	8.88888	8.8891		± 1.4 mV
	9.99999	10.0002		± 1.6 mV
	10.00000	10.0003		± 1.6 mV
100.0V	50.000	50.002		± 8.0 mV
	100.000	100.003		± 16.0 mV
	-100.000	-100.003		± 16.0 mV
	-50.000	-50.002		± 8.0 mV
AUTO RANGE	50.000	50.002		± 8.0 mV
	5.0000	5.0002		± .8 mV
	.50000	.50003		± 80 μ V
	.050000	.049999		± 10 μ V
10V 4 1/2 DIGIT	9.000	9.000		± 3.0 mV
10V 3 1/2 DIGIT	9.00	9.00		± 20 mV

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John S. White
4/25/97

The following
known value
Fluke calib
internal an

Note the

WEC * CC
DACS WEC *
Sib *
DACS Sib *

Point of measurement

WEC 1
DACS WEC
SIG 1
DACS SIG
WEC 2
DACS WEC
SIG 2
DACS SIG
WEC 3
DACS WEC
SIG 3
DACS SIG
WEC 4
DACS WEC
SIG 4
DACS SIG
WEC 5
DACS WEC
SIG 5
DACS SIG

8.0 APPENDIX A: MEASUREMENT AND TEST EQUIPMENT RECORD

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DOCUMENT NO.	REVISION	PAGE NO.
HNF-SD-WM-TC-072	0	16 OF 203

Atmospheric pressures have been obtained on five separate days from the 390 Area weather station. On each occasion the obtained values have been within 0.01 PSI of the indicated value on our test Rosemount P.I.T.

★ Today's value for atmospheric pressure from weather station was 14.444 psia & the Rosemont P.I.T. shows a value of 14.44 psia.

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1/25/97
H. Varghese 11-25-97

The following table lists millivolt values obtained by injecting a known value into the system (in place of a W.E.C. cell) using the Fluke calibrator. The environmental chamber was open with an internal ambient temperature of 71° F.

Note the following designators:

* denotes a channel number

WEC* corresponds to the benchtop terminal strip input for a respective WEC
DACS WEC* " " " HP Data Acquisition System displayed value
SIG X " " " benchtop terminal strip input from an intrinsic
DACS SIG X " " " HP Data Acq. displayed value from intrinsic barrier

Point of Measurement	SOURCE (0.0mV) (0.000mV)	SOURCE (0.1mV) (0.100mV)	SOURCE (0.5mV) (0.500mV)	SOURCE (1.0mV) (1.000mV)	SOURCE (1.5mV) (1.500mV)
WEC 1	0.0 ± 0.02	1.00 ± 0.01	5.00 ± 0.02	1.000 ± 0.01	1.502 ± 0.01
DACS WEC 1	-1.1 × 10 ⁻⁶	1.04 ± 0.02	5.00 ± 0.04	1.000 ± 0.03	1.500 ± 0.05
SIG 1	0.21 mV ± 0.03	1.15 ± 0.03	5.14 ± 0.03	1.010 ± 0.02	1.510 ± 0.04
DACS SIG 1	0.25 mV ± 0.03	1.01 ± 0.04	5.15 ± 0.03	1.010 ± 0.05	1.510 ± 0.05
WEC 2	0.0 ± 0.02	1.00 ± 0.02	5.00 ± 0.02	1.002 ± 0.03	1.500 ± 0.01
DACS WEC 2	0.0 ± 2 × 10 ⁻⁶	1.08 ± 0.02	5.03 ± 0.03	1.000 ± 0.02	1.501 ± 0.05
SIG 2	0.001 ± 0.00	1.02 ± 0.02	5.00 ± 0.03	1.000 ± 0.04	1.497 ± 0.03
DACS SIG 2	3 × 10 ⁻⁶ ± 2 × 10 ⁻⁶	1.04 ± 0.04	5.03 ± 0.04	1.000 ± 0.03	1.500 ± 0.03
WEC 3	0.0 ± 0.02	1.00 ± 0.02	5.00 ± 0.02	1.000 ± 0.02	1.500 ± 0.02
DACS WEC 3	0.0 ± 5 × 10 ⁻⁶	1.08 ± 0.03	5.00 ± 0.02	1.002 ± 0.04	1.500 ± 0.02
SIG 3	-0.02 ± 0.03	0.93 ± 0.04	4.97 ± 0.03	1.000 ± 0.03	1.495 ± 0.03
DACS SIG 3	-6 × 10 ⁻⁶ ± 3 × 10 ⁻⁶	1.00 ± 0.03	4.95 ± 0.03	1.000 ± 0.04	1.496 ± 0.03
WEC 4	0.0 ± 0.02 mV	1.01 ± 0.02	5.00 ± 0.01	1.000 ± 0.02	1.500 ± 0.02
DACS WEC 4	1 × 10 ⁻⁶ ± 1 × 10 ⁻⁶	1.02 ± 0.02	5.03 ± 0.02	1.003 ± 0.03	1.502 ± 0.02
SIG 4	-5 × 10 ⁻⁶ ± 2 × 10 ⁻⁶	0.96 ± 0.04	4.90 ± 0.05	9.97 ± 0.03	1.498 ± 0.02
DACS SIG 4	-2 × 10 ⁻⁶ ± 2 × 10 ⁻⁶	0.97 ± 0.03	4.95 ± 0.05	9.98 ± 0.04	1.497 ± 0.03
WEC 5	0.0 ± 0.02	1.00 ± 0.03	5.00 ± 0.02	1.000 ± 0.03	1.500 ± 0.03
DACS WEC 5	1 × 10 ⁻⁶ ± 2 × 10 ⁻⁶	1.00 ± 0.03	5.00 ± 0.02	1.000 ± 0.02	1.500 ± 0.04
SIG 5	-0.04 ± 0.05	0.95 ± 0.04	4.95 ± 0.04	9.93 ± 0.03	1.497 ± 0.03
DACS SIG 5	-4 × 10 ⁻⁶ ± 2 × 10 ⁻⁶	0.95 ± 0.03	4.95 ± 0.03	9.95 ± 0.04	1.496 ± 0.03

HP DACS VERIFICATION
SHEET

6FV
1-24-97
1-25-97

STARTED TEST PROCEDURE HNF-SD-WM-TC-072 @ 0800

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12

G.F. Vance Jr
1-25-97

CHANGE #1 TO PROCEDURE HNF-SO-WM-TC-072 (SEE APPENDIX C EN#)

(CHANGED) CONFIGURATION OF SYSTEM TO WIRING DIAGRAM BELOW. THIS CHANGED ADDED AN ISOLATION RELAY BETWEEN THE OUTPUT OF WELCS & THE INPUT OF TOTRINSL BARRIES. THIS NEW CONFIGURATION PROVIDES THE OPTION OF TAKING MEASUREMENTS ON THE WELCS ISOLATED FROM THE ISPLS. APPROVED BY G.F. VANCE JR, K.S. WITWER, JR ROBINSON 1/24/97.

G.F. Vance Jr
1-24-97

G.F.V 1-25-97

INITIATE CELL
TEMPERATURE TEST
DUPINX-D-N-01-11
G.F.V 1/16/97

CHANGE #2

CHANGED 2
INSTRUCTIONS
PERSONNEL
THIS NEW S
THE PROCE
CORRECTLY

APPR

CHANGE #3

CHANGE NU
File: whitchg1.

CHANGES T

NOTE: TH
ch
90
th
ce

30% TEST

After

60% TEST

After

90% TEST

After

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F. Vaughn
1-25-97

G.F. Vaughn
1-25-97 13

APPENDIX C EN#1)

CHANGE #2 TO PROCEDURE HMF-SD-WM-TC-072 (SEE APPENDIX C EN#2)

1. BELOW THIS
OF WELLS &
PROVIDES THE
IN THE ISPS.
2/9/97.

CHANGED INITIAL TEMPERATURE (STEP 7.4) TO +40°F. THIS WAS ON
INSTRUCTIONS FROM J.R. ROBINSON WHO WAS IN CONTACT WITH WHITTAKER
PERSONNEL & E.J. WALD IN THE WHITTAKER FACTORY, POMONA CA.
THIS NEW STARTING TEMPERATURE WAS RECOMMENDED BY WHITTAKER FACTORY.
THE PROCEDURE WILL GO DOWN IN TEMPERATURE IF CELL OPERATES
CORRECTLY A +40°F OR WILL GO UP IN TEMPERATURE IF CELL FAILS

APPROVED BY: G.F. Vaughn 1/25/97
James D. [Signature] 1/25/97

CHANGE #3 TO PROCEDURE HMF-SD-WM-TC-072 (SEE APPENDIX C EN#3)

CHANGE NUMBER #3 TO HMF-SD-WM-TC-072
File:whitchng1.pro

APPROVED BY:
G.F. Vaughn
1-24-97

CHANGES TO 30%, 60%, 90% TEST

NOTE: This change allows the gas header supply line, to the cell, to be
charged with the specific concentration of calibration gas (30%, 60%,
90%) before allowing the gas to enter the cell. In this manner the
transit time of the gas, from the gas divider to the input of the
cell, is minimized.

30% TEST

After Step 7.19: Go to Step 7.29 only for 2 minutes
Step 7.30
Step 7.21: Purge for 2 minutes
Step 7.19: Reset and start stopwatch
Step 7.20
Step 7.22: Take data

60% TEST

After Step 7.22: Go to to Step 7.27(0% calibration gas)
Step 7.29: Purge for 2 minutes
Step 7.30
Step 7.23: Purge for 2 minutes
Step 7.19: Reset and start stopwatch
Step 7.20
Step 7.22: Take data

90% TEST

After Step 7.22: Go to to Step 7.27(0% calibration gas)
Step 7.29: Purge for 2 minutes
Step 7.30
Step 7.25: Purge for 2 minutes
Step 7.19: Reset and start stopwatch
Step 7.20
Step 7.22: Take data

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14

Geoffrey Vargo
1-27-90

CHANGE #4 TO PROCEDURE HNF-SD-WM-TL-072 (SEE APPENDIX C EN#4)

CHANGED PURGE TIME AT SP7.32 FROM 15 MINUTES TO 2 MINUTES. THIS
 ALLOWS THE TEST TIME TO BE REDUCED. THE TRANSPORT TIME OF
 THE GAS FROM THE GAS DIVIDER TO THE SOLENOID VALVE IS
 APPROXIMATELY 25 SECONDS. THEREFORE, A LONGER PURGE TIME IS NOT
 REQUIRED.

APPROVED: G.F. Vargo 1-25-97

1/29/97
K.S.W.

Log Notes

- Takes 25 seconds for gas to get from divider to WEC cell
- After running test, it has been taking 20 to 30 minutes to restore the WEC cell and it still shows a higher initial value.

- ~~Approx 12 secs. to see indication on WEC cell after gas is injected from solenoid valve. It takes about 25 seconds after gas is injected from divider unit. Thus much of this is cell response time - not gas transport time.~~

- Tighten chamber door latch

- N₂ allowed to run for about 12,000 secs on last test - then shut off.

G.F.V

BAZ TODAY
 STATION, IS
 14.77 PSIA @

Continued to
 23 mwe

000850
 000820
 000790
 000760
 000730
 000700
 000670
 000640
 000610
 000580
 000550

(VOLTS)

There is
 OF CELL #
 THEN LOG

1-28-97 -
 DRINK WE
 INDICATES

OTHER SWAP
 WECs (1-
 HIGH VOLTS
 CRCA CELL

THE HIGH
 COMMON

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27-90
KC ED #4

OUTER THIS
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1/29/97
K.S.W.

under

notes

sher

if after
7 takes
divider
ime - not

G.F.V.

~~BAZ~~ TODAY'S VALUE FOR ATMOSPHERIC PRESSURE, FROM PINK WEATHER STATION, IS 14.7739 PSIA. THE ROSEMOUNT P.I.T. INDICATES A VALUE OF 14.77 PSIA @ 0925 1/27/97 G.F.V.

Continued testing WECs. WEC 1 was tested on 1-25-97. WECs 2 & 3 were tested on 1-27-97.

Here is HP file TEST RESTORE 1. THIS WAS A TEST OF THE RECOVERY OF CELL #1 AFTER THE 32.100% TEST. THE DEVICE WAS PURGED & THEN LEFT TO VENT (OVER SUNDAY 1-26-97). G.F.V.

1-28-97 - TODAY'S VALUE FOR ATMOSPHERIC PRESSURE FROM PINK WEATHER STATION IS 14.71 PSIA. THE ROSEMOUNT P.I.T. INDICATES A VALUE OF 14.72 PSIA @ 10:00 1/28/97 G.F.V.

WATER SYSTEM WAS STARTED TODAY (1-28-97) NOTICED ALL THE WECs (1-5) WERE SATURATED WITH GAS (CALIBRATION GAS CAUSING HIGH VOLTAGE READINGS OF 1.000 - 1.2 MV. STARTED PURGING EACH CELL WITH N₂. G.F.V. 1/28/97

THE HIGH READINGS SEEMED TO BE COMING FROM THE COMMON VENT LINE CONNECTED TO ALL WECs (1-5) (CONT ON 16)

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16

GFVaugo
1-29-97

(CONT FROM 15)

CHANGED CONFIGURATION FROM COMMON TO INDIVIDUAL VENT ON ALL WECs (1-5). RAL TEST 441 (WEC 4 @ 440°F, 30%, 60%, 90%) WITH COMMON VENT. CONTINUED TESTING WEC 4 FOR TEST 442, 443, & 444 UNDER NEW INDIVIDUAL VENT CONFIGURATION. GFV 1-28-97

CHANGE #5 TO PROCEDURE HNF-SD-WM-TC-072 (SEE APPENDIX CENTS)

CHANGED PIPING CONFIGURATION ON TEST SET-UP TO FROM COMMON VENT FROM WECs (1-5) TO INDIVIDUAL VENT FOR EACH WEC. THIS CONFIGURATION SHOULD PREVENT CALIBRATION GAS FROM EFFECTING OFF-LINE WECs BY FEEDING BACK THROUGH VENT

Approved: GFVaugo 1-28-97

WHITTAKER CELL TEMPERATURE
TEST PIPING CONFIGURATION

GFV
1/16/97

ABOVE IS NEW PIPING CONFIGURATION FOR CHANGE #5. GFVaugo 1-28-97

TODAYS VA
WEATHER STA
0645 1/2

COMPLETED
OR CELLS

INCREMENT
CELL FAIL
PASSED

INCREMENT
FOLLOWING

INCREMENT
THE FOLLOW

THE 1ST
DELETED
HOWEVER

INCREMENT
FOLLOWING

CONTINUE
FOLLOW

CONTIN
FILE

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-Vargo
29-97G.F. Vargo
1-29-97 17EXT ON
60% 90%
TEST 442
G.F.V. 1-28-97TODAYS VALUE FOR ATMOSPHERIC PRESSURE IS 14.78, FROM PINK
WEATHER STATION. THE ROSEMOUNT PIT INDICATES A VALUE OF 14.78 IN/HG
0645 1/29/97 G.F.V.

50% CENTS)

COMPLETED TESTING ALL WECs (1-5) ON 1-28-97, AT 40°F MAJORITY
OF CELLS FAILED RATE TEST. G.F.V. 1-29-97. WEC 5 EXCESSIVELY NOISY.A COMMON
H. WEC. THIS
TIME OFF-INCREMNTED TEMPERATURE TO 50°F. TESTED CELL 2 @ 100% &
CELL FAILED (HP FILE WEC 252). TESTED CELL 4 @ 100% & CELL
PASSED (HP FILE WEC 452). G.F.V. 1-29-97INCREMNTED TEMPERATURE TO 60°F. TEST WECs (1-5) @ 100% WITH THE
FOLLOWING RESULTS: WEC 1 (HP FILE 162): PASSED

WEC 2 (HP FILE 262): PASSED

WEC 3 (HP FILE 362): FAILED

WEC 4 (HP FILE 462): PASSED

WEC 5 (HP FILE 562): FAILED

G.F. Vargo 1-29-97

INCREMNTED TEMPERATURE TO 65°F. TESTED WEC 3 @ 100% WITH
THE FOLLOWING RESULTS: WEC 3 (HP FILE 363): FAILED (1.1V)

WEC 3 (HP FILE WEC 364): PASSED (7.34V)

THE 1ST TEST, HP FILE WEC 363, FAILED BY 1.1V & TEST WAS
DECEIDED TO BE REPEATED. 2ND TEST, HP FILE WEC 364, PASSED BY 7.34V.
HOWEVER, INITIAL VALUE WAS HIGHER 9uV.

G.F. Vargo 1-29-97

INCREMNTED TEMPERATURE TO 70°F. TESTED WEC 3 & 5 @ 100% WITH
FOLLOWING RESULTS: WEC 3 (HP DATA FILE WEC 372): PASSED

WEC 5 (HP DATA FILE WEC 572): FAILED

G.F. Vargo 1-29-97

CONTINUED TESTING WECs (1, 2, 4) @ 100%, @ 70°F. RESULTS AS
FOLLOWS:

WEC 1 (HP DATA FILE 172): PASSED

WEC 2 (HP DATA FILE 272): PASSED

WEC 3 (HP DATA FILE 372): PASSED

WEC 4

472

G.F.V.

1-29-97

G.F. Vargo 1-29-97

CONTINUED TESTING WEC (1) @ 100% @ 80°F. FILE WEC 182: FAILED;
FILE WEC 183: PASSED; FILE WEC 184: FAILED 1-30-97 (AFV)WHITTAKER CELL TEMPERATURE
PIPING CONFIGURATION
TESTG.F.V.
1/16/97

G.F. Vargo 1-28-97

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18

TODAYS VALUE FOR ATMOSPHERIC PRESSURE IS 14.58 ^{PSIA} FROM
PNNL WEATHER STATION. THE ROSEMOUNT PIT INDICATES A VALUE OF
14.58 ^{PSIA} @ 0830 ~~4/31/97~~
1/31/97 GPN

SEE RESULTS ON BOTTOM OF PAGE 17 FOR ACTIVITIES ON
1/31/97 CONTINUED BELOW:

TODAYS VALUE FOR ATMOSPHERIC PRESSURE IS 14.55 ^{PSIA} FROM PNNL
WEATHER STATION 2/1/97. THE ROSEMOUNT PIT INDICATES A VALUE
OF 14.60 @ 0900 2/1/97. GPN 2/3/97

THE FOLLOWING TESTS WERE CONDUCTED ON 1/31/97:

WEC 1 (HP FILE WEC 184) : FAILED @ 80°F (100%)
WEC 2 (HP FILE WEC 282) : PASSED @ 80°F (100%)
WEC 2 (HP FILE WEC 212) : PASSED @ 100°F (100%)
WEC 4 (HP FILE WEC 482) : PASSED @ 80°F (100%)
WEC 4 (HP FILE WEC 412) : PASSED @ 100°F (100%)
WEC 4 (HP FILE WEC 422) : PASSED @ 120°F (100%)

THE FOLLOWING TESTS WERE CONDUCTED ON 2/1/97:

WEC 2 (HP FILE WEC 222) : PASSED @ 120°F (100%)

TODAYS VALUE FOR ATMOSPHERIC PRESSURE IS 14.55 ^{PSIA} FROM
PNNL WEATHER STATION. THE ROSEMOUNT PIT INDICATES A VALUE OF
14.60 @ 0900 2/1/97.

TODAYS VALUE FOR ATMOSPHERIC PRESSURE IS 14.70 ^{PSIA} FROM
PNNL WEATHER STATION. THE ROSEMOUNT PIT INDICATES A
VALUE OF 14.71 ^{PSIA} @ 0930 2/3/97. GPN

CONTINUED TESTING AT 60°F ^{461 gpm}

WEC 4 (HP FILE 41A) : 1ST 30% @ 60°F (PASSED)
WEC 4 (HP FILE 41B) : 1ST 60% @ 60°F (PASSED)
WEC 4 (HP FILE 41C) : 1ST 60% @ 60°F (PASSED)

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HNF-SD-WM-TRP-274
Rev 0

8.4 ATTACHMENT 4: HNF-SD-WM-TC-072, Rev 0

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WHITTAKER CELL TEMPERATURE TESTING

*Engineering Testing Laboratory - 305 Building
Numatec Hanford Company*

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JAN 23 1997

20

ENGINEERING DATA TRANSMITTAL

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1. EDT 619113

2. To: (Receiving Organization) DISTRIBUTION		3. From: (Originating Organization) REMOTE SENSING AND SAMPLING EQUIPMENT ENGINEERING		4. Related EDT No.: 619112	
5. Proj./Prog./Dept./Div.: CHARACTERIZATION		6. Design Authority/ Design Agent/Cog. Engr.: E.J. WALDO		7. Purchase Order No.: N/A	
8. Originator Remarks: THIS DOCUMENT IS BEING TRANSMITTED FOR APPROVAL AND RELEASE				9. Equip./Component No.: N/A	
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11A. Design Baseline Document? ☐ Yes ☒ No				13. Permit/Permit Application No.: N/A	
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1	HNF-SD-WM-TC-072	ALL	0	TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE OF WHITTAKER ELECTROCHEMICAL CELL	SQ	1	1,2	
16.	KEY							
Approval Designator (F)		Reason for Transmittal (G)			Disposition (H) & (I)			
E, S, Q, D or N/A (see WHC-CM-3-5, Sec.12.7)		1. Approval 2. Release 3. Information 4. Review 5. Post-Review 6. Dist. (Receipt Acknow. Required)			1. Approved 2. Approved w/comment 3. Disapproved w/comment 4. Reviewed no/comment 5. Reviewed w/comment 6. Receipt acknowledged			

17. SIGNATURE/DISTRIBUTION (See Approval Designator for required signatures)											
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1	/	Design Authority G.P. J. Vargo	<i>[Signature]</i>	1/22/97	S7-12	1		305 Facility Eng. K.S. Witte	<i>[Signature]</i>	1/22/97	S7-12
		Design Agent				1		305 Facility Mgr. M.J. [Signature]		1/22/97	S7-12
1	/	Cog.Eng. E.J. Waldo	<i>[Signature]</i>	1/22/97	S7-12	1		Gas Char. T.S. Schneider	<i>[Signature]</i>	1/22/97	S7-12
1	/	Cog. Mgr. J.S. Schofield	<i>[Signature]</i>	1/22/97	S7-12	1	/	Eng. Author G.F. Vargo	<i>[Signature]</i>	1/22/97	S7-12
1	/	QA M.L. McElroy	<i>[Signature]</i>	1-22-97	S7-07	1	/	Eng. Author Mgr. C.E. Hanson	<i>[Signature]</i>	1/22/97	S7-12
1	/	Safety J.A. Ranschau	<i>[Signature]</i>	1/22/97	S7-07	1	/	Eng. Mgr. R.E. Raymon	<i>[Signature]</i>	1/22/97	S7-12
		Env.				1	/	CPD Mgr. C.B. Bryan	<i>[Signature]</i>	1/22/97	S7-12
18. Signature of EDT Originator G.F. Vargo, Jr. 1-22-97						19. Authorized Representative Date for Receiving Organization J.S. Schofield 1-22-97					
20. Design Authority Cognizant Manager J.S. Schofield 1/22/97						21. DOE APPROVAL (if required) Ctrl. No. ☐ Approved ☐ Approved w/comments ☐ Disapproved w/comments					

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TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE OF WHITTAKER ELECTROCHEMICAL CELL

G. F. Vargo, Jr.

SGN Eurisys Services Corporation, Richland, WA 99352

U.S. Department of Energy Contract DE-AC06-87RL10930-96RL13200

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Total Pages: 204

Key Words: Whittaker, chamber, electrochemical, interlock

Abstract: This document is the test procedure to systematically test the Whittaker cells between the temperatures of -20°F and $+120^{\circ}\text{F}$. These sensors are used on the Rotary Mode Core Sampling (RMCS) flammable gas interlock (FGI), to detect and quantify hydrogen gas. This procedure supports the testing, that is being performed, after cold weather calibration attempts, on the Whittaker cell, failed.

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TEST PROCEDURE FOR MEASUREMENT OF
PERFORMANCE VS TEMPERATURE OF WHITTAKER
ELECTROCHEMICAL CELL

G. F. Vargo, Jr.

SGN Eurisys Services Corporation, Richland, WA 99352
U.S. Department of Energy Contract DE-AC06-87RL10930
January 1997

TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE OF WHITTAKER CELL

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WHITTAKER CELL**

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TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE OF WHITTAKER CELL

ACRONYMS AND ABBREVIATIONS

ETL	Engineering Testing Laboratory
T/C	Thermocouple
WEC	Whittaker Electrochemical Cell

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<p align="center">TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE OF WHITTAKER CELL</p>

1.0 PURPOSE/SCOPE

This procedure will systematically evaluate the performance versus temperature of the Whittaker electrochemical cell in accordance with HNF-SD-WM-TP-527. See Section 2.0 of this document.

This test will be performed in the 305 ETL using the environmental test chamber.

2.0 REFERENCES

- 2.1 HNF-SD-WM-TP-527, *Test Plan for Measurement of Performance vs. Temperature of Whittaker Electrochemical Cell*, Rev. 0, SGN Eurisys Services Corporation, Richland, WA 99352, January 1997.
- 2.2 WHC-SD-WM-SAD-035, *A Safety Assessment of Rotary Mode Core Sampling in Flammable Gas Single Shell Tanks*, Rev 0A, Los Alamos National Laboratory, Los Alamos, New Mexico, August 1996.

3.0 RESPONSIBILITIES

The following personnel will be required for the performance of this procedure:

- Test Director: The engineer assigned responsibility for the performance of this test.
- Test Personnel: One(1) or more engineers and/or technicians assigned to assist the Test Director during the performance of this test.

The key personnel designated to perform this test are identified in Section 3.1.1.7 of HNF-SD-WM-TP-527. See Attachment 2 of this document.

4.0 DOCUMENTATION RECORD

The appendices of this procedure shall be the document record. They are designated as follows:

- APPENDIX A: MEASUREMENT AND TEST EQUIPMENT RECORD
- APPENDIX B: DATA RECORD
- APPENDIX C: EXCEPTION RECORD
- APPENDIX D: TEST LOG RECORD
- APPENDIX E: GAS BOTTLE RECORD

These appendices designations are as defined in HNF-SD-WM-TP-527. See Attachment 2 of this document.

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<p>TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE OF WHITTAKER CELL</p>

5.0 SYSTEM DESCRIPTION

Reference Section(s) 1.0 and 2.0 of HNF-SD-WM-527. See Attachment 2 of this document.

6.0 TEST PREREQUISITES

6.1 Prior to initiation of testing, the following conditions shall be verified:

6.1.1 The job hazards analysis(JHA), for performance activities for this test is 305 ETL, has been performed and all personnel have signed the record sheet.

Verified by: G.F. Vargoh 1-25-97
(Test Director) Date

6.1.2 The information for all instruments and test equipment have been recorded in APPENDIX A.

Verified by: G.F. Vargoh 1-25-97
(Test Director) Date

6.1.3 The information for all gas bottles have been recorded in APPENDIX E.

Verified by: G.F. Vargoh 1-25-97
(Test Director) Date

6.1.4 The test apparatus has been configured, connected, and tested, according to FIGURES 1 and 2 of HNF-SD-WM-TP-527 in the environmental test chamber, the T/C readout for the chamber is operational, and the door of the chamber has been closed. See Attachment 2 of this document.

Verified by: G.F. Vargoh 1-25-97
(Test Director) Date

6.1.5 The atmospheric pressure has been verified by calling the Hanford weather service(373-2716) in the 300 area.

See Appendix C
Exception #1
G.F. Vargoh 1-25-97
See Appendix C
Exception #5
G.F. Vargoh 1-28-97

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TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE OF WHITTAKER CELL

~~ROSENBLUTH~~ READ: 14.44 PSIA

Atmospheric pressure: 14.444 PSIA 0620 1-25-97
 Reading Time Date

Verified by: H.F. Vaughn 1-25-97
 (Test Director) Date

6.2 Prior to initiation of testing, the following equipment shall be available for use:

6.2.1 Two(2) calibrated microvoltmeter(s), capable of measuring circuit voltage to .1 mV +/- .01 mV. Record in Appendix A.

Verified by: H.F. Vaughn 1-25-97
 (Test Director) Date

NOTE: The 305 ETL Hewlett Packard (HP) microvolt data acquisition system will be used as the microvoltmeter readout device capable of measuring circuit voltage to .1 mV +/- .01 mV. The calibrated microvoltmeters will be used to verify the HP voltage readings.

6.2.2 T/C readout device capable of reading Type K T/C to +/- 3.96° F. Record in Appendix A.

Verified by: H.F. Vaughn 1-25-97
 (Test Director) Date

NOTE: The 305 ETL Hewlett Packard (HP) T/C data acquisition system will be used as the readout device capable of reading Type K T/Cs to +/- 3.96° F. Furthermore, the 305 ETL Omega temperature calibrator will be used to verify the HP temperature readings.

7.0 TEMPERATURE TEST

7.1 If any step in this section cannot be successfully performed or results in an abnormal condition, then record a description of the condition in Appendix C.

7.1.1 For each discrepancy recorded, enter an identifying number in the "EXCEPTION NUMBER" column of Appendix C.

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TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE OF WHITTAKER CELL

- 7.1.2 Reproduce Appendix C as required, and attach the additional pages to this procedure, to record all discrepancies noted during testing.

WARNING: This test involves the use of bottled gas under high pressure. Operating personnel must be continuously on the alert for leaks from any gas lines, fittings, or devices. Any leaks are to be corrected immediately by appropriate action.

- 7.2 Ensure that the five(5) 3-way solenoid valves(V6,V7,V8,V9,V10) are in the de-energized ("VENT") position by opening the five(5) solenoid control switches(S1,S2,S3,S4,S5).

NOTE: When the 3-way solenoid valve(s)(V6,V7,V8,V9,V10) are DE-ENERGIZED the gas header is lined up VENT TO ATMOSPHERE(VENT) through the manual vent valve(s)(V11,V12,V13,V14,V15).

When the 3-way solenoid valve(s)(V6,V7,V8,V9,V10) are ENERGIZED the gas header is lined up to the WHITTAKER CELL(WEC).

- 7.3 Ensure that all the manual vent valves(V11,V12,V13,V14,V15) from the five(5) WECs, are in the closed position by turning each valve operator, on each valve, clockwise and by observing no gas flow on flowmeter(F1).

- 7.4 Energize the environmental test chamber and begin to heat up to 120°F. When temperature is reached and stabilized go to Step 7.5

- 7.5 Ensure power is de-energized to the +24 Vdc system power supply(PS 1) with a zero energy check using a test meter.

- 7.6 Connect a microvolt readout device(HP microvolt data acquisition system)to the output terminals terminating the (+) and (-) leads of the Whittaker cell under test. Plus(+) lead of microvoltmeter device connects to (+) lead from the cell and (-) lead of the microvolt device connects to the (-) lead of the cell.

- 7.7 Connect a microvolt readout device(HP microvolt data acquisition system) to the output terminals terminating the (+) and (-) leads of the respective 9323/10-10-11 Stahl intrinsic voltage isolating repeater, of the Whittaker cell under test. Plus(+) lead of microvoltmeter device connects to (+) lead from the barrier and (-) lead of the microvolt device connects to the (-) lead of the barrier.

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<p align="center">TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE OF WHITTAKER CELL</p>

- 7.8 Connect the T/C readout device(HP T/C data acquisition system) to the T/C attached to the Whittaker cell under test.
- 7.9 Energize the +24 Vdc power supply(PS 1) to the system. Verify live power by check with a test meter.
- 7.10 Ensure that the gas divider(G1) is selected to the 0%(100% balance gas) on the selector switch.
- 7.11 Ensure that the balance gas is on by opening the bottle stop valve(V1) and observing the bottle pressure and the header output pressure past the regulator(R1).
- 7.12 Ensure that regulated balance gas pressure is reading 20 psi. by adjustment of the regulator(R1). Clockwise(CW) rotation of the adjustment knob increases the pressure, counter clockwise(CCW) decreases the pressure.
- 7.13 Ensure that the regulated balance gas is energized to the gas divider by opening of the balance gas isolation valve(V3) operator in the CCW direction.
- 7.14 Ensure that the calibration gas is on by opening the bottle stop valve(V2) and observing the bottle pressure and the output pressure past the regulator(R2).
- 7.15 Ensure that regulated calibration gas pressure is reading between 22 and 24 psi. by adjustment of the regulator(R2). CW rotation of the adjustment knob increases the pressure, CCW decreases the pressure.
- 7.16 Ensure that the regulated calibration gas is energized to the gas divider by opening of the calibration gas isolation valve(V4) operator in the CCW direction.
- 7.17 Ensure that the 3 way solenoid valve(V6,V7,V8,V9,V10), to Wittaker cell under test, is in *venting to atmosphere*("VENT") position by opening the respective manual vent isolation valve(V11,V12,V13,V14,V15) operator, in the CCW direction, and by closing(CW), and then re-opening(CCW). When valve is closed there should be a momentary loss of flow observed on flow meter(F1). Adjust the needle flow valve(V5) for 2 cu. ft/hr flow rate and pressure +/- 2.0" W.C.(of atmospheric pressure), by using the in-line flowmeter(F1) indication and the reading from the Rosemount pressure indicating transmitter(PIT 1).
- 7.18 Purge the input gas line to atmosphere, to the Whittaker cell

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CHANGE NUMBER #3 TO HNF-SD-WM-TC-072

File:whitohg1.pro

CHANGES TO 30%, 60%, 90% TEST

NOTE: This change allows the gas header supply line, to the cell, to be charged with the specific concentration of calibration gas(30%, 60%, 90%) before allowing the gas to enter the cell. In this manner the transit time of the gas, from the gas divider to the input of the cell, is minimized.

30% TEST

After Step 7.19: Go to Step 7.29 only for 2 minutes
 Step 7.30
 Step 7.21: Purge for 2 minutes
 Step 7.19: Reset and start stopwatch
 Step 7.20
 Step 7.22: Take data

60% TEST

After Step 7.22: Go to to Step 7.27(0% calibration gas)
 Step 7.29: Purge for 2 minutes
 Step 7.30
 Step 7.23: Purge for 2 minutes
 Step 7.19: Reset and start stopwatch
 Step 7.20
 Step 7.22: Take data

90% TEST

After Step 7.22: Go to to Step 7.27(0% calibration gas)
 Step 7.29: Purge for 2 minutes
 Step 7.30
 Step 7.25: Purge for 2 minutes
 Step 7.19: Reset and start stopwatch
 Step 7.20
 Step 7.22: Take data

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**TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE OF
WHITTAKER CELL**

under test, for approximately 2 minutes(from Step 7.17).

*See Appendix C.19
Change Number #3
G.F. [unclear]
1-25-87*

- 19 After 2 minutes of purge energize the solenoid valve(V6,V7,V8,V9,V10), to the Whittaker under test, by actuation of the respective solenoid control switch(S1,S2,S3,S4,S5) to the "WEC" position.
- 7.20 Verify that the 3 way solenoid valve(V6,V7,V8,V9,V10), to the Whittaker cell under test, is energized, and gas is flowing through the cell, by closing, and then re-opening, the respective manual vent isolation valve(V11,V12,V13,V14,V15) for the Whittaker under test. There should be no interruption to gas flowing on flow meter(F1).

NOTE: The 3 way solenoid may not actuate correctly at the extreme test temperatures. If the correct flow of gas cannot be verified, for a particular step in the procedure, actuate the switch from "WEC" to "VENT" until proper flow is observed.

- 7.21 Move selector switch, on gas divider, to 30% position. Start stop watch.
- 7.22 At 2 minutes(120s), at 14 minutes and 30 seconds(870s), and at 15 minutes(900s) record the voltage output from the HP/microvoltmeter system in Appendix B. Also, record one value for the gas pressure from PT 1, the gas flow from F1, the environmental chamber temperature, and the WEC T/C temperature, from the HP, in Appendix B. Reset stop watch.
- 7.23 Move selector switch, on gas divider, to 60% position. Start stop watch.
- 7.24 Repeat Step 7.22
- 7.25 Move selector switch, on gas divider, to 90% position. Start stop watch.
- 7.26 Repeat Step 7.22
- 7.27 Ensure that the gas divider(G1) is selected to the 0%(100% balance gas) on the selector switch.
- 7.28 Purge the Whittaker cell under test for 15 minutes.

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**TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE OF
WHITTAKER CELL**

- 7.29 After 15 minutes of purge de-energize the solenoid valve(V6, V7, V8, V9, V10), to the Whittaker under test, by actuation of the respective solenoid control switch(S1,S2,S3,S4,S5) to the "VENT" position.
- 7.30 Verify that the 3 way solenoid valve(V6,V7,V8,V9,V10), to the Whittaker cell under test, is de-energized, and valve is in *venting to atmosphere* position by closing, and then re-opening, the respective manual vent isolation valve(V11,V12,V13,V14,V15) for the Whittaker under test. When the valve is closed there should be a momentary loss of flow observed on flow meter(F1).
- 7.31 Move selector switch, on gas divider, to 100% position.
- 7.32 Purge the input gas line to atmosphere, to the Whittaker cell under test, for approximately ²15 minutes.
- 7.33 After 15 minutes of purge energize the solenoid valve(V6,V7,V8,V9,V10), to the Whittaker under test, by actuation of the respective solenoid control switch(S1,S2,S3,S4,S5) to the "WEC" position.
- 7.34 Verify that the 3 way solenoid valve(V6,V7,V8,V9,V10), to the Whittaker cell under test, is energized, and gas is flowing through the cell, by closing, and then re-opening, the respective manual vent isolation valve(V11,V12,V13,V14,V15) for the Whittaker under test. There should be no interruption to gas flowing on flow meter(F1).
- 7.35 At every 15 seconds for 2 minutes(15s, 30s, 45s, 60s, 75s, 90s, 105s, 120s) and at 14 minutes and 30 seconds(870s) and at 15 minutes(900s), record the voltage output from HP/microvoltmeter system in Appendix B. Also, record one value for the gas pressure from PT 1, the gas flow from F1, the environmental chamber temperature, and the WEC T/C temperature, from the HP, in Appendix B.
- 7.36 Ensure that the gas divider(G1) is selected to the 0%(100% balance gas) on the selector switch.
- 7.37 Repeat Steps 7.28 through 7.36 two(2) more times then go to Step 7.38.
- 7.38 After 15 minutes of purge to the Whittaker cell under test, repeat Steps 7.2, 7.3.

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TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE OF WHITTAKER CELL

- 7.39 If this is the last Whittaker cell to be tested, at the same temperature, go to Step 7.40. If this is not the last Whittaker cell, to be tested, repeat Steps 7.5 through 7.38 until all Whittaker cells have been tested at the same temperature.
- 7.40 Decrease the temperature to the environmental chamber by 20°F. If this temperature IS NOT -20°F, and is stable, repeat Steps 7.5 through 7.39. If this temperature IS -20°F, and is stable, repeat Steps 7.5 through 7.39, then go to Step 7.41.
- 7.41 Testing as directed by this procedure has been completed. Any discrepancies have been listed on Appendix C.

Test Director: _____ Date: _____

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TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE
WHITTAKER CELL

8.0 APPENDIX A: MEASUREMENT AND TEST EQUIPMENT RECORD

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TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE WHITTAKER CELL
--

9.0 APPENDIX B: DATA RECORD

DATA RECORD TEST NUMBER KEY

XYZ

X: Whittaker Identification Number (WIN) 1 -5

Y: Temperature Identification Number (TIN) 1 -8

1: -20°F	5: +60°F
2: 0°F	6: +80°F
3: +20°F	7: +100°F
4: +40°F	8: +120°F

Z: Test Identification Number (TEIN) 1 -4

1: 30%, 60%, 90%
2: 1st. 100%
3: 2nd. 100%
4: 3rd. 100%

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TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE
WHITTAKER CELL

9.1 DATA RECORD SHEET 111

TEST 111 -20°F(30%, 60%, 90% CALIBRATION GAS)

	VOLTAGE @ 30% CAL. GAS			VOLTAGE @ 60% CAL. GAS			VOLTAGE @ 90% CAL. GAS			GAS PRESS	GAS FLOW	CHAMB T/C	CELL T/C	TEST DIR INIT
	T ₁ 120s	T ₂ 870s	T ₃ 900s	T ₁ 120s	T ₂ 870s	T ₃ 900s	T ₁ 120s	T ₂ 870s	T ₃ 900s					
WEC 1														
SIG 1														
WEC 2														
SIG 2														
WEC 3														
SIG 3														
WEC 4														
SIG 4														
WEC 5														
SIG 5														

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TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE
WHITTAKER CELL

9.2 DATA RECORD SHEET 112

TEST 112 0-20°F (1ST. 100% CALIBRATION RATE TEST)

	VOLTAGE										GAS PRESS	GAS FLOW	CHAM T/C	CELL T/C	TEST DIR. INIT
	T ₁ 15s	T ₂ 30s	T ₃ 45s	T ₄ 60s	T ₅ 75s	T ₆ 90s	T ₇ 105s	T ₈ 120s	T ₉ 870s	T ₁₀ 900s					
WEC 1															HNF-SD-WM-TR-274, Rev 0
SIG 1															
WEC 2															
SIG 2															
WEC 3															
SIG 3															
WEC 4															
SIG 4															
WEC 5															
SIG 5															

TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE
WHITTAKER CELL

9.3 DATA RECORD SHEET 113

TEST 113 @-20°F(2ND. 100% CALIBRATION RATE TEST)

	VOLTAGE										GAS PRESS	GAS FLOW	CHAM T/C	CELL T/C	TEST DIR. INIT
	T ₁ 15s	T ₂ 30s	T ₃ 45s	T ₄ 60s	T ₅ 75s	T ₆ 90s	T ₇ 105s	T ₈ 120s	T ₉ 870s	T ₁₀ 900s					
WEC 1															
SIG 1															
WEC 2															
SIG 2															
WEC 3															
SIG 3															
WEC 4															
SIG 4															
WEC 5															
SIG 5															

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TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE
WHITTAKER CELL

9.4 DATA RECORD SHEET 114

TEST 114 @-20°F(3RD. 100% CALIBRATION RATE TEST)

	VOLTAGE										GAS PRESS	GAS FLOW	CHAM T/C	CELL T/C	TEST DIR. INIT
	T ₁ 15s	T ₂ 30s	T ₃ 45s	T ₄ 60s	T ₅ 75s	T ₆ 90s	T ₇ 105s	T ₈ 120s	T ₉ 870s	T ₁₀ 900s					
WEC 1															HNF-SD-WM-TCP-274, Rev. 0
SIG 1															
WEC 2															
SIG 2															
WEC 3															
SIG 3															
WEC 4															
SIG 4															
WEC 5															
SIG 5															

TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE
WHITTAKER CELL

9.5 DATA RECORD SHEET 121

TEST 121 0°F(30%, 60%, 90% CALIBRATION GAS)

	VOLTAGE @ 30% CAL. GAS			VOLTAGE @ 60% CAL. GAS			VOLTAGE @ 90% CAL. GAS			GAS PRESS	GAS FLOW	CHAMB T/C	CELL T/C	TEST DIR INIT
	T ₁ 120s	T ₂ 870s	T ₃ 900s	T ₁ 120s	T ₂ 870s	T ₃ 900s	T ₁ 120s	T ₂ 870s	T ₃ 900s					
WEC 1														
SIG 1														
WEC 2														
SIG 2														
WEC 3														
SIG 3														
WEC 4														
SIG 4														
WEC 5														
SIG 5														

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TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE
WHITTAKER CELL

9.6 DATA RECORD SHEET 122

TEST 122 @0°F (1ST. 100% CALIBRATION RATE TEST)

	VOLTAGE										GAS PRESS	GAS FLOW	CHAM T/C	CELL T/C	TEST DIR. INIT
	T ₁ 15s	T ₂ 30s	T ₃ 45s	T ₄ 60s	T ₅ 75s	T ₆ 90s	T ₇ 105s	T ₈ 120s	T ₉ 870s	T ₁₀ 900s					
WEC 1															HNF-SD-WM-TR-274, Rev. 0
SIG 1															
WEC 2															
SIG 2															
WEC 3															
SIG 3															
WEC 4															
SIG 4															
WEC 5															
SIG 5															

TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE
WHITTAKER CELL

9.7 DATA RECORD SHEET 123

TEST 123 @0°F(2ND. 100% CALIBRATION RATE TEST)

	VOLTAGE										GAS PRESS	GAS FLOW	CHAM T/C	CELL T/C	TEST DIR. INIT
	T ₁ 15s	T ₂ 30s	T ₃ 45s	T ₄ 60s	T ₅ 75s	T ₆ 90s	T ₇ 105s	T ₈ 120s	T ₉ 870s	T ₁₀ 900s					
WEC 1															
SIG 1															
WEC 2															
SIG 2															
WEC 3															
SIG 3															
WEC 4															
SIG 4															
WEC 5															
SIG 5															

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TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE
WHITTAKER CELL

9.8 DATA RECORD SHEET 124

TEST 124 @0°F(3RD. 100% CALIBRATION RATE TEST)

	VOLTAGE										GAS PRESS	GAS FLOW	CHAM T/C	CELL T/C	TEST DIR. INIT
	T ₁ 15s	T ₂ 30s	T ₃ 45s	T ₄ 60s	T ₅ 75s	T ₆ 90s	T ₇ 105s	T ₈ 120s	T ₉ 870s	T ₁₀ 900s					
WEC 1															HNF-SD-WM-TRP-274, Rev. 0
SIG 1															
WEC 2															
SIG 2															
WEC 3															
SIG 3															
WEC 4															
SIG 4															
WEC 5															
SIG 5															

TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE
WHITTAKER CELL

9.9 DATA RECORD SHEET 131

TEST 131 +20°F(30%, 60%, 90% CALIBRATION GAS)

	VOLTAGE @ 30% CAL. GAS			VOLTAGE @ 60% CAL. GAS			VOLTAGE @ 90% CAL. GAS			GAS PRESS	GAS FLOW	CHAMB T/C	CELL T/C	TEST DIR INIT
	T ₁ 120s	T ₂ 870s	T ₃ 900s	T ₁ 120s	T ₂ 870s	T ₃ 900s	T ₁ 120s	T ₂ 870s	T ₃ 900s					
WEC 1														
SIG 1														
WEC 2														
SIG 2														
WEC 3														
SIG 3														
WEC 4														
SIG 4														
WEC 5														
SIG 5														

TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE
WHITTAKER CELL

9.10 DATA RECORD SHEET 132

TEST 132 @+20°F (1ST. 100% CALIBRATION RATE TEST)

	VOLTAGE										GAS PRESS	GAS FLOW	CHAM T/C	CELL T/C	TEST DIR. INIT
	T ₁ 15s	T ₂ 30s	T ₃ 45s	T ₄ 60s	T ₅ 75s	T ₆ 90s	T ₇ 105s	T ₈ 120s	T ₉ 870s	T ₁₀ 900s					
WEC 1															HNF-SD-WM-TIP-274, REV. 0
SIG 1															
WEC 2															
SIG 2															
WEC 3															
SIG 3															
WEC 4															
SIG 4															
WEC 5															
SIG 5															

TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE
WHITTAKER CELL

9.11 DATA RECORD SHEET 133

TEST 133 @+20°F(2ND. 100% CALIBRATION RATE TEST)

	VOLTAGE										GAS PRESS	GAS FLOW	CHAM T/C	CELL T/C	TEST DIR. INIT
	T ₁ 15s	T ₂ 30s	T ₃ 45s	T ₄ 60s	T ₅ 75s	T ₆ 90s	T ₇ 105s	T ₈ 120s	T ₉ 870s	T ₁₀ 900s					
WEC 1															
SIG 1															
WEC 2															
SIG 2															
WEC 3															
SIG 3															
WEC 4															
SIG 4															
WEC 5															
SIG 5															

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HNF-SD-WM-TRP-274, Rev. 0

TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE
WHITTAKER CELL

9.12 DATA RECORD SHEET 134

TEST 134 @+20°F(3RD. 100% CALIBRATION RATE TEST)

	VOLTAGE										GAS PRESS	GAS FLOW	CHAM T/C	CELL T/C	TEST DIR. INIT
	T ₁ 15s	T ₂ 30s	T ₃ 45s	T ₄ 60s	T ₅ 75s	T ₆ 90s	T ₇ 105s	T ₈ 120s	T ₉ 870s	T ₁₀ 900s					
WEC 1															HNF-SD-WM-TC-072, Rev. 0
SIG 1															
WEC 2															
SIG 2															
WEC 3															
SIG 3															
WEC 4															
SIG 4															
WEC 5															
SIG 5															

TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE
WHITTAKER CELL

9.13 DATA RECORD SHEET 141

GFVargo
1-25-97

TEST 141 +40°F(30%, 60%, 90% CALIBRATION GAS)

	VOLTAGE @ 30% CAL. GAS			VOLTAGE @ 60% CAL. GAS			VOLTAGE @ 90% CAL. GAS			GAS PRESS (PSIA)	GAS FLOW (14 FT ³ /HR)	CHAMB T/C (°F)	CELL T/C (°F)	TEST DIR INIT
	T ₁ 120s	T ₂ 870s	T ₃ 900s	T ₁ 120s	T ₂ 870s	T ₃ 900s	T ₁ 120s	T ₂ 870s	T ₃ 900s					
WEC 1	.545 mV .892 mV .555 mV .890 mV	.921 mV	.923 mV	.560 mV 1.486 mV .560 mV 1.488 mV	1.613 mV	1.616 mV	.595 mV 1.989 mV .595 mV 1.982 mV	2.167 mV	2.168 mV	14.44	2.0	40	40	GFV 1-25-97 GFV 1-25-97
SIG 1		.913 mV	.913 mV		1.607 mV	1.610 mV		2.166 mV	2.162 mV	14.44	2.0	40	40	
WEC 2														
SIG 2														
WEC 3														
SIG 3														
WEC 4														
SIG 4														
WEC 5														
SIG 5														

HP DATA FILES

WEC 141A - 30%

WEC 141B - 60%

WEC 141C - 90%

NOTES

1. UPPER PORTION OF T₁ BLOCK IS
INITIAL VALUE.

TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE
WHITTAKER CELL

9.14 DATA RECORD SHEET 142

G.F. Vangoh
1-25-97

TEST 142 @+40°F (1ST. 100% CALIBRATION RATE TEST)

	VOLTAGE										GAS PRESS (PSIA)	GAS FLOW (OO FY/HR)	CHAM T/C (°F)	CELL T/C (°F)	TEST DIR. INIT
	T ₁ 15s	T ₂ 30s	T ₃ 45s	T ₄ 60s	T ₅ 75s	T ₆ 90s	T ₇ 105s	T ₈ 120s	T ₉ 870s	T ₁₀ 900s					
WEC 1	.613mV .739mV	1.333mV	1.728mV	1.940mV	2.049mV	2.112mV	2.144mV	2.176mV	2.372mV	2.376mV	14.40	2.0	40	40	4FV 1-25-97
SIG 1	.606mV .732mV	1.328mV	1.722mV	1.933mV	2.048mV	2.108mV	2.144mV	2.172mV	2.365mV	2.376mV	14.40	2.0	40	40	4FV 1-25-97
WEC 2															HNF-SD-WM-TC-072, Rev. 0
SIG 2															
WEC 3															
SIG 3															
WEC 4															
SIG 4															
WEC 5															
SIG 5															

HP DATA FILE

WEC 1422 -1ST 100%

NOTES

1. UPPER PORTION OF T₁ BLOCK IS INITIAL VALUE.

TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE
WHITTAKER CELL

9.15 DATA RECORD SHEET 143

G.F. Vargo
1-25-97

TEST 143 @+40°F (2ND. 100% CALIBRATION RATE TEST)

VOLTAGE

	T ₁ 15s	T ₂ 30s	T ₃ 45s	T ₄ 60s	T ₅ 75s	T ₆ 90s	T ₇ 105s	T ₈ 120s	T ₉ 870s	T ₁₀ 900s	GAS PRESS (PSIA)	GAS FLOW (CU FT / HR)	CHAM T/C (°F)	CELL T/C (°F)	TEST DIR. INIT
WEC 1	1.38mV 1.343mV 1.343mV 1.343mV	1.343mV	1.761mV	1.970mV	2.079mV	2.144mV	2.180mV	2.208mV	2.404mV	2.405mV	14.41	2.0	40	40	GFV 1-25-97
SIG 1	1.343mV	1.343mV	1.761mV	1.965mV	2.077mV	2.138mV	2.175mV	2.207mV	2.398mV	2.406mV	14.41	2.0	40	40	GFV 1-25-97
WEC 2															
SIG 2															
WEC 3															
SIG 3															
WEC 4															
SIG 4															
WEC 5															
SIG 5															

HNF-SD-WM-TRF-274, REV. 0

HP DATA FILE

WEC 143-2ND 100%

NOTES

1. UPPER PORTION OF T₁ BLOCK IS INITIAL VALUE
2. PURGE TIME ON CELL 30M @ 0%

TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE
WHITTAKER CELL

9.16 DATA RECORD SHEET 144

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TEST 144 @+40°F (3RD. 100% CALIBRATION RATE TEST)

TEST 144 @+40°F (3RD, 100% CALIBRATION RATE TEST)																											
TEST DIR. INIT	CELL T/C (°C)	CHAM T/C (°C)	GAS FLOW (cu ft/hr)	GAS PRESS (PSIA)	VOLTAGE										MEC 1 15s 1.701mV 1.829mV 1.409mV	SIG 1 15s 1.700mV 1.828mV 1.406mV	MEC 2	SIG 2	MEC 3	SIG 3	MEC 4	SIG 4	MEC 5	SIG 5			
					1 ¹⁰ 900s	1 ⁸ 870s	1 ⁶ 120s	1 ⁵ 105s	1 ⁴ 90s	1 ³ 75s	1 ² 60s	1 ¹ 45s	1 ⁰ 30s	1 ⁻¹ 15s													
4FV 1-25-97	40	40	2.0	14.41	2.490mV	2.487mV	2.284mV	2.258mV	2.217mV	2.153mV	2.038mV	1.823mV	1.409mV	1.701mV 1.829mV 1.409mV	1.700mV 1.828mV 1.406mV	2.035mV	2.149mV	2.213mV	2.254mV	2.283mV	2.482mV	2.485mV	14.41	2.0	40	40	4FV 1-25-97
HMF-SD-WF-TRP-274, Rev. 0																											

HP DATA FILE
WEC 144-3RD 100%
NOTES
1. UPPER PORTION OF T. BLACK IS
INITIAL VALUE

TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE
WHITTAKER CELL

9.17 DATA RECORD SHEET 151

64V.
50°F

TEST 151 +60°F (30%, 60%, 90% CALIBRATION GAS)

	VOLTAGE @ 30% CAL. GAS			VOLTAGE @ 60% CAL. GAS			VOLTAGE @ 90% CAL. GAS			GAS PRESS	GAS FLOW	CHAMB T/C	CELL T/C	TEST DIR INIT
	T ₁ 120s	T ₂ 870s	T ₃ 900s	T ₁ 120s	T ₂ 870s	T ₃ 900s	T ₁ 120s	T ₂ 870s	T ₃ 900s					
WEC 1														
SIG 1														
WEC 2														
SIG 2														
WEC 3														
SIG 3														
WEC 4														
SIG 4														
WEC 5														
SIG 5														

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HNF-SD-WM-TRP-274, Rev. 0

TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE
WHITTAKER CELL

9.18 DATA RECORD SHEET 152

60°F G.F.V.

TEST 152 @ 60°F (1ST. 100% CALIBRATION RATE TEST)

	VOLTAGE										GAS PRESS	GAS FLOW	CHAM T/C	CELL T/C	TEST DIR. INIT
	T ₁ 15s	T ₂ 30s	T ₃ 45s	T ₄ 60s	T ₅ 75s	T ₆ 90s	T ₇ 105s	T ₈ 120s	T ₉ 870s	T ₁₀ 900s					
WEC 1															HNF-SD-WM-TRP-274, Rev. 0
SIG 1															
WEC 2															
SIG 2															
WEC 3															
SIG 3															
WEC 4															
SIG 4															
WEC 5															
SIG 5															

HP DATA FILE

WEC 1

NOTES

1. UPPER PORTION OF T₁ BLOCK IS INITIAL VALUE.

TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE
WHITTAKER CELL

9.19 DATA RECORD SHEET 153

TEST 153 @+60°F (2ND. 100% CALIBRATION RATE TEST)

	VOLTAGE										GAS PRESS	GAS FLOW	CHAM T/C	CELL T/C	TEST DIR. INIT
	T ₁ 15s	T ₂ 30s	T ₃ 45s	T ₄ 60s	T ₅ 75s	T ₆ 90s	T ₇ 105s	T ₈ 120s	T ₉ 870s	T ₁₀ 900s					
WEC 1															
SIG 1															
WEC 2															
SIG 2															
WEC 3															
SIG 3															
WEC 4															
SIG 4															
WEC 5															
SIG 5															

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HNF-SD-WM-TRP-274, Rev. 0

TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE
WHITTAKER CELL

9.20 DATA RECORD SHEET 154

TEST 154 @+60°F(3RD. 100% CALIBRATION RATE TEST)

	VOLTAGE										GAS PRESS	GAS FLOW	CHAM T/C	CELL T/C	TEST DIR. INIT
	T ₁ 15s	T ₂ 30s	T ₃ 45s	T ₄ 60s	T ₅ 75s	T ₆ 90s	T ₇ 105s	T ₈ 120s	T ₉ 870s	T ₁₀ 900s					
WEC 1															HNF-SD-WM-TC-072, Rev. 0
SIG 1															
WEC 2															
SIG 2															
WEC 3															
SIG 3															
WEC 4															
SIG 4															
WEC 5															
SIG 5															

TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE
WHITTAKER CELL

9.21 DATA RECORD SHEET 161

TEST 161 +80°F(30%, 60%, 90% CALIBRATION GAS)

	VOLTAGE @ 30% CAL. GAS			VOLTAGE @ 60% CAL. GAS			VOLTAGE @ 90% CAL. GAS			GAS PRESS	GAS FLOW	CHAMB T/C	CELL T/C	TEST DIR INIT
	T ₁ 120s	T ₂ 870s	T ₃ 900s	T ₁ 120s	T ₂ 870s	T ₃ 900s	T ₁ 120s	T ₂ 870s	T ₃ 900s					
WEC 1														
SIG 1														
WEC 2														
SIG 2														
WEC 3														
SIG 3														
WEC 4														
SIG 4														
WEC 5														
SIG 5														

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HNF-SD-WM-TRP-274, Rev. 0

TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE
WHITTAKER CELL

9.22 DATA RECORD SHEET 162

60°F
GFV
1-29-97

P

GFVargo
1-29-97

TEST 162 @+80°F (1ST. 100% CALIBRATION RATE TEST)

	VOLTAGE										GAS PRESS (PSIA)	GAS FLOW (SCFH)	CHAM T/C (°F)	CELL T/C (°F)	TEST DIR INIT
	T ₁ 15s	T ₂ 30s	T ₃ 45s	T ₄ 60s	T ₅ 75s	T ₆ 90s	T ₇ 105s	T ₈ 120s	T ₉ 870s	T ₁₀ 900s					
WEC 1	331mV	1.436mV	1.686mV	1.782mV	1.829mV	1.861mV	1.882mV	1.898mV	2.090mV	2.093mV	14.80	2	60	60	GFV 1-29-97
SIG 1	769mV	1.434mV	1.682mV	1.775mV	1.826mV	1.852mV	1.877mV	1.895mV	2.080mV	2.086mV	14.80	2	60	60	GFV 1-29-97
WEC 2	327mV														HNF-SD-WM-TRP-2/4, Rev. 0
SIG 2	768mV														
WEC 3															
SIG 3															
WEC 4															
SIG 4															Rev. 0
WEC 5															
SIG 5															

HP DATA FILE

WEC 162 - 1ST 100% @ 60°F

NOTES

1. UPPER PORTION OF T₁ BLOCK IS INITIAL VALUE

TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE
WHITTAKER CELL

9.23 DATA RECORD SHEET 163

TEST 163 @+80°F (2ND. 100% CALIBRATION RATE TEST)

VOLTAGE

	T ₁ 15s	T ₂ 30s	T ₃ 45s	T ₄ 60s	T ₅ 75s	T ₆ 90s	T ₇ 105s	T ₈ 120s	T ₉ 870s	T ₁₀ 900s	GAS PRESS	GAS FLOW	CHAM T/C	CELL T/C	TEST DIR. INIT
WEC 1															
SIG 1															
WEC 2															
SIG 2															
WEC 3															
SIG 3															
WEC 4															
SIG 4															
WEC 5															
SIG 5															

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HNF-SD-WM-TRP-274, Rev. 0

TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE
WHITTAKER CELL

9.24 DATA RECORD SHEET 164

TEST 164 @+80°F (3RD. 100% CALIBRATION RATE TEST)

	VOLTAGE										GAS PRESS	GAS FLOW	CHAM T/C	CELL T/C	TEST DIR. INIT
	T ₁ 15s	T ₂ 30s	T ₃ 45s	T ₄ 60s	T ₅ 75s	T ₆ 90s	T ₇ 105s	T ₈ 120s	T ₉ 870s	T ₁₀ 900s					
WEC 1															HNF-SD-WM-TRP-274, Rev. D
SIG 1															
WEC 2															
SIG 2															
WEC 3															
SIG 3															
WEC 4															
SIG 4															
WEC 5															
SIG 5															

TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE
WHITTAKER CELL

9.25 DATA RECORD SHEET 171

TEST 171 +100°F(30%, 60%, 90% CALIBRATION GAS)

	VOLTAGE @ 30% CAL. GAS			VOLTAGE @ 60% CAL. GAS			VOLTAGE @ 90% CAL. GAS			GAS PRESS	GAS FLOW	CHAMB T/C	CELL T/C	TEST DIR INIT
	T ₁ 120s	T ₂ 870s	T ₃ 900s	T ₁ 120s	T ₂ 870s	T ₃ 900s	T ₁ 120s	T ₂ 870s	T ₃ 900s					
WEC 1														
SIG 1														
WEC 2														
SIG 2														
WEC 3														
SIG 3														
WEC 4														
SIG 4														
WEC 5														
SIG 5														

64-1

HNF-SD-WM-TRP-274, Rev. 0

TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE
WHITTAKER CELL

9.26 DATA RECORD SHEET 172

G.F. Vargo
1-29-97

70°F G.F.V. 1-29-97
TEST 172 @ 100°F (1ST. 100% CALIBRATION RATE TEST)

	VOLTAGE										GAS PRESS (PSIA)	GAS FLOW (CC/HR)	CHAM T/C (°F)	CELL T/C (°F)	TEST DIR. INIT
	T ₁ 15s	T ₂ 30s	T ₃ 45s	T ₄ 60s	T ₅ 75s	T ₆ 90s	T ₇ 105s	T ₈ 120s	T ₉ 870s	T ₁₀ 900s					
WEC 1	286mV 922mV	1.526mV	1.689mV	1.753mV	1.785mV	1.809mV	1.824mV	1.841mV	2.027mV	2.033mV	14.75	2	70	70	G.F.V. 1-29-97
SIG 1	288mV 928mV	1.529mV	1.687mV	1.753mV	1.786mV	1.809mV	1.826mV	1.841mV	2.024mV	2.026mV	14.75	2	70	70	G.F.V. 1-29-97
WEC 2															HNF-SD-WM-TC-072, REV. 0
SIG 2															
WEC 3															
SIG 3															
WEC 4															
SIG 4															HNF-SD-WM-TC-072, REV. 0
WEC 5															
SIG 5															

HP DATA FILE

WEC 172 - 1st 100% @ 70°F

NOTES

1. UPPER PORTION OF T₁ BLOCK
IS INITIAL VALUE

TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE
WHITTAKER CELL

9.27 DATA RECORD SHEET 173

800K
HFV
1-30-97

TEST 173 @+100°F (2ND. 100% CALIBRATION RATE TEST)

VOLTAGE

	T ₁ 15s	T ₂ 30s	T ₃ 45s	T ₄ 60s	T ₅ 75s	T ₆ 90s	T ₇ 105s	T ₈ 120s	T ₉ 870s	T ₁₀ 900s	GAS PRESS (PSIA)	GAS FLOW (CFE /HR)	CHAM T/C (°F)	CELL T/C (°F)	TEST DIR. INIT
WEC 1															
SIG 1															
WEC 2															
SIG 2															
WEC 3															
SIG 3															
WEC 4															
SIG 4															
WEC 5															
SIG 5															

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HP DATA FILE

NOTES

1. UPPER PORTION OF T_i BLOCK IS
INITIAL VALUE.

HNF-SD-WM-TRP-274, Rev. 0

TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE
WHITTAKER CELL

9.28 DATA RECORD SHEET 174

TEST 174 @+100°F(3RD. 100% CALIBRATION RATE TEST)

	VOLTAGE										GAS PRESS	GAS FLOW	CHAM T/C	CELL T/C	TEST DIR. INIT
	T ₁ 15s	T ₂ 30s	T ₃ 45s	T ₄ 60s	T ₅ 75s	T ₆ 90s	T ₇ 105s	T ₈ 120s	T ₉ 870s	T ₁₀ 900s					
WEC 1															HNF-SD-WM-TP-274, Rev. D
SIG 1															
WEC 2															
SIG 2															
WEC 3															
SIG 3															
WEC 4															
SIG 4															
WEC 5															
SIG 5															

TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE
WHITTAKER CELL

9.29 DATA RECORD SHEET 181

TEST 181 +120°F(30%, 60%, 90% CALIBRATION GAS)

	VOLTAGE @ 30% CAL. GAS			VOLTAGE @ 60% CAL. GAS			VOLTAGE @ 90% CAL. GAS			GAS PRESS	GAS FLOW	CHAMB T/C	CELL T/C	TEST DIR INIT
	T ₁ 120s	T ₂ 870s	T ₃ 900s	T ₁ 120s	T ₂ 870s	T ₃ 900s	T ₁ 120s	T ₂ 870s	T ₃ 900s					
WEC 1														
SIG 1														
WEC 2														
SIG 2														
WEC 3														
SIG 3														
WEC 4														
SIG 4														
WEC 5														
SIG 5														

66-1

HNF-SD-WM-TRP-274, Rev. 0

TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE
WHITTAKER CELL

9.30 DATA RECORD SHEET 182

G.F. Vargo
1-30-97

80°F GFV
1-20-97

TEST 182 @ +120°F (1ST. 100% CALIBRATION RATE TEST)

	VOLTAGE										GAS PRESS (PSIA)	GAS FLOW (CFH) (HR)	CHAM T/C (°F)	CELL T/C (°F)	TEST DIR. INIT
	T ₁ 15s	T ₂ 30s	T ₃ 45s	T ₄ 60s	T ₅ 75s	T ₆ 90s	T ₇ 105s	T ₈ 120s	T ₉ 870s	T ₁₀ 900s					
WEC 1	1.209mV 1.972mV 1.202mV 1.973mV	1.451mV	1.560mV	1.606mV	1.633mV	1.655mV	1.669mV	1.682mV	1.873mV	1.876mV	14.59	2	80	80	GFV 1-30-97
SIG 1		1.444mV	1.558mV	1.602mV	1.625mV	1.649mV	1.664mV	1.676mV	1.867mV	1.870mV	14.59	2	80	80	GFV 1-30-97
WEC 2															HNF-SD-WM-TR-274, Rev. 0
SIG 2															
WEC 3															
SIG 3															
WEC 4															
SIG 4															
WEC 5															
SIG 5															

HP DATA FILE

WEC 182 - 1st 100% @ 80°F

NOTES

- UPPER PORTION OF T_i BLOCK IS INITIAL VALUE

TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE
WHITTAKER CELL

9.31 DATA RECORD SHEET 183

TEST 183 @+120°F (2ND. 100% CALIBRATION RATE TEST)

VOLTAGE

	T ₁ 15s	T ₂ 30s	T ₃ 45s	T ₄ 60s	T ₅ 75s	T ₆ 90s	T ₇ 105s	T ₈ 120s	T ₉ 870s	T ₁₀ 900s	GAS PRESS (PSIA)	GAS FLOW CU FT HR	CHAM T/C (°F)	CELL T/C (°F)	TEST DIR. INIT
WEC 1	1.267mV 1.082mV	1.541mV	1.662mV	1.706mV	1.735mV	1.754mV	1.770mV	1.782mV	1.964mV	1.969mV	14.56	2	80	80	
SIG 1	1.264mV 1.084mV	1.548mV	1.657mV	1.708mV	1.729mV	1.745mV	1.765mV	1.776mV	1.964mV	1.966mV	14.56	2	80	80	
WEC 2															
SIG 2															
WEC 3															
SIG 3															
WEC 4															
SIG 4															
WEC 5															
SIG 5															

HP DATA FILE

WEC 183 - 100% 2m @ 80°F

Notes

1. UPPER PORTION OF T₁ BLOCK
IS INITIAL VALUE.

TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE
WHITTAKER CELL

9.32 DATA RECORD SHEET 184

80°F 12-31-97

TEST 184 @ +120°F (3RD. 100% CALIBRATION RATE TEST)

	VOLTAGE										GAS PRESS (PSIA)	GAS FLOW Ft ³ /hr	CHAM T/C (°F)	CELL T/C (°F)	TEST DIR. INIT
	T ₁ 15s	T ₂ 30s	T ₃ 45s	T ₄ 60s	T ₅ 75s	T ₆ 90s	T ₇ 105s	T ₈ 120s	T ₉ 870s	T ₁₀ 900s					
WEC 1	.223 mV 987 mV	1.486 mV	1.597 mV	1.643 mV	1.674 mV	1.691 mV	1.707 mV	1.720 mV	1.917 mV	1.923 mV	14.51	2	80	80	
SIG 1	.213 mV 982	1.478 mV	1.590 mV	1.638 mV	1.667 mV	1.685 mV	1.705 mV	1.715 mV	1.916 mV	1.917 mV	14.51	2	80	80	
WEC 2															HNF-SD-WM-TCP-274, Rev. 0
SIG 2															
WEC 3															
SIG 3															
WEC 4															
SIG 4															
WEC 5															
SIG 5															

HP DATA FILE

WEC 184 - 100% 3rd @ 80°F

NOTES:

- Upper portion of T₁ block is the Time zero value, the lower portion is the 15 Sec value.

TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE
WHITTAKER CELL

9.33 DATA RECORD SHEET 211

TEST 211 -20°F(30%, 60%, 90% CALIBRATION GAS)

	VOLTAGE @ 30% CAL. GAS			VOLTAGE @ 60% CAL. GAS			VOLTAGE @ 90% CAL. GAS			GAS PRESS (PSIA)	GAS FLOW ft ³ /hr	CHAMB T/C °F	CELL T/C °F	TEST DIR INIT
	T ₁ 120s	T ₂ 870s	T ₃ 900s	T ₁ 120s	T ₂ 870s	T ₃ 900s	T ₁ 120s	T ₂ 870s	T ₃ 900s					
WEC 1														
SIG 1														
WEC 2	mV	mV	mV	mV	mV	mV	mV	mV	mV		2	60	60	
SIG 2	mV	mV	mV	mV	mV	mV	mV	mV	mV		2	60	60	
WEC 3														
SIG 3														
WEC 4														
SIG 4														
WEC 5														
SIG 5														

TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE
WHITTAKER CELL

9.34 DATA RECORD SHEET 212

K.S.W.

100°F

TEST 212 @ 20°F (1ST. 100% CALIBRATION RATE TEST)

	VOLTAGE										GAS PRESS (PSIA)	GAS FLOW (ft^3/HR)	CHAM T/C (°F)	CELL T/C (°F)	TEST DIR. INIT
	T ₁ 15s	T ₂ 30s	T ₃ 45s	T ₄ 60s	T ₅ 75s	T ₆ 90s	T ₇ 105s	T ₈ 120s	T ₉ 870s	T ₁₀ 900s					
WEC 1															
SIG 1															
WEC 2	140 mV 905 mV	1.260 mV	1.359 mV	1.404 mV	1.430 mV	1.448 mV	1.461 mV	1.471 mV	1.577 mV	1.579 mV	14.59	2	100	100	HNF-SD-WM-TRP-274 REV. 0
SIG 2	130 mV 901 mV	1.255 mV	1.354 mV	1.399 mV	1.424 mV	1.442 mV	1.456 mV	1.466 mV	1.574 mV	1.575 mV	14.59	2	100	100	
WEC 3															
SIG 3															
WEC 4															
SIG 4															
WEC 5															
SIG 5															

HP DATA FILE

WEC 212 - 100°F, 100% Cal - 1st Run

NOTES

- UPPER PORTION OF T₁ IS THE TIME ZERO VALUE, LOWER IS THE 15 SEC VALUE.

TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE
WHITTAKER CELL

9.35 DATA RECORD SHEET 213

TEST 213 0-20°F (2ND. 100% CALIBRATION RATE TEST)

	VOLTAGE										GAS PRESS	GAS FLOW	CHAM T/C	CELL T/C	TEST DIR. INIT
	T ₁ 15s	T ₂ 30s	T ₃ 45s	T ₄ 60s	T ₅ 75s	T ₆ 90s	T ₇ 105s	T ₈ 120s	T ₉ 870s	T ₁₀ 900s					
WEC 1															
SIG 1															
WEC 2															
SIG 2															
WEC 3															
SIG 3															
WEC 4															
SIG 4															
WEC 5															
SIG 5															

TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE
WHITTAKER CELL

9.36 DATA RECORD SHEET 214

TEST 214 @-20°F(3RD. 100% CALIBRATION RATE TEST)															
	VOLTAGE										GAS PRESS	GAS FLOW	CHAM T/C	CELL T/C	TEST DIR. INIT
	T ₁ 15s	T ₂ 30s	T ₃ 45s	T ₄ 60s	T ₅ 75s	T ₆ 90s	T ₇ 105s	T ₈ 120s	T ₉ 870s	T ₁₀ 900s					
WEC 1															HNF-SD-WM-TRP-274, Rev. 0
SIG 1															
WEC 2															
SIG 2															
WEC 3															
SIG 3															
WEC 4															
SIG 4															
WEC 5															
SIG 5															

TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE
WHITTAKER CELL

9.37 DATA RECORD SHEET 221

TEST 221 0°F(30%, 60%, 90% CALIBRATION GAS)

	VOLTAGE @ 30% CAL. GAS			VOLTAGE @ 60% CAL. GAS			VOLTAGE @ 90% CAL. GAS			GAS PRESS	GAS FLOW	CHAMB T/C	CELL T/C	TEST DIR INIT
	T ₁ 120s	T ₂ 870s	T ₃ 900s	T ₁ 120s	T ₂ 870s	T ₃ 900s	T ₁ 120s	T ₂ 870s	T ₃ 900s					
WEC 1														
SIG 1														
WEC 2														
SIG 2														
WEC 3														
SIG 3														
WEC 4														
SIG 4														
WEC 5														
SIG 5														

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TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE
WHITTAKER CELL

9.38 DATA RECORD SHEET 222

120° F ^{KSW}
2/1/97

[Signature]
2/1/97

TEST 222 00°F (1ST. 100% CALIBRATION RATE TEST)

	VOLTAGE										GAS PRESS (PSIA)	GAS FLOW (FZ/HR)	CHAM T/C (°F)	CELL T/C (°F)	TEST DIR. INIT
	T ₁ 15s	T ₂ 30s	T ₃ 45s	T ₄ 60s	T ₅ 75s	T ₆ 90s	T ₇ 105s	T ₈ 120s	T ₉ 870s	T ₁₀ 900s					
WEC 1															HNF-SD-WM-TRD-274, Rev. 0
SIG 1															
WEC 2	1.178 mV 1.132 mV	1.376 mV	1.443 mV	1.475 mV	1.494 mV	1.509 mV	1.519 mV	1.529 mV	1.625 mV	1.626 mV	14.60	2	120	120	
SIG 2	1.174 mV 1.129 mV	1.373 mV	1.439 mV	1.472 mV	1.490 mV	1.506 mV	1.515 mV	1.525 mV	1.622 mV	1.623 mV	14.60	2	120	120	
WEC 3															
SIG 3															
WEC 4															
SIG 4															
WEC 5															
SIG 5															

HP DATA FILE

WEC 222 - 1ST RUN 100% @ 120° F

NOTES

- UPPER PORTION OF T₁ IS FOR TIME ZERO VALUE, LOWER IS FOR 15 SEC VALUE

TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE
WHITTAKER CELL

9.39 DATA RECORD SHEET 223

TEST 223 @0°F (2ND. 100% CALIBRATION RATE TEST)

	VOLTAGE										GAS PRESS	GAS FLOW	CHAM T/C	CELL T/C	TEST DIR. INIT
	T ₁ 15s	T ₂ 30s	T ₃ 45s	T ₄ 60s	T ₅ 75s	T ₆ 90s	T ₇ 105s	T ₈ 120s	T ₉ 870s	T ₁₀ 900s					
WEC 1															
SIG 1															
WEC 2															
SIG 2															
WEC 3															
SIG 3															
WEC 4															
SIG 4															
WEC 5															
SIG 5															

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TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE
WHITTAKER CELL

9.40 DATA RECORD SHEET 224

TEST 224 00°F(3RD. 100% CALIBRATION RATE TEST)															
	VOLTAGE										GAS PRESS	GAS FLOW	CHAM T/C	CELL T/C	TEST DIR. INIT
	T ₁ 15s	T ₂ 30s	T ₃ 45s	T ₄ 60s	T ₅ 75s	T ₆ 90s	T ₇ 105s	T ₈ 120s	T ₉ 870s	T ₁₀ 900s					
WEC 1															
SIG 1														HNF-SD-WM-TR-27A, Rev. 0	
WEC 2															
SIG 2															
WEC 3															
SIG 3															
WEC 4															
SIG 4															
WEC 5															
SIG 5															

TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE
WHITTAKER CELL

9.41 DATA RECORD SHEET 231

TEST 231 +20°F(30%, 60%, 90% CALIBRATION GAS)

	VOLTAGE @ 30% CAL. GAS			VOLTAGE @ 60% CAL. GAS			VOLTAGE @ 90% CAL. GAS			GAS PRESS	GAS FLOW	CHAMB T/C	CELL T/C	TEST DIR INIT
	T ₁ 120s	T ₂ 870s	T ₃ 900s	T ₁ 120s	T ₂ 870s	T ₃ 900s	T ₁ 120s	T ₂ 870s	T ₃ 900s					
WEC 1														
SIG 1														
WEC 2														
SIG 2														
WEC 3														
SIG 3														
WEC 4														
SIG 4														
WEC 5														
SIG 5														

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TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE
WHITTAKER CELL

9.42 DATA RECORD SHEET 232

TEST 232 @+20°F(1ST. 100% CALIBRATION RATE TEST)															
	VOLTAGE										GAS PRESS	GAS FLOW	CHAM T/C	CELL T/C	TEST DIR. INIT
	T ₁ 15s	T ₂ 30s	T ₃ 45s	T ₄ 60s	T ₅ 75s	T ₆ 90s	T ₇ 105s	T ₈ 120s	T ₉ 870s	T ₁₀ 900s					
WEC 1														HNF-SD-WM-TRF-27A, Rev. 0	
SIG 1															
WEC 2															
SIG 2															
WEC 3															
SIG 3															
WEC 4															
SIG 4															
WEC 5															
SIG 5															

TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE
WHITTAKER CELL

9.43 DATA RECORD SHEET 233

TEST 233 @+20°F (2ND. 100% CALIBRATION RATE TEST)

	VOLTAGE										GAS PRESS	GAS FLOW	CHAM T/C	CELL T/C	TEST DIR. INIT
	T ₁ 15s	T ₂ 30s	T ₃ 45s	T ₄ 60s	T ₅ 75s	T ₆ 90s	T ₇ 105s	T ₈ 120s	T ₉ 870s	T ₁₀ 900s					
WEC 1															
SIG 1															
WEC 2															
SIG 2															
WEC 3															
SIG 3															
WEC 4															
SIG 4															
WEC 5															
SIG 5															

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TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE
WHITTAKER CELL

9.44 DATA RECORD SHEET 234

TEST 234 @+20°F (3RD. 100% CALIBRATION RATE TEST)

	VOLTAGE										GAS PRESS	GAS FLOW	CHAM T/C	CELL T/C	TEST DIR. INIT
	T ₁ 15s	T ₂ 30s	T ₃ 45s	T ₄ 60s	T ₅ 75s	T ₆ 90s	T ₇ 105s	T ₈ 120s	T ₉ 870s	T ₁₀ 900s					
WEC 1															HNF-SD-WM-TR-274, Rev. 0
SIG 1															
WEC 2															
SIG 2															
WEC 3															
SIG 3															
WEC 4															
SIG 4															
WEC 5															
SIG 5															

**TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE
WHITTAKER CELL**

9.45 DATA RECORD SHEET 241

G.F. Vargoh
1-27-97

TEST 241 +40°F(30%, 60%, 90% CALIBRATION GAS)

	VOLTAGE @ 30% CAL. GAS			VOLTAGE @ 60% CAL. GAS			VOLTAGE @ 90% CAL. GAS			GAS PRESS (PSIA)	GAS FLOW (CFE7 HK)	CHAMB T/C (°F)	CELL T/C (°F)	TEST DIR INIT
	T ₁ 120s	T ₂ 870s	T ₃ 900s	T ₁ 120s	T ₂ 870s	T ₃ 900s	T ₁ 120s	T ₂ 870s	T ₃ 900s					
WEC 1														
SIG 1														
WEC 2	.529mV .921mV	.994mV	.994mV	.525mV 1.291mV	1.425mV	1.426mV	.564mV 1.682mV	1.863mV	1.864mV	14.75	2.0	40	40	GRV 1-27-97
SIG 2	.521mV .919mV	.983mV	.985mV	.525mV 1.280mV	1.414mV	1.418mV	.577mV 1.673mV	1.855mV	1.856mV	14.75	2.0	40	40	GRV 1-27-97
WEC 3														
SIG 3														
WEC 4														
SIG 4														
WEC 5														
SIG 5														

HP DATA FILES

WEC 241A - 30%
WEC 241B - 60%
WEC 241C - 90%

NOTES

1. UPPER PORTION OF T₁ BLOCK IS INITIAL VALUE.

**TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE
WHITTAKER CELL**

9.46 DATA RECORD SHEET 242

G.F. Vargo Jr
1-27-97

TEST 242 @+40°F(1ST. 100% CALIBRATION RATE TEST)

	VOLTAGE										GAS PRESS (PSIA)	GAS FLOW (COFT /HR)	CHAM T/C (°F)	CELL T/C (°F)	TEST DIR. INIT
	T ₁ 15s	T ₂ 30s	T ₃ 45s	T ₄ 60s	T ₅ 75s	T ₆ 90s	T ₇ 105s	T ₈ 120s	T ₉ 870s	T ₁₀ 900s					
WEC 1															
SIG 1															
WEC 2	.550mV	1.019mV	1.365mV	1.584mV	1.716mV	1.798mV	1.850mV	1.891mV	2.099mV	2.098mV	14.73	2.0	40	40	GFV 1-27-97
SIG 2	.545mV	1.008mV	1.356mV	1.575mV	1.707mV	1.789mV	1.841mV	1.882mV	2.086mV	2.089mV	14.73	2.0	40	40	GFV 1-27-97
WEC 3															
SIG 3															
WEC 4															
SIG 4															
WEC 5															
SIG 5															

HNF-SD-WM-TRD-274

NOTES

1. UPPER PORTION OF T₁ BLOCK IS INITIAL VALUE.

HP DATA FILES

WEC 242 - 1st 100%

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TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE
WHITTAKER CELL

9.47 DATA RECORD SHEET 243

G.F. Vargo
1-27-97

TEST 243 @+40°F (2ND. 100% CALIBRATION RATE TEST)

	VOLTAGE										GAS PRESS (PSIA)	GAS FLOW (SCFH)	CHAM T/C (°F)	CELL T/C (°F)	TEST DIR. INIT
	T ₁ 15s	T ₂ 30s	T ₃ 45s	T ₄ 60s	T ₅ 75s	T ₆ 90s	T ₇ 105s	T ₈ 120s	T ₉ 870s	T ₁₀ 900s					
WEC 1															
SIG 1									2.117 mV	GFV					
WEC 2	.562 mV .642 mV	1.036 mV	1.378 mV	1.598 mV	1.728 mV	1.811 mV	1.865 mV	1.903 mV	2.109 mV	2.120 mV	14.73	2.0	40	40	GFV 1-27-97
SIG 2	.550 mV .634 mV	1.028 mV	1.370 mV	1.589 mV	1.719 mV	1.803 mV	1.856 mV	1.894 mV	2.119 mV	2.110 mV	14.73	2.0	40	40	GFV 1-27-97
WEC 3									2.109 mV	GFV					
SIG 3															
WEC 4															
SIG 4															
WEC 5															
SIG 5															

HP DATA FILES

WEC 243 - 2ND 100%

NOTES

1. UPPER PORTION OF T_i BLOCK IS INITIAL VALUE

TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE
WHITTAKER CELL

9.48 DATA RECORD SHEET 244

G.F. Vargo
1-27-97

TEST 244 @+40°F (3RD. 100% CALIBRATION RATE TEST)

	VOLTAGE										GAS PRESS (PSIA)	GAS FLOW (CUB FT /HR)	CHAM T/C (°F)	CELL T/C (°F)	TEST DIR. INIT
	T ₁ 15s	T ₂ 30s	T ₃ 45s	T ₄ 60s	T ₅ 75s	T ₆ 90s	T ₇ 105s	T ₈ 120s	T ₉ 870s	T ₁₀ 900s					
WEC 1															
SIG 1															
WEC 2	571mV 1.660mV	1.034mV	1.377mV	1.584mV 1.574mV	1.728mV	1.812mV	1.868mV	1.906mV	2.125mV	2.124mV	14.72	2.0	40	40	64V 1-27-97
SIG 2	561mV 1.639mV	1.026mV	1.368mV	1.584mV	1.720mV	1.803mV	1.860mV	1.897mV	2.116mV	2.115mV	14.72	2.0	40	40	64V 1-27-97
WEC 3															
SIG 3															
WEC 4															
SIG 4															
WEC 5															
SIG 5															

H.P DATA FILES

NOTES

1. UPPER PORTION OF T₁ BLOCK IS INITIAL VALUE

WEC 244 - 3RD 100%

WHITTAKER CELL

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TEST 251 +60°F (30%, 60%, 90% CALIBRATION GAS)

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TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE
WHITTAKER CELL

9.52 DATA RECORD SHEET 254

5-7019

TEST 254 @+60°F(3RD. 100% CALIBRATION RATE TEST)															
	VOLTAGE										GAS PRESS	GAS FLOW	CHAM T/C	CELL T/C	TEST DIR. INIT
	T ₁ 15s	T ₂ 30s	T ₃ 45s	T ₄ 60s	T ₅ 75s	T ₆ 90s	T ₇ 105s	T ₈ 120s	T ₉ 870s	T ₁₀ 900s					
WEC 1															HNF-SD-WM-TRP-274, Rev. 0
SIG 1															
WEC 2															
SIG 2															
WEC 3															
SIG 3															
WEC 4															
SIG 4															
WEC 5															
SIG 5															

HP DATA FILE

NOTES

1.

TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE
WHITTAKER CELL

9.53 DATA RECORD SHEET 261

John Switzer
3 Feb '97

TEST 261 +80°F (30%, 60%, 90% CALIBRATION GAS)

	VOLTAGE @ 30% CAL. GAS			VOLTAGE @ 60% CAL. GAS			VOLTAGE @ 90% CAL. GAS			GAS PRESS (PSIA)	GAS FLOW (ft ³ /hr)	CHAMB T/C (°F)	CELL T/C (°F)	TEST DIR INIT
	T ₁ 120s	T ₂ 870s	T ₃ 900s	T ₁ 120s	T ₂ 870s	T ₃ 900s	T ₁ 120s	T ₂ 870s	T ₃ 900s					
WEC 1														
SIG 1														
WEC 2	304 mV 735 mV	785 mV	785 mV	303 mV 1,189 mV	1,276 mV	1,276 mV	312 mV 1,639 mV	1,765 mV	1,767 mV	14.70	2	60	60	
SIG 2	296 mV 727 mV	777 mV	777 mV	302 mV 1,182 mV	1,268 mV	1,269 mV	301 mV 1,630 mV	1,757 mV	1,760 mV	14.70	2	60	60	
WEC 3														
SIG 3														
WEC 4														
SIG 4														
WEC 5														
SIG 5														

HNF-SD-WM-TRP-274, REV. 0

HP DATA FILE

WEC261A - 30% CAL GAS
WEC261B - 60% CAL GAS
WEC261C - 90% CAL GAS

NOTES:

- UPPER PORTION OF THE T₁ BLOCK IS THE TIME ZERO VALU, THE LOWER PORTION IS THE 120 SEC VALUE.
- THESE TESTS - 30, 60 & 90% OF 1% H₂ CAL GAS USED A 3% H₂ CAL GAS DIVIDED DOWN AS 10%, 20%, 30% RESPECTIVELY

**TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE
WHITTAKER CELL**

9.54 DATA RECORD SHEET 262

John S. White

TEST 262 @ ^{60°F} 80°F (1ST. 100% CALIBRATION RATE TEST)

	VOLTAGE										GAS PRESS (PSIA)	GAS FLOW ft ³ /hr	CHAM T/C (°F)	CELL T/C (°F)	TEST DIR. INIT
	T ₁ 15s	T ₂ 30s	T ₃ 45s	T ₄ 60s	T ₅ 75s	T ₆ 90s	T ₇ 105s	T ₈ 120s	T ₉ 870s	T ₁₀ 900s					
WEC 1															HNF-SD-WM-TRP-274, Rev. 0
SIG 1															
WEC 2	1.317 mV	1.142 mV	1.147 mV	1.547 mV	1.617 mV	1.659 mV	1.690 mV	1.710 mV	1.853 mV	1.854 mV	14.80	2	60	60	
SIG 2	1.596 mV	1.137 mV	1.411 mV	1.542 mV	1.613 mV	1.652 mV	1.683 mV	1.705 mV	1.847 mV	1.847 mV	14.80	2	60	60	
WEC 3	1.312 mV														
SIG 3	1.594 mV														
WEC 4															
SIG 4															
WEC 5															
SIG 5															

HP DATA FILE

WEC 262 1ST 100% @ 60°F

NOTES

1. UPPER PORTION OF T,
BLOCK IS TIME ZERO VALUE,
LOWER PORTION IS 15 SEC VALUE

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TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE
WHITTAKER CELL

9.55 DATA RECORD SHEET 263

TEST 263 @+80°F(2ND. 100% CALIBRATION RATE TEST)

	VOLTAGE										GAS PRESS	GAS FLOW	CHAM T/C	CELL T/C	TEST DIR. INIT
	T ₁ 15s	T ₂ 30s	T ₃ 45s	T ₄ 60s	T ₅ 75s	T ₆ 90s	T ₇ 105s	T ₈ 120s	T ₉ 870s	T ₁₀ 900s					
WEC 1															
SIG 1															
WEC 2															
SIG 2															
WEC 3															
SIG 3															
WEC 4															
SIG 4															
WEC 5															
SIG 5															

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TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE
WHITTAKER CELL

9.56 DATA RECORD SHEET 264

TEST 264 @+80°F(3RD. 100% CALIBRATION RATE TEST)															
	VOLTAGE										GAS PRESS	GAS FLOW	CHAM T/C	CELL T/C	TEST DIR. INIT
	T ₁ 15s	T ₂ 30s	T ₃ 45s	T ₄ 60s	T ₅ 75s	T ₆ 90s	T ₇ 105s	T ₈ 120s	T ₉ 870s	T ₁₀ 900s					
WEC 1														HNF-SD-WM-TNP-274, Rev. 0	
SIG 1															
WEC 2															
SIG 2															
WEC 3															
SIG 3															
WEC 4															
SIG 4															
WEC 5															
SIG 5															

TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE
WHITTAKER CELL

9.57 DATA RECORD SHEET 271

70°F ^{K_{SW}} 2/4/97

2/4/97

TEST 271 +100°F (30%, 60%, 90% CALIBRATION GAS)

	VOLTAGE @ 30% CAL. GAS			VOLTAGE @ 60% CAL. GAS			VOLTAGE @ 90% CAL. GAS			GAS PRESS	GAS FLOW	CHAMB T/C	CELL T/C	TEST DIR
	T ₁ 120s	T ₂ 870s	T ₃ 900s	T ₁ 120s	T ₂ 870s	T ₃ 900s	T ₁ 120s	T ₂ 870s	T ₃ 900s	(PSIA)	FL ³ /hr	(°F)	(°F)	INIT
WEC 1														
SIG 1														
WEC 2	.239 mV .675 mV	.715 mV	.717 mV	.243 mV 1.130 mV	1.203 mV	1.204 mV	.248 mV 1.591 mV	1.695 mV	1.695 mV	14.73	2	70	70	
SIG 2	.234 mV .671 mV	.710 mV	.711 mV	.238 mV 1.126 mV	1.198 mV	1.199 mV	.241 mV 1.536 mV	1.689 mV	1.691 mV	14.73	2	70	70	
WEC 3														
SIG 3														
WEC 4														
SIG 4														
WEC 5														
SIG 5														

HNF-SD-WM-TRP274 Rev. 0

HP DATA FILES

WEC271A - 30% Cal Gas
WEC271B - 60% Cal Gas
WEC271C - 90% Cal Gas

NOTES:

1. THE UPPER PORTION OF T₁ IS THE TIME ZERO VALUE - THE LOWER PORTION IS THE 120 SEC VALUE
2. A 30% H₂ remainder N₂ ^{K_{SW}} Cal Gas was used for these tests and was set to proper % using Gas Divider

TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE
WHITTAKER CELL

9.58 DATA RECORD SHEET 272

70°F
GFV

G.F. Vargo
1-29-97

TEST 272 @ 100°F (1ST. 100% CALIBRATION RATE TEST)

	VOLTAGE										GAS PRESS (PSIA)	GAS FLOW (COEFF FIK)	CHAM T/C (°F)	CELL T/C (°F)	TEST DIR. INIT
	T ₁ 15s	T ₂ 30s	T ₃ 45s	T ₄ 60s	T ₅ 75s	T ₆ 90s	T ₇ 105s	T ₈ 120s	T ₉ 870s	T ₁₀ 900s					
WEC 1															
SIG 1															
WEC 2	.245mV .687mV	1.216mV	1.428mV	1.520mV	1.572mV	1.602mV	1.627mV	1.641mV	1.764mV	1.764mV	14.74	2	70	70	GFV 1-29-97
SIG 2	.239mV .684mV	1.210mV	1.424mV	1.515mV	1.567mV	1.596mV	1.622mV	1.635mV	1.759mV	1.760mV	14.74	2	70	70	GFV 1-29-97
WEC 3															
SIG 3															
WEC 4															
SIG 4															
WEC 5															
SIG 5															

HP DATA FILE

WEC 272 - 1ST 100% @ 70°F

NOTES

1. UPPER PORTION OF T₁ BLOCK IS INITIAL VALUE

Rev. 0

TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE
WHITTAKER CELL

9.59 DATA RECORD SHEET 273

TEST 273 @+100°F (2ND. 100% CALIBRATION RATE TEST)

	VOLTAGE										GAS PRESS	GAS FLOW	CHAM T/C	CELL T/C	TEST DIR. INIT
	T ₁ 15s	T ₂ 30s	T ₃ 45s	T ₄ 60s	T ₅ 75s	T ₆ 90s	T ₇ 105s	T ₈ 120s	T ₉ 870s	T ₁₀ 900s					
WEC 1															
SIG 1															
WEC 2															
SIG 2															
WEC 3															
SIG 3															
WEC 4															
SIG 4															
WEC 5															
SIG 5															

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TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE
WHITTAKER CELL

9.60 DATA RECORD SHEET 274

TEST 274 @+100°F (3RD. 100% CALIBRATION RATE TEST)

	VOLTAGE										GAS PRESS	GAS FLOW	CHAM T/C	CELL T/C	TEST DIR. INIT
	T ₁ 15s	T ₂ 30s	T ₃ 45s	T ₄ 60s	T ₅ 75s	T ₆ 90s	T ₇ 105s	T ₈ 120s	T ₉ 870s	T ₁₀ 900s					
WEC 1															HNF-SD-WM-TRP-274, Rev. 0
SIG 1															
WEC 2															
SIG 2															
WEC 3															
SIG 3															
WEC 4															
SIG 4															
WEC 5															
SIG 5															

TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE
WHITTAKER CELL

9.61 DATA RECORD SHEET 281

TEST 281 +120°F(30%, 60%, 90% CALIBRATION GAS)

	VOLTAGE @ 30% CAL. GAS			VOLTAGE @ 60% CAL. GAS			VOLTAGE @ 90% CAL. GAS			GAS PRESS	GAS FLOW	CHAMB T/C	CELL T/C	TEST DIR INIT
	T ₁ 120s	T ₂ 870s	T ₃ 900s	T ₁ 120s	T ₂ 870s	T ₃ 900s	T ₁ 120s	T ₂ 870s	T ₃ 900s					
WEC 1														
SIG 1														
WEC 2														
SIG 2														
WEC 3														
SIG 3														
WEC 4														
SIG 4														
WEC 5														
SIG 5														

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TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE
WHITTAKER CELL

9.62 DATA RECORD SHEET 282

80°F
250/1/1/97

2/1/97

TEST 282 @ 120°F (1ST. 100% CALIBRATION RATE TEST)

	VOLTAGE										GAS PRESS (PSIA)	GAS FLOW (ft^3/min)	CHAM T/C (°F)	CELL T/C (°F)	TEST DIR. INIT
	T ₁ 15s	T ₂ 30s	T ₃ 45s	T ₄ 60s	T ₅ 75s	T ₆ 90s	T ₇ 105s	T ₈ 120s	T ₉ 870s	T ₁₀ 900s					
WEC 1															
SIG 1															
WEC 2	1.93 mV 1.717 mV	1.211 mV	1.379 mV	1.451 mV	1.492 mV	1.519 mV	1.536 mV	1.552 mV	1.656 mV	1.657 mV	14.58	2	80	80	HNF-SD-WM-TRP-274, Rev. 0
SIG 2	1.90 mV 1.717 mV	1.208 mV	1.376 mV	1.448 mV	1.488 mV	1.515 mV	1.531 mV	1.546 mV	1.652 mV	1.653 mV	14.58	2	80	80	
WEC 3															
SIG 3															
WEC 4															
SIG 4															
WEC 5															
SIG 5															

HP DATA FILE

WEC 282 - 1ST 100% @ 80°F

NOTES

- UPPER PORTION OF T₁ BLOCK IS INITIAL VALUE, LOWER PORTION IS 15 SEC VALUE.

TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE
WHITTAKER CELL

9.63 DATA RECORD SHEET 283

TEST 283 @+120°F(2ND. 100% CALIBRATION RATE TEST)

	VOLTAGE										GAS PRESS	GAS FLOW	CHAM T/C	CELL T/C	TEST DIR. INIT
	T ₁ 15s	T ₂ 30s	T ₃ 45s	T ₄ 60s	T ₅ 75s	T ₆ 90s	T ₇ 105s	T ₈ 120s	T ₉ 870s	T ₁₀ 900s					
WEC 1															
SIG 1															
WEC 2															
SIG 2															
WEC 3															
SIG 3															
WEC 4															
SIG 4															
WEC 5															
SIG 5															

HNF-SD-WM-TRP-274, Rev. 0

TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE
WHITTAKER CELL

9.64 DATA RECORD SHEET 284

TEST 284 @+120°F(3RD. 100% CALIBRATION RATE TEST)

	VOLTAGE										GAS PRESS	GAS FLOW	CHAM T/C	CELL T/C	TEST DIR. INIT
	T ₁ 15s	T ₂ 30s	T ₃ 45s	T ₄ 60s	T ₅ 75s	T ₆ 90s	T ₇ 105s	T ₈ 120s	T ₉ 870s	T ₁₀ 900s					
WEC 1															HNF-SD-WM-TRR-274, Rev. 0
SIG 1															
WEC 2															
SIG 2															
WEC 3															
SIG 3															
WEC 4															
SIG 4															
WEC 5															
SIG 5															

TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE
WHITTAKER CELL

9.65 DATA RECORD SHEET 311

TEST 311 -20°F(30%, 60%, 90% CALIBRATION GAS)

	VOLTAGE @ 30% CAL. GAS			VOLTAGE @ 60% CAL. GAS			VOLTAGE @ 90% CAL. GAS			GAS PRESS	GAS FLOW	CHAMB T/C	CELL T/C	TEST DIR INIT
	T ₁ 120s	T ₂ 870s	T ₃ 900s	T ₁ 120s	T ₂ 870s	T ₃ 900s	T ₁ 120s	T ₂ 870s	T ₃ 900s					
WEC 1														
SIG 1														
WEC 2														
SIG 2														
WEC 3														
SIG 3														
WEC 4														
SIG 4														
WEC 5														
SIG 5														

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TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE
WHITTAKER CELL

9.66 DATA RECORD SHEET 312

TEST 312 0-20°F (1ST. 100% CALIBRATION RATE TEST)

	VOLTAGE										GAS PRESS	GAS FLOW	CHAM T/C	CELL T/C	TEST DIR. INIT
	T ₁ 15s	T ₂ 30s	T ₃ 45s	T ₄ 60s	T ₅ 75s	T ₆ 90s	T ₇ 105s	T ₈ 120s	T ₉ 870s	T ₁₀ 900s					
WEC 1															HNF-SD-WM-TIRP-274, Rev. 0
SIG 1															
WEC 2															
SIG 2															
WEC 3															
SIG 3															
WEC 4															
SIG 4															
WEC 5															
SIG 5															

TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE
WHITTAKER CELL

9.67 DATA RECORD SHEET 313

TEST 313 @-20°F(2ND. 100% CALIBRATION RATE TEST)

	VOLTAGE										GAS PRESS	GAS FLOW	CHAM T/C	CELL T/C	TEST DIR. INIT
	T ₁ 15s	T ₂ 30s	T ₃ 45s	T ₄ 60s	T ₅ 75s	T ₆ 90s	T ₇ 105s	T ₈ 120s	T ₉ 870s	T ₁₀ 900s					
WEC 1															
SIG 1															
WEC 2															
SIG 2															
WEC 3															
SIG 3															
WEC 4															
SIG 4															
WEC 5															
SIG 5															

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TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE
WHITTAKER CELL

9.68 DATA RECORD SHEET 314

TEST 314 @-20°F(3RD. 100% CALIBRATION RATE TEST)															
	VOLTAGE										GAS PRESS	GAS FLOW	CHAM T/C	CELL T/C	TEST DIR. INIT
	T ₁ 15s	T ₂ 30s	T ₃ 45s	T ₄ 60s	T ₅ 75s	T ₆ 90s	T ₇ 105s	T ₈ 120s	T ₉ 870s	T ₁₀ 900s					
WEC 1															
SIG 1														HNF-SD-WM-TRP-274, Rev. 0	
WEC 2															
SIG 2															
WEC 3															
SIG 3															
WEC 4															
SIG 4															
WEC 5															
SIG 5															

TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE
WHITTAKER CELL

9.69 DATA RECORD SHEET 321

TEST 321 0°F(30%, 60%, 90% CALIBRATION GAS)

	VOLTAGE @ 30% CAL. GAS			VOLTAGE @ 60% CAL. GAS			VOLTAGE @ 90% CAL. GAS			GAS PRESS	GAS FLOW	CHAMB T/C	CELL T/C	TEST DIR INIT
	T ₁ 120s	T ₂ 870s	T ₃ 900s	T ₁ 120s	T ₂ 870s	T ₃ 900s	T ₁ 120s	T ₂ 870s	T ₃ 900s					
WEC 1														
SIG 1														
WEC 2														
SIG 2														
WEC 3														
SIG 3														
WEC 4														
SIG 4														
WEC 5														
SIG 5														

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TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE
WHITTAKER CELL

9.70 DATA RECORD SHEET 322

TEST 322 00°F(1ST. 100% CALIBRATION RATE TEST)															
	VOLTAGE										GAS PRESS	GAS FLOW	CHAM T/C	CELL T/C	TEST DIR. INIT
	T ₁ 15s	T ₂ 30s	T ₃ 45s	T ₄ 60s	T ₅ 75s	T ₆ 90s	T ₇ 105s	T ₈ 120s	T ₉ 870s	T ₁₀ 900s					
WEC 1															HNF-SD-WM-TRP-274, Rev. 0
SIG 1															
WEC 2															
SIG 2															
WEC 3															
SIG 3															
WEC 4															
SIG 4															
WEC 5															
SIG 5															

TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE
WHITTAKER CELL

9.71 DATA RECORD SHEET 323

TEST 323 @0°F (2ND. 100% CALIBRATION RATE TEST)

	VOLTAGE										GAS PRESS	GAS FLOW	CHAM T/C	CELL T/C	TEST DIR. INIT
	T ₁ 15s	T ₂ 30s	T ₃ 45s	T ₄ 60s	T ₅ 75s	T ₆ 90s	T ₇ 105s	T ₈ 120s	T ₉ 870s	T ₁₀ 900s					
WEC 1															
SIG 1															
WEC 2															
SIG 2															
WEC 3															
SIG 3															
WEC 4															
SIG 4															
WEC 5															
SIG 5															

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TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE
WHITTAKER CELL

9.72 DATA RECORD SHEET 324

TEST 324 @0°F(3RD. 100% CALIBRATION RATE TEST)															
	VOLTAGE										GAS PRESS	GAS FLOW	CHAM T/C	CELL T/C	TEST DIR. INIT
	T ₁ 15s	T ₂ 30s	T ₃ 45s	T ₄ 60s	T ₅ 75s	T ₆ 90s	T ₇ 105s	T ₈ 120s	T ₉ 870s	T ₁₀ 900s					
WEC 1															HNF-SD-WM-TRP-274, Rev. 0
SIG 1															
WEC 2															
SIG 2															
WEC 3															
SIG 3															
WEC 4															
SIG 4															
WEC 5															
SIG 5															

TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE
WHITTAKER CELL

9.73 DATA RECORD SHEET 331

TEST 331 +20°F(30%, 60%, 90% CALIBRATION GAS)

	VOLTAGE @ 30% CAL. GAS			VOLTAGE @ 60% CAL. GAS			VOLTAGE @ 90% CAL. GAS			GAS PRESS	GAS FLOW	CHAMB T/C	CELL T/C	TEST DIR INIT
	T ₁ 120s	T ₂ 870s	T ₃ 900s	T ₁ 120s	T ₂ 870s	T ₃ 900s	T ₁ 120s	T ₂ 870s	T ₃ 900s					
WEC 1														
SIG 1														
WEC 2														
SIG 2														
WEC 3														
SIG 3														
WEC 4														
SIG 4														
WEC 5														
SIG 5														

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TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE
WHITTAKER CELL

9.74 DATA RECORD SHEET 332

TEST 332 @+20°F (1ST. 100% CALIBRATION RATE TEST)

	VOLTAGE										GAS PRESS	GAS FLOW	CHAM T/C	CELL T/C	TEST DIR. INIT
	T ₁ 15s	T ₂ 30s	T ₃ 45s	T ₄ 60s	T ₅ 75s	T ₆ 90s	T ₇ 105s	T ₈ 120s	T ₉ 870s	T ₁₀ 900s					
WEC 1															HNF-SD-WM-TRP-274, REV. 0
SIG 1															
WEC 2															
SIG 2															
WEC 3															
SIG 3															
WEC 4															
SIG 4															
WEC 5															
SIG 5															

TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE
WHITTAKER CELL

9.75 DATA RECORD SHEET 333

TEST 333 @+20°F (2ND. 100% CALIBRATION RATE TEST)

	VOLTAGE										GAS PRESS	GAS FLOW	CHAM T/C	CELL T/C	TEST DIR. INIT
	T ₁ 15s	T ₂ 30s	T ₃ 45s	T ₄ 60s	T ₅ 75s	T ₆ 90s	T ₇ 105s	T ₈ 120s	T ₉ 870s	T ₁₀ 900s					
WEC 1															
SIG 1															
WEC 2															
SIG 2															
WEC 3															
SIG 3															
WEC 4															
SIG 4															
WEC 5															
SIG 5															

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TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE
WHITTAKER CELL

9.76 DATA RECORD SHEET 334

TEST 334 @+20°F (3RD. 100% CALIBRATION RATE TEST)

VOLTAGE

T₁ 15s T₂ 30s T₃ 45s T₄ 60s T₅ 75s T₆ 90s T₇ 105s T₈ 120s T₉ 870s T₁₀ 900s

GAS PRESS

GAS FLOW

CHAM T/C

CELL T/C

TEST DIR. INIT

MEC 1 SIG 1 MEC 2 SIG 2 MEC 3 SIG 3 MEC 4 SIG 4 MEC 5 SIG 5

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TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE
WHITTAKER CELL

9.77 DATA RECORD SHEET 341

G.F. Vargo
1-27-98

TEST 341 +40°F (30%, 60%, 90% CALIBRATION GAS)

	VOLTAGE @ 30% CAL. GAS			VOLTAGE @ 60% CAL. GAS			VOLTAGE @ 90% CAL. GAS			GAS PRESS (PSIA)	GAS FLOW (WFT /HR)	CHAMB T/C (°F)	CELL T/C (°F)	TEST DIR INIT
	T ₁ 120s	T ₂ 870s	T ₃ 900s	T ₁ 120s	T ₂ 870s	T ₃ 900s	T ₁ 120s	T ₂ 870s	T ₃ 900s					
WEC 1														
SIG 1														
WEC 2														
SIG 2														
WEC 3	.543mV .889mV	.984mV	.985mV	.550mV 1.245mV	1.431mV	1.433mV	.558mV 1.617mV	1.885mV	1.888mV	14.71	2	40	40	GFV 1-27-97
SIG 3	.533mV .879mV	.975mV	.972mV	.536mV 1.234mV	1.422mV	1.420	.549mV 1.606mV	1.876mV	1.877mV	14.71	2	40	40	GFV 1-27-97
WEC 4														
SIG 4														
WEC 5														
SIG 5														

HP DATA FILES

WEC 341A - 30%
WEC 341B - 60%
WEC 341C - 90%

NOTES

1. UPPER PORTION OF T₁ BLOCK IS INITIAL VALUE

TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE
WHITTAKER CELL

9.78 DATA RECORD SHEET 342

G.F. Vargo
1-27-97

TEST 342 @+40°F (1ST. 100% CALIBRATION RATE TEST)

	VOLTAGE										GAS PRESS (PSIA)	GAS FLOW (CUFT /HR)	CHAM T/C (°F)	CELL T/C (°F)	TEST DIR. INIT
	T ₁ 15s	T ₂ 30s	T ₃ 45s	T ₄ 60s	T ₅ 75s	T ₆ 90s	T ₇ 105s	T ₈ 120s	T ₉ 870s	T ₁₀ 900s					
WEC 1															
SIG 1															
WEC 2															
SIG 2															
WEC 3	.561mV .608mV	.854mV	1.128mV	1.341mV	1.444mV	1.605mV	1.685mV	1.744mV	2.042mV	2.044mV	14.71	2	40	40	GRV 1-27-97
SIG 3	.556mV .596mV	.843mV	1.118mV	1.333mV	1.483mV	1.591mV	1.674mV	1.731mV	2.033mV	2.033mV	14.71	2	40	40	GRV 1-27-97
WEC 4															
SIG 4															
WEC 5															
SIG 5															

HP DATA FILES

WEC 342 - 1ST 100%

NOTES

1. UPPER PORTION OF T₁ BLOCK IS INITIAL VALUE.

TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE
WHITTAKER CELL

9.79 DATA RECORD SHEET 343

G.F. Vargo
1-27-90

TEST 343 @ +40°F (2ND. 100% CALIBRATION RATE TEST)

	VOLTAGE										GAS PRESS (PSIA)	GAS FLOW (CC/ET HR)	CHAM T/C (°F)	CELL T/C (°F)	TEST DIR. INIT
	T ₁ 15s	T ₂ 30s	T ₃ 45s	T ₄ 60s	T ₅ 75s	T ₆ 90s	T ₇ 105s	T ₈ 120s	T ₉ 870s	T ₁₀ 900s					
WEC 1															
SIG 1															
WEC 2															
SIG 2															
WEC 3	568mV 612mV	858mV	1.133mV	1.343mV	1.497mV	1.603mV	1.685mV	1.742mV	2.044mV	2.098mV	14.7	2	40	40	GRV 1-27-97
SIG 3	558mV 601mV	849mV	1.121mV	1.334mV	1.487mV	1.593mV	1.674mV	1.734mV	2.033mV	2.097mV	14.7	2	40	40	GRV 1-27-97
WEC 4															
SIG 4															
WEC 5															
SIG 5															

HP DATA FILES

WEC 343 - 2ND 100%

NOTES

1. UPPER PORTION OF T₁ BLOCK IS INITIAL VALUE

WEC 344 - 3rd 100%

HP DATA FILES

NOTES

1. Upper portion of T block is initial value.

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[illegible]

9.80 DATA RECORD SHEET 344

TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE
WHITTAKER CELL

WHITTAKER CELL

GT Vascoz
1-27-97

TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE
WHITTAKER CELL

9.81 DATA RECORD SHEET 351

TEST 351 +60°F(30%, 60%, 90% CALIBRATION GAS)

	VOLTAGE @ 30% CAL. GAS			VOLTAGE @ 60% CAL. GAS			VOLTAGE @ 90% CAL. GAS			GAS PRESS	GAS FLOW	CHAMB T/C	CELL T/C	TEST DIR INIT
	T ₁ 120s	T ₂ 870s	T ₃ 900s	T ₁ 120s	T ₂ 870s	T ₃ 900s	T ₁ 120s	T ₂ 870s	T ₃ 900s					
WEC 1														
SIG 1														
WEC 2														
SIG 2														
WEC 3														
SIG 3														
WEC 4														
SIG 4														
WEC 5														
SIG 5														

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TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE
WHITTAKER CELL

9.82 DATA RECORD SHEET 352

TEST 352 @+60°F(1ST. 100% CALIBRATION RATE TEST)															
	VOLTAGE										GAS PRESS	GAS FLOW	CHAM T/C	CELL T/C	TEST DIR. INIT
	T ₁ 15s	T ₂ 30s	T ₃ 45s	T ₄ 60s	T ₅ 75s	T ₆ 90s	T ₇ 105s	T ₈ 120s	T ₉ 870s	T ₁₀ 900s					
WEC 1															HNF-SD-WM-TRP-274, Rev. D
SIG 1															
WEC 2															
SIG 2															
WEC 3															
SIG 3															
WEC 4															
SIG 4															
WEC 5															
SIG 5															

TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE
WHITTAKER CELL

9.83 DATA RECORD SHEET 353

TEST 353 @+60°F(2ND. 100% CALIBRATION RATE TEST)

	VOLTAGE										GAS PRESS	GAS FLOW	CHAM T/C	CELL T/C	TEST DIR. INIT
	T ₁ 15s	T ₂ 30s	T ₃ 45s	T ₄ 60s	T ₅ 75s	T ₆ 90s	T ₇ 105s	T ₈ 120s	T ₉ 870s	T ₁₀ 900s					
WEC 1															
SIG 1															
WEC 2															
SIG 2															
WEC 3															
SIG 3															
WEC 4															
SIG 4															
WEC 5															
SIG 5															

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HNF-SD-WM-TRP-274, Rev. 0

TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE
WHITTAKER CELL

9.84 DATA RECORD SHEET 354

TEST 354 @+60°F (3RD. 100% CALIBRATION RATE TEST)

	VOLTAGE										GAS PRESS	GAS FLOW	CHAM T/C	CELL T/C	TEST DIR. INIT
	T ₁ 15s	T ₂ 30s	T ₃ 45s	T ₄ 60s	T ₅ 75s	T ₆ 90s	T ₇ 105s	T ₈ 120s	T ₉ 870s	T ₁₀ 900s					
WEC 1															HNF-SD-WM-TRP-274, Rev. 0
SIG 1															
WEC 2															
SIG 2															
WEC 3															
SIG 3															
WEC 4															
SIG 4															
WEC 5															
SIG 5															

TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS. TEMPERATURE
WHITTAKER CELL

9.85 DATA RECORD SHEET 361

TEST 361 +80°F(30%, 60%, 90% CALIBRATION GAS)

	VOLTAGE @ 30% CAL. GAS			VOLTAGE @ 60% CAL. GAS			VOLTAGE @ 90% CAL. GAS			GAS PRESS	GAS FLOW	CHAMB T/C	CELL T/C	TEST DIR INIT
	T ₁ 120s	T ₂ 870s	T ₃ 900s	T ₁ 120s	T ₂ 870s	T ₃ 900s	T ₁ 120s	T ₂ 870s	T ₃ 900s					
WEC 1														
SIG 1														
WEC 2														
SIG 2														
WEC 3														
SIG 3														
WEC 4														
SIG 4														
WEC 5														
SIG 5														

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TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE
WHITTAKER CELL

9.86 DATA RECORD SHEET 362

G.F. Vargo
1-29-97

60°F GFV 1-29-97 F

TEST 362 @ 80°F (1ST. 100% CALIBRATION RATE TEST)

	VOLTAGE										GAS PRESS (PSIA)	GAS FLOW (SCFH)	CHAM T/C (°F)	CELL T/C (°F)	TEST DIR. INIT
	T ₁ 15s	T ₂ 30s	T ₃ 45s	T ₄ 60s	T ₅ 75s	T ₆ 90s	T ₇ 105s	T ₈ 120s	T ₉ 870s	T ₁₀ 900s					
WEC 1															
SIG 1															
WEC 2															
SIG 2															
WEC 3	308mV	.884mV	1.158mV	1.319mV	1.418mV	1.482mV	1.527mV	1.558mV	1.738mV	1.739mV	14.80	2	60	60	GFV 1-29-97
SIG 3	291mV	.877mV	1.151mV	1.314mV	1.409mV	1.471mV	1.520mV	1.548mV	1.728mV	1.730mV	14.80	2	60	60	GFV 1-29-97
WEC 4															
SIG 4															
WEC 5															
SIG 5															

HP DATA FILE

WEC 362 - 1st 100% @ 60°F

NOTES

1. UPPER PORTION OF T₁ BLOCK IS INITIAL VALUE.

HNF-SD-WM-TRP-274, Rev. 0

TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE
WHITTAKER CELL

9.87 DATA RECORD SHEET 363

G.F. Vargo
1-29-97

65°F
GFV
1-29-97

1ST GFV
1-29-97

TEST 363 @ +80°F (2ND. 100% CALIBRATION RATE TEST)

	VOLTAGE										GAS PRESS (PSIA)	GAS FLOW (SCFH) HE GFV 1-29-97	CHAM T/C (°F)	CELL T/C (°F)	TEST DIR. INIT
	T ₁ 15s	T ₂ 30s	T ₃ 45s	T ₄ 60s	T ₅ 75s	T ₆ 90s	T ₇ 105s	T ₈ 120s	T ₉ 870s	T ₁₀ 900s					
WEC 1															
SIG 1															
WEC 2															
SIG 2															
WEC 3	269mV	.920mV	1.178mV	1.323mV	1.408mV	1.464mV	1.500mV	1.528mV	1.696mV	1.700mV	14.80	2	65	65	GFV 1-29-97
SIG 3	262mV	.912mV	1.169mV	1.314mV	1.397mV	1.453mV	1.490mV	1.521mV	1.687mV	1.691mV	14.80	2	65	65	GFV 1-29-97
WEC 4															
SIG 4															
WEC 5															
SIG 5															

HP DATA FILE

WEC 363 - 2ND 100% @ 65°F
1ST
GFV
1-29-97

Notes

1. UPPER PORTION OF T₁ BLOCK IS INITIAL VALUE.

HP DATA FILE

WEL 364 - 200/100% @ 65%

Notes

1. UPPER PORTION OF T. BLOCK IS INITIAL VALUE

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[illegible]

9.88 DATA RECORD SHEET 364

TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE
WHITTAKER CELL

WHITTAKER CELL

TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE
WHITTAKER CELL

9.89 DATA RECORD SHEET 371

TEST 371 +100°F (30%, 60%, 90% CALIBRATION GAS)

	VOLTAGE @ 30% CAL. GAS			VOLTAGE @ 60% CAL. GAS			VOLTAGE @ 90% CAL. GAS			GAS PRESS	GAS FLOW	CHAMB T/C	CELL T/C	TEST DIR INIT
	T ₁ 120s	T ₂ 870s	T ₃ 900s	T ₁ 120s	T ₂ 870s	T ₃ 900s	T ₁ 120s	T ₂ 870s	T ₃ 900s					
WEC 1														
SIG 1														
WEC 2														
SIG 2														
WEC 3														
SIG 3														
WEC 4														
SIG 4														
WEC 5														
SIG 5														

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TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE
WHITTAKER CELL

9.90 DATA RECORD SHEET 372

G.T. Vargo
1-29-90

70°F
GFV
1-29-90

TEST 372 @ +100°F (1ST. 100% CALIBRATION RATE TEST)

	VOLTAGE										GAS PRESS (PSIA)	GAS FLOW (CUB FT /HR)	CHAM T/C (°C)	CELL T/C (°F)	TEST DIR. INIT
	T ₁ 15s	T ₂ 30s	T ₃ 45s	T ₄ 60s	T ₅ 75s	T ₆ 90s	T ₇ 105s	T ₈ 120s	T ₉ 870s	T ₁₀ 900s					
WEC 1															
SIG 1															
WEC 2															
SIG 2															
WEC 3	1.242mV 1.520mV	.987mV	1.240mV	1.376mV	1.456mV	1.505mV	1.540mV	1.563mV	1.718mV	1.718mV	14.76	2	70	70	GFV 1-29-90
SIG 3	1.233mV 1.514mV	.980mV	1.233mV	1.367mV	1.449mV	1.498mV	1.530mV	1.557mV	1.708mV	1.708mV	14.76	2	70	70	GFV 1-27-90
WEC 4															
SIG 4															
WEC 5															
SIG 5															

HNF-SD-WM-TRP-274, Rev. 0

HP DATA FILE

WEC 372 - (1ST 100%) @ 70°F

NOTE

1. UPPER PORTION OF T₁ BLOCK IS
INITIAL VALUE.

TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE
WHITTAKER CELL

9.91 DATA RECORD SHEET 373

TEST 373 @+100°F(2ND. 100% CALIBRATION RATE TEST)

	VOLTAGE										GAS PRESS	GAS FLOW	CHAM T/C	CELL T/C	TEST DIR. INIT
	T ₁ 15s	T ₂ 30s	T ₃ 45s	T ₄ 60s	T ₅ 75s	T ₆ 90s	T ₇ 105s	T ₈ 120s	T ₉ 870s	T ₁₀ 900s					
WEC 1															
SIG 1															
WEC 2															
SIG 2															
WEC 3															
SIG 3															
WEC 4															
SIG 4															
WEC 5															
SIG 5															

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TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE
WHITTAKER CELL

9.92 DATA RECORD SHEET 374

TEST 374 @+100°F (3RD. 100% CALIBRATION RATE TEST)

	VOLTAGE										GAS PRESS	GAS FLOW	CHAM T/C	CELL T/C	TEST DIR. INIT
	T ₁ 15s	T ₂ 30s	T ₃ 45s	T ₄ 60s	T ₅ 75s	T ₆ 90s	T ₇ 105s	T ₈ 120s	T ₉ 870s	T ₁₀ 900s					
WEC 1															HNF-SD-WM-TR-27A, Rev. 0
SIG 1															
WEC 2															
SIG 2															
WEC 3															
SIG 3															
WEC 4															
SIG 4															
WEC 5															
SIG 5															

TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE
WHITTAKER CELL

9.93 DATA RECORD SHEET 381

TEST 381 +120°F(30%, 60%, 90% CALIBRATION GAS)

	VOLTAGE @ 30% CAL. GAS			VOLTAGE @ 60% CAL. GAS			VOLTAGE @ 90% CAL. GAS			GAS PRESS	GAS FLOW	CHAMB T/C	CELL T/C	TEST DIR INIT
	T ₁ 120s	T ₂ 870s	T ₃ 900s	T ₁ 120s	T ₂ 870s	T ₃ 900s	T ₁ 120s	T ₂ 870s	T ₃ 900s					
WEC 1														
SIG 1														
WEC 2														
SIG 2														
WEC 3														
SIG 3														
WEC 4														
SIG 4														
WEC 5														
SIG 5														

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TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE
WHITTAKER CELL

9.94 DATA RECORD SHEET 382

TEST 382 0+120°F (1ST. 100% CALIBRATION RATE TEST)

	VOLTAGE										GAS PRESS	GAS FLOW	CHAM T/C	CELL T/C	TEST DIR. INIT
	T ₁ 15s	T ₂ 30s	T ₃ 45s	T ₄ 60s	T ₅ 75s	T ₆ 90s	T ₇ 105s	T ₈ 120s	T ₉ 870s	T ₁₀ 900s					
WEC 1															HNF-SD-WM-TRP-274, Rev. 0
SIG 1															
WEC 2															
SIG 2															
WEC 3															
SIG 3															
WEC 4															
SIG 4															
WEC 5															
SIG 5															

TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE
WHITTAKER CELL

9.95 DATA RECORD SHEET 383

TEST 383 @+120°F(2ND. 100% CALIBRATION RATE TEST)

	VOLTAGE										GAS PRESS	GAS FLOW	CHAM T/C	CELL T/C	TEST DIR. INIT
	T ₁ 15s	T ₂ 30s	T ₃ 45s	T ₄ 60s	T ₅ 75s	T ₆ 90s	T ₇ 105s	T ₈ 120s	T ₉ 870s	T ₁₀ 900s					
WEC 1															
SIG 1															
WEC 2															
SIG 2															
WEC 3															
SIG 3															
WEC 4															
SIG 4															
WEC 5															
SIG 5															

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HNF-SD-WM-TRP-274, Rev. 0

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side of page
needs and
be separated

11/15/14
11/15/14
11/15/14

11/15/14

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TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE
WHITTAKER CELL

9.98 DATA RECORD SHEET 412

100°F 100%/31/97

Handwritten signature
1/31/97

TEST 412 0-20°F (1ST. 100% CALIBRATION RATE TEST)

	VOLTAGE										GAS PRESS PSIA	GAS FLOW SCFH	CHAM T/C °F	CELL T/C °F	TEST DIR. INIT
	T ₁ 15s	T ₂ 30s	T ₃ 45s	T ₄ 60s	T ₅ 75s	T ₆ 90s	T ₇ 105s	T ₈ 120s	T ₉ 870s	T ₁₀ 900s					
WEC 2	.169 mV .805 mV	1.276 mV	1.440 mV	1.511 mV	1.546 mV	1.567 mV	1.580 mV	1.590 mV	1.657 mV	1.659 mV	14.51	2	100	100	HNF-SD-WM-TRP-274, Rev. 0
SIG 2	.164 mV .804 mV	1.271 mV	1.436 mV	1.506 mV	1.541 mV	1.562 mV	1.575 mV	1.585 mV	1.651 mV	1.653 mV	14.51	2	100	100	
WEC 2															
SIG 2															
WEC 3															
SIG 3															
WEC 4															
SIG 4															
WEC 5															
SIG 5															

HP DATA FILE

WEC 412 - 1st Run 100% @ 100°F

NOTES

The top entry of T₁ is the initial cell value @ Time 0. The bottom entry is the value @ 15 seconds.

TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE
WHITTAKER CELL

9.99 DATA RECORD SHEET 413

TEST 413 @-20°F (2ND. 100% CALIBRATION RATE TEST)

	VOLTAGE										GAS PRESS	GAS FLOW	CHAM T/C	CELL T/C	TEST DIR. INIT
	T ₁ 15s	T ₂ 30s	T ₃ 45s	T ₄ 60s	T ₅ 75s	T ₆ 90s	T ₇ 105s	T ₈ 120s	T ₉ 870s	T ₁₀ 900s					
WEC 1															
SIG 1															
WEC 2															
SIG 2															
WEC 3															
SIG 3															
WEC 4															
SIG 4															
WEC 5															
SIG 5															

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TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE
WHITTAKER CELL

9.100 DATA RECORD SHEET 414

TEST 414 @-20°F (3RD. 100% CALIBRATION RATE TEST)

	VOLTAGE										GAS PRESS	GAS FLOW	CHAM T/C	CELL T/C	TEST DIR. INIT
	T ₁ 15s	T ₂ 30s	T ₃ 45s	T ₄ 60s	T ₅ 75s	T ₆ 90s	T ₇ 105s	T ₈ 120s	T ₉ 870s	T ₁₀ 900s					
WEC 1															HNF-SD-WM-TC-072, REV. 0
SIG 1															
WEC 2															
SIG 2															
WEC 3															
SIG 3															
WEC 4															
SIG 4															
WEC 5															
SIG 5															

TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE
WHITTAKER CELL

9.101 DATA RECORD SHEET 421

TEST 421 0°F(30%, 60%, 90% CALIBRATION GAS)

	VOLTAGE @ 30% CAL. GAS			VOLTAGE @ 60% CAL. GAS			VOLTAGE @ 90% CAL. GAS			GAS PRESS	GAS FLOW	CHAMB T/C	CELL T/C	TEST DIR INIT
	T ₁ 120s	T ₂ 870s	T ₃ 900s	T ₁ 120s	T ₂ 870s	T ₃ 900s	T ₁ 120s	T ₂ 870s	T ₃ 900s					
WEC 1														
SIG 1														
WEC 2														
SIG 2														
WEC 3														
SIG 3														
WEC 4														
SIG 4														
WEC 5														
SIG 5														

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TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE
WHITTAKER CELL

9.102 DATA RECORD SHEET 422

1/31/97
120°F

P.

TEST 422 80°F (1ST. 100% CALIBRATION RATE TEST)

	VOLTAGE										GAS PRESS (PSIA)	GAS FLOW ^{SCFH} T ₁ HR T ₁₀ MIN	CHAM T/C ^{°F} K °F	CELL T/C °F	TEST DIR. INIT
	T ₁ 15s	T ₂ 30s	T ₃ 45s	T ₄ 60s	T ₅ 75s	T ₆ 90s	T ₇ 105s	T ₈ 120s	T ₉ 870s	T ₁₀ 900s					
WEC 1															
SIG 1															
WEC 2															
SIG 2															
WEC 3															
SIG 3															
WEC 4	1.202 mV 1.170 mV	1.294 mV	1.389 mV	1.431 mV	1.453 mV	1.468 mV	1.478 mV	1.487 mV	1.578 mV	1.579 mV	14.51	2	120	120	
SIG 4	1.201 mV 1.169 mV	1.292 mV	1.386 mV	1.428 mV	1.450 mV	1.465 mV	1.475 mV	1.484 mV	1.576 mV	1.577 mV	14.51	2	120	120	
WEC 5															
SIG 5															

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HP DATA FILE

WEC 422 - 1ST Run, 100% @ 120°F

NOTES

- The top ENTRY FOR T₁ IS THE INITIAL TIME ZERO VALUE, THE BOTTOM IS THE 15 SEC VALUE.

TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE
WHITTAKER CELL

9.103 DATA RECORD SHEET 423

TEST 423 @0°F(2ND. 100% CALIBRATION RATE TEST)

	VOLTAGE										GAS PRESS	GAS FLOW	CHAM T/C	CELL T/C	TEST DIR. INIT
	T ₁ 15s	T ₂ 30s	T ₃ 45s	T ₄ 60s	T ₅ 75s	T ₆ 90s	T ₇ 105s	T ₈ 120s	T ₉ 870s	T ₁₀ 900s					
WEC 1															
SIG 1															
WEC 2															
SIG 2															
WEC 3															
SIG 3															
WEC 4															
SIG 4															
WEC 5															
SIG 5															

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TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE
WHITTAKER CELL

9.104 DATA RECORD SHEET 424

TEST 424 @0°F(3RD. 100% CALIBRATION RATE TEST)															
	VOLTAGE										GAS PRESS	GAS FLOW	CHAM T/C	CELL T/C	TEST DIR. INIT
	T ₁ 15s	T ₂ 30s	T ₃ 45s	T ₄ 60s	T ₅ 75s	T ₆ 90s	T ₇ 105s	T ₈ 120s	T ₉ 870s	T ₁₀ 900s					
WEC 1														HNF-SD-WM-TRP-274, Rev. 0	
SIG 1															
WEC 2															
SIG 2															
WEC 3															
SIG 3															
WEC 4															
SIG 4															
WEC 5															
SIG 5															

TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE
WHITTAKER CELL

9.105 DATA RECORD SHEET 431

TEST 431 +20°F(30%, 60%, 90% CALIBRATION GAS)

	VOLTAGE @ 30% CAL. GAS			VOLTAGE @ 60% CAL. GAS			VOLTAGE @ 90% CAL. GAS			GAS PRESS	GAS FLOW	CHAMB T/C	CELL T/C	TEST DIR INIT
	T ₁ 120s	T ₂ 870s	T ₃ 900s	T ₁ 120s	T ₂ 870s	T ₃ 900s	T ₁ 120s	T ₂ 870s	T ₃ 900s					
WEC 1														
SIG 1														
WEC 2														
SIG 2														
WEC 3														
SIG 3														
WEC 4														
SIG 4														
WEC 5														
SIG 5														

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TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE
WHITTAKER CELL

9.106 DATA RECORD SHEET 432

TEST 432 @+20°F(1ST. 100% CALIBRATION RATE TEST)															
	VOLTAGE										GAS PRESS	GAS FLOW	CHAM T/C	CELL T/C	TEST DIR. INIT
	T ₁ 15s	T ₂ 30s	T ₃ 45s	T ₄ 60s	T ₅ 75s	T ₆ 90s	T ₇ 105s	T ₈ 120s	T ₉ 870s	T ₁₀ 900s					
WEC 1															HNF-SD-WM-TRF-274, Rev. 0
SIG 1															
WEC 2															
SIG 2															
WEC 3															
SIG 3															
WEC 4															
SIG 4															
WEC 5															
SIG 5															

TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE
WHITTAKER CELL

9.107 DATA RECORD SHEET 433

TEST 433 @+20°F (2ND. 100% CALIBRATION RATE TEST)

	VOLTAGE										GAS PRESS	GAS FLOW	CHAM T/C	CELL T/C	TEST DIR. INIT
	T ₁ 15s	T ₂ 30s	T ₃ 45s	T ₄ 60s	T ₅ 75s	T ₆ 90s	T ₇ 105s	T ₈ 120s	T ₉ 870s	T ₁₀ 900s					
WEC 1															
SIG 1															
WEC 2															
SIG 2															
WEC 3															
SIG 3															
WEC 4															
SIG 4															
WEC 5															
SIG 5															

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TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE
WHITTAKER CELL

9.108 DATA RECORD SHEET 434

TEST 434 @+20°F(3RD. 100% CALIBRATION RATE TEST)

	VOLTAGE										GAS PRESS	GAS FLOW	CHAM T/C	CELL T/C	TEST DIR. INIT
	T ₁ 15s	T ₂ 30s	T ₃ 45s	T ₄ 60s	T ₅ 75s	T ₆ 90s	T ₇ 105s	T ₈ 120s	T ₉ 870s	T ₁₀ 900s					
WEC 1															
SIG 1															HNF-SD-WM-TRR-27A, Rev. 0
WEC 2															
SIG 2															
WEC 3															
SIG 3															
WEC 4															
SIG 4															
WEC 5															
SIG 5															

TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE
WHITTAKER CELL

9.109 DATA RECORD SHEET 441

G.F. Vargo
1-28-96

TEST 441 +40°F (30%, 60%, 90% CALIBRATION GAS)

	VOLTAGE @ 30% CAL. GAS			VOLTAGE @ 60% CAL. GAS			VOLTAGE @ 90% CAL. GAS			GAS PRESS (PSIA)	GAS FLOW (CU FT / HR)	CHAMBER T/C (°F)	CELL T/C (°F)	TEST DIR INIT
	T ₁ 120s	T ₂ 870s	T ₃ 900s	T ₁ 120s	T ₂ 870s	T ₃ 900s	T ₁ 120s	T ₂ 870s	T ₃ 900s					
WEC 1														
SIG 1														
WEC 2														
SIG 2														
WEC 3														
SIG 3														
WEC 4	.577mV .441mV	1.073mV	1.073mV	.586mV 1.418mV	1.571mV	1.580mV	.592mV 1.863mV	2.096mV	2.098mV	14.75	2	40	40	GFV 1-28-97
SIG 4	.560mV .979mV	1.056mV	1.057mV	.567mV 1.400mV	1.561mV	1.563mV	.576mV 1.847mV	2.079mV	2.083mV	14.75	2	40	40	GFV 1-28-97
WEC 5														
SIG 5														

HP DATA FILES

WEC 441A - 30%
WEC 441B - 60%
WEC 441C - 90%

NOTES

1. UPPER PORTION OF T₁ BLOCK IS INITIAL VALUE.

TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE
WHITTAKER CELL

9.110 DATA RECORD SHEET 442

G.F. Vargo
1-28-97

TEST 442 @+40°F (1ST. 100% CALIBRATION RATE TEST)

	VOLTAGE										GAS PRESS (PSIA)	GAS FLOW (L/ET HR)	CHAM T/C (°F)	CELL T/C (°F)	TEST DIR. INIT
	T ₁ 15s	T ₂ 30s	T ₃ 45s	T ₄ 60s	T ₅ 75s	T ₆ 90s	T ₇ 105s	T ₈ 120s	T ₉ 870s	T ₁₀ 900s					
WEC 1															
SIG 1															
WEC 2															
SIG 2															
WEC 3															
SIG 3															
WEC 4	.576mV	.904mV	1.240mV	1.509mV	1.702mV	1.840mV	1.937mV	2.007mV	2.265mV	2.267mV	14.76	2	40	40	GFV 1-28-97
SIG 4	.618mV	.891mV	1.226mV	1.494mV	1.688mV	1.825mV	1.922mV	1.993mV	2.250mV	2.252mV	14.76	2	40	40	GFV 1-28-97
WEC 5															
SIG 5															

HP DATA FILES

WEC 442 - 1st 100%

NOTES

1. UPPER PORTION OF T₁ BLOCK IS INITIAL VALUE.

TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE
WHITTAKER CELL

9.111 DATA RECORD SHEET 443

G.F. Vargo
1-28-90

TEST 443 @+40°F (2ND. 100% CALIBRATION RATE TEST)

	VOLTAGE										GAS PRESS (PSIA)	GAS FLOW (CFI/HR)	CHAM T/C (°F)	CELL T/C (°F)	TEST DIR. INIT
	T ₁ 15s	T ₂ 30s	T ₃ 45s	T ₄ 60s	T ₅ 75s	T ₆ 90s	T ₇ 105s	T ₈ 120s	T ₉ 870s	T ₁₀ 900s					
WEC 1															
SIG 1															
WEC 2															
SIG 2															
WEC 3															
SIG 3															
WEC 4	571mV 621mV 560mV 604mV	.918mV	1.256mV	1.522mV 1.507mV GFV	1.715mV	1.851mV	1.948mV	2.017mV	2.282mV	2.289mV	14.76	2	40	40	GFV 1-28-90
SIG 4		.902mV	1.241mV	1.507mV	1.698mV	1.835mV	1.933mV	2.003mV	2.288mV	2.289mV	14.76	2	40	40	GFV 1-28-90
WEC 5															
SIG 5															

HP DATA FILE

WEC 443 - 200 100%

NOTES

1. UPPER PORTION OF T₁ BLOCK IS INITIAL VALUE.

107-1

TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE
WHITTAKER CELL

9.112 DATA RECORD SHEET 444

GF Vargas
1-28-97

TEST 444 @+40°F (3RD. 100% CALIBRATION RATE TEST)

	VOLTAGE										GAS PRESS (PSIA)	GAS FLOW (CU FT HR)	CHAM T/C (°F)	CELL T/C (°F)	TEST DIR. INIT
	T ₁ 15s	T ₂ 30s	T ₃ 45s	T ₄ 60s	T ₅ 75s	T ₆ 90s	T ₇ 105s	T ₈ 120s	T ₉ 870s	T ₁₀ 900s					
WEC 1															
SIG 1															
WEC 2															
SIG 2															
WEC 3															
SIG 3															
WEC 4	.559mV .609mV	.912mV	1.254mV	1.525mV	1.717mV	1.856mV	1.953mV	2.023mV	2.283mV	2.294mV	14.78	2	40	40	6FV 1-28-97
SIG 4	.541mV .594mV	.898mV	1.238mV	1.509mV	1.701mV	1.839mV	1.937mV	2.007mV	2.278mV	2.291mV	14.78	2	40	40	6FV 1-28-97
WEC 5															
SIG 5															

HP DATA FILE

WEC 444 - 3R 100%

NOTES

1. UPPER PORTION OF T₁ BLOCK IS INITIAL VALUE

50°F
KSW

TEST 451 + 50°F (30%,

108-1

WEC 451A - ¹⁵ 30% CAL GAS [OF 10% H₂, 90% OTHER (AIR, N₂)]

WTC 451C - 90% CAR GAS

UPPER ENTRY FOR TIME ZERO VALUE, THE IS SEC. VALUE.

NOTES.

TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE
WHITTAKER CELL

9.114 DATA RECORD SHEET 452

50°F G.F.V.

G.F.V. 1-28-97

TEST 452 @ 60°F (1ST. 100% CALIBRATION RATE TEST)

	VOLTAGE										GAS PRESS (PSIA)	GAS FLOW (WET HL)	CHAM T/C (°F) 50 G.F.V.	CELL T/C (°F)	TEST DIR. INIT
	T ₁ 15s	T ₂ 30s	T ₃ 45s	T ₄ 60s	T ₅ 75s	T ₆ 90s	T ₇ 105s	T ₈ 120s	T ₉ 870s	T ₁₀ 900s					
WEC 1															HNF-SD-WM-TRP-274, Rev
SIG 1															
WEC 2															
SIG 2															
WEC 3															
SIG 3															
WEC 4	1.435mV 1.557mV	.946mV	1.307mV	1.552mV	1.712mV	1.818mV	1.889mV	1.936mV 1.922mV	2.116mV	2.118mV	14.83	2	50	50	
SIG 4	1.420mV 1.524mV	.935mV	1.295mV	1.539mV	1.698mV	1.804mV	1.874mV	1.922mV	2.102mV	2.105mV	14.83	2	50	50	
WEC 5															
SIG 5															

HP DATA FILES

WEC 452 - 1ST 100%

NOTES

- UPPER PORTION OF T₁ BLOCK IS INITIAL VALUE.

TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE
WHITTAKER CELL

9.115 DATA RECORD SHEET 453

TEST 453 @+60°F (2ND. 100% CALIBRATION RATE TEST)

	VOLTAGE										GAS PRESS	GAS FLOW	CHAM T/C	CELL T/C	TEST DIR. INIT
	T ₁ 15s	T ₂ 30s	T ₃ 45s	T ₄ 60s	T ₅ 75s	T ₆ 90s	T ₇ 105s	T ₈ 120s	T ₉ 870s	T ₁₀ 900s					
WEC 1															
SIG 1															
WEC 2															
SIG 2															
WEC 3															
SIG 3															
WEC 4															
SIG 4															
WEC 5															
SIG 5															

1-69-1

TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE
WHITTAKER CELL

9.96 DATA RECORD SHEET ⁴⁵⁴~~384~~

TEST 384 @+120°F(3RD. 100% CALIBRATION RATE TEST)

	VOLTAGE										GAS PRESS	GAS FLOW	CHAM T/C	CELL T/C	TEST DIR. INIT
	T ₁ 15s	T ₂ 30s	T ₃ 45s	T ₄ 60s	T ₅ 75s	T ₆ 90s	T ₇ 105s	T ₈ 120s	T ₉ 870s	T ₁₀ 900s					
WEC 1															
SIG 1															
WEC 2															HNF-SD-WM-TRP-274, Rev. 0
SIG 2															
WEC 3															
SIG 3															
WEC 4															
SIG 4															
WEC 5															
SIG 5															

TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE
WHITTAKER CELL

9.97 DATA RECORD SHEET 411

461 KSW

60°F

GFV 2-3-97

G.F. Vance
2/3/97

TEST 411 -20°F (30%, 60%, 90% CALIBRATION GAS)

	VOLTAGE @ 30% CAL. GAS			VOLTAGE @ 60% CAL. GAS			VOLTAGE @ 90% CAL. GAS			GAS PRESS (PSIA)	GAS FLOW (CY FT HR)	CHAMB T/C (°F)	CELL T/C (°F)	TEST DIR INIT
	T ₁ 120s	T ₂ 870s	T ₃ 900s	T ₁ 120s	T ₂ 870s	T ₃ 900s	T ₁ 120s	T ₂ 870s	T ₃ 900s					
WEC 1														
SIG 1														
WEC 2														
SIG 2														
WEC 3														
SIG 3														
WEC 4	1.321mV 1.776mV 1.309mV 1.765mV	.816mV	.816mV	1.328mV 1.244mV 1.307mV 1.231mV	1.327mV	1.327mV	1.823mV 1.723mV 1.310mV 1.712mV	1.844mV	1.844mV	14.73	2	60	60	GFV 2-3-97
SIG 4		.805mV	.803mV		1.315mV	1.315mV		1.833mV	1.833mV	14.73	2	60	60	GFV 2-3-97
WEC 5														
SIG 5														

HP DATA FILE

WEC 461 A - 1ST 30% @ 60°F
WEC 461 B - 60% @ 60°F
WEC 461 C - 90% @ 60°F
GFV
2-3-97

Notes:

1. UPPER VALUE OF T₁ BLOCK IS INITIAL VALUE
2. CHANGED GAS TO 3% H₂. USE 10%
± 30% ON DIVIDER SETTING.

TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE
WHITTAKER CELL

9.118 DATA RECORD SHEET 462

60°F 4FV
1-29-97

TEST 462 @ 80°F (1ST. 100% CALIBRATION RATE TEST)

	VOLTAGE										GAS PRESS (PSIA)	GAS FLOW (CU FT HR)	CHAM T/C (°F)	CELL T/C (°F)	TEST DIR. INIT
	T ₁ 15s	T ₂ 30s	T ₃ 45s	T ₄ 60s	T ₅ 75s	T ₆ 90s	T ₇ 105s	T ₈ 120s	T ₉ 870s	T ₁₀ 900s					
WEC 1															
SIG 1															
WEC 2															
SIG 2															
WEC 3															
SIG 3															
WEC 4	324mV 515mV	1.013mV	1.355mV	1.588mV	1.678mV	1.753mV	1.800mV	1.833mV	1.968mV	1.971mV	14.8	2	60	60	4FV 1-29-97
SIG 4	312mV 605mV	1.008mV	1.346mV	1.548mV	1.668mV	1.743mV	1.789mV	1.821mV	1.959mV	1.960mV	14.8	2	60	60	4FV 1-29-97
WEC 5															
SIG 5															

HP DATA FILE

WEC 462 - 1st @ 60°F 100%

NOTES

1. UPPER PORTION OF T₁ BLOCK IS
INITIAL VALUE.

TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE
WHITTAKER CELL

9.119 DATA RECORD SHEET 463

TEST 463 @+80°F (2ND. 100% CALIBRATION RATE TEST)

	VOLTAGE									GAS PRESS	GAS FLOW	CHAM T/C	CELL T/C	TEST DIR. INIT
	T ₁ 15s	T ₂ 30s	T ₃ 45s	T ₄ 60s	T ₅ 75s	T ₆ 90s	T ₇ 105s	T ₈ 120s	T ₉ 870s	T ₁₀ 900s				
WEC 1														
SIG 1														
WEC 2														
SIG 2														
WEC 3														
SIG 3														
WEC 4														
SIG 4														
WEC 5														
SIG 5														

TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS. TEMPERATURE
WHITTAKER CELL

9.120 DATA RECORD SHEET 464

TEST 464 @+80°F (3RD. 100% CALIBRATION RATE TEST)

	VOLTAGE										GAS PRESS	GAS FLOW	CHAM T/C	CELL T/C	TEST DIR. INIT
	T ₁ 15s	T ₂ 30s	T ₃ 45s	T ₄ 60s	T ₅ 75s	T ₆ 90s	T ₇ 105s	T ₈ 120s	T ₉ 870s	T ₁₀ 900s					
WEC 1															
SIG 1															HNF-SD-WM-TRP-274, Rev. 0
WEC 2															
SIG 2															
WEC 3															
SIG 3															
WEC 4															
SIG 4															
WEC 5															
SIG 5															

TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE
WHITTAKER CELL

9.121 DATA RECORD SHEET 471

70°F

TEST 471 +100°F (30%, 60%, 90% CALIBRATION GAS)

	VOLTAGE @ 30% CAL. GAS			VOLTAGE @ 60% CAL. GAS			VOLTAGE @ 90% CAL. GAS			GAS PRESS (PSIA)	GAS FLOW FL ³ /hr	CHAMB T/C (°F)	CELL T/C (°F)	TEST DIR INIT
	T ₁ 120s	T ₂ 870s	T ₃ 900s	T ₁ 120s	T ₂ 870s	T ₃ 900s	T ₁ 120s	T ₂ 870s	T ₃ 900s					
WEC 1														
SIG 1														
WEC 2														
SIG 2														
WEC 3														
SIG 3														
WEC 4	255 mV 324 mV	757 mV	757 mV	257 mV 2205 mV	1.270 mV	1.271 mV	309 mV 1.647 mV	1.734 mV	1.735 mV	14.73	2	70	70	
SIG 4	245 mV 714 mV	746 mV	746 mV	248 mV 1.196 mV	1.262 mV	1.263 mV	302 mV 1.632 mV	1.725 mV	1.727 mV	14.73	2	70	70	
WEC 5														
SIG 5														

HP DATA FILE

WEC471A - 30% CAL GAS
WEC471B - 60% " "
WEC471C - 90% " "

NOTES

- UPPER PORTION OF T₁ IS THE TIME ZERO VALUE, THE LOWER PORTION IS THE 120 SEC VALUE
-

TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE
WHITTAKER CELL

9.122 DATA RECORD SHEET 472

70°F
GFV
1-29-97

GFVargo
1-29-97

TEST 472 @ +100°F (1ST. 100% CALIBRATION RATE TEST)

	VOLTAGE										GAS PRESS (PSIA)	GAS FLOW (CFT/Hr)	CHAM T/C (°F)	CELL T/C (°F)	TEST DIR. INIT
	T ₁ 15s	T ₂ 30s	T ₃ 45s	T ₄ 60s	T ₅ 75s	T ₆ 90s	T ₇ 105s	T ₈ 120s	T ₉ 870s	T ₁₀ 900s					
WEC 1															
SIG 1															
WEC 2															
SIG 2															
WEC 3															
SIG 3															
WEC 4	250mV 520mV	1.102mV	1.389mV	1.541mV	1.625mV	1.675mV	1.707mV	1.730mV	1.841mV	1.843mV	14.77	2	70	70	GFV 1-29-97
SIG 4	242mV 572mV	1.094mV	1.380mV	1.532mV	1.617mV	1.667mV	1.697mV	1.721mV	1.832mV	1.834mV	14.77	2	70	70	GFV 1-29-97
WEC 5															
SIG 5															

HP DATA FILE

WEC 472 - 1ST 100% @ 70°F

NOTES

1. UPPER PORTION OF T₁ BLOCK IS INITIAL VALUE.

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TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE
WHITTAKER CELL

9.123 DATA RECORD SHEET 473

TEST 473 @+100°F (2ND. 100% CALIBRATION RATE TEST)

	VOLTAGE										GAS PRESS	GAS FLOW	CHAM T/C	CELL T/C	TEST DIR. INIT
	T ₁ 15s	T ₂ 30s	T ₃ 45s	T ₄ 60s	T ₅ 75s	T ₆ 90s	T ₇ 105s	T ₈ 120s	T ₉ 870s	T ₁₀ 900s					
WEC 1															
SIG 1															
WEC 2															
SIG 2															
WEC 3															
SIG 3															
WEC 4															
SIG 4															
WEC 5															
SIG 5															

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TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE
WHITTAKER CELL

9.124 DATA RECORD SHEET 474

TEST 474 @+100°F(3RD. 100% CALIBRATION RATE TEST)

	VOLTAGE										GAS PRESS	GAS FLOW	CHAM T/C	CELL T/C	TEST DIR. INIT
	T ₁ 15s	T ₂ 30s	T ₃ 45s	T ₄ 60s	T ₅ 75s	T ₆ 90s	T ₇ 105s	T ₈ 120s	T ₉ 870s	T ₁₀ 900s					
WEC 1															
SIG 1															HNF-SD-WM-TRP-274, REV. 0
WEC 2															
SIG 2															
WEC 3															
SIG 3															
WEC 4															
SIG 4															
WEC 5															
SIG 5															

TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE
WHITTAKER CELL

9.125 DATA RECORD SHEET 481

TEST 481 +120°F(30%, 60%, 90% CALIBRATION GAS)

	VOLTAGE @ 30% CAL. GAS			VOLTAGE @ 60% CAL. GAS			VOLTAGE @ 90% CAL. GAS			GAS PRESS	GAS FLOW	CHAMB T/C	CELL T/C	TEST DIR INIT
	T ₁ 120s	T ₂ 870s	T ₃ 900s	T ₁ 120s	T ₂ 870s	T ₃ 900s	T ₁ 120s	T ₂ 870s	T ₃ 900s					
WEC 1														
SIG 1														
WEC 2														
SIG 2														
WEC 3														
SIG 3														
WEC 4														
SIG 4														
WEC 5														
SIG 5														

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TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE
WHITTAKER CELL

9.126 DATA RECORD SHEET 482

80°F
KSW
1/31/97

[Signature]
1/31/97

TEST 482 @ +120°F (1ST. 100% CALIBRATION RATE TEST)

	VOLTAGE										GAS PRESS (PSIA)	GAS FLOW ^{1/2} SCFH Fe ³ /HR DATA	CHAM T/C 80°F	CELL T/C 80°F	TEST DIR. INIT
	T ₁ 15s	T ₂ 30s	T ₃ 45s	T ₄ 60s	T ₅ 75s	T ₆ 90s	T ₇ 105s	T ₈ 120s	T ₉ 870s	T ₁₀ 900s					
WEC 1	1.201 mV	1.104 mV	1.345 mV	1.461 mV	1.523 mV	1.559 mV	1.581 mV	1.597 mV	1.689 mV	1.689 mV	14.50	2	80	80	
SIG 1	1.192 mV	1.096 mV	1.338 mV	1.454 mV	1.514 mV	1.550 mV	1.571 mV	1.586 mV	1.679 mV	1.680 mV	14.50	2	80	80	
WEC 2															
SIG 2															
WEC 3															
SIG 3															
WEC 4															
SIG 4															
WEC 5															
SIG 5															

HNF-SD-WM-TRP-274, REV. 0

HP DATA FILE

WEC 482 - 1ST 100% @ 80°F

NOTES

- UPPER PORTION OF T₁ IS INITIAL VALUE - LOWER IS 15s VALUE

TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE
WHITTAKER CELL

9.127 DATA RECORD SHEET 483

TEST 483 @+120°F(2ND. 100% CALIBRATION RATE TEST)

	VOLTAGE										GAS PRESS	GAS FLOW	CHAM T/C	CELL T/C	TEST DIR. INIT
	T ₁ 15s	T ₂ 30s	T ₃ 45s	T ₄ 60s	T ₅ 75s	T ₆ 90s	T ₇ 105s	T ₈ 120s	T ₉ 870s	T ₁₀ 900s					
WEC 1															
SIG 1															
WEC 2															
SIG 2															
WEC 3															
SIG 3															
WEC 4															
SIG 4															
WEC 5															
SIG 5															

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TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE
WHITTAKER CELL

9.128 DATA RECORD SHEET 484

TEST 484 @+120°F(3RD. 100% CALIBRATION RATE TEST)

	VOLTAGE										GAS PRESS	GAS FLOW	CHAM T/C	CELL T/C	TEST DIR. INIT
	T ₁ 15s	T ₂ 30s	T ₃ 45s	T ₄ 60s	T ₅ 75s	T ₆ 90s	T ₇ 105s	T ₈ 120s	T ₉ 870s	T ₁₀ 900s					
WEC 1															HNF-SD-WM-TP-274, Rev. 0
SIG 1															
WEC 2															
SIG 2															
WEC 3															
SIG 3															
WEC 4															
SIG 4															
WEC 5															
SIG 5															

TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE
WHITTAKER CELL

9.129 DATA RECORD SHEET 511

TEST 511 -20°F(30%, 60%, 90% CALIBRATION GAS)

	VOLTAGE @ 30% CAL. GAS			VOLTAGE @ 60% CAL. GAS			VOLTAGE @ 90% CAL. GAS			GAS PRESS	GAS FLOW	CHAMB T/C	CELL T/C	TEST DIR INIT
	T ₁ 120s	T ₂ 870s	T ₃ 900s	T ₁ 120s	T ₂ 870s	T ₃ 900s	T ₁ 120s	T ₂ 870s	T ₃ 900s					
WEC 1														
SIG 1														
WEC 2														
SIG 2														
WEC 3														
SIG 3														
WEC 4														
SIG 4														
WEC 5														
SIG 5														

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TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE
WHITTAKER CELL

9.130 DATA RECORD SHEET 512

TEST 512 @-20°F(1ST. 100% CALIBRATION RATE TEST)															
	VOLTAGE										GAS PRESS	GAS FLOW	CHAM T/C	CELL T/C	TEST DIR. INIT
	T ₁ 15s	T ₂ 30s	T ₃ 45s	T ₄ 60s	T ₅ 75s	T ₆ 90s	T ₇ 105s	T ₈ 120s	T ₉ 870s	T ₁₀ 900s					
WEC 1															HNF-SD-MH-TTR-274, Rev. 0
SIG 1															
WEC 2															
SIG 2															
WEC 3															
SIG 3															
WEC 4															
SIG 4															
WEC 5															
SIG 5															

HNF-SD-WM-TRO-214, Rev. 0

TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE

WHITTAKER CELL

9.131 DATA RECORD SHEET 513

[illegible]

1-211

TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE
WHITTAKER CELL

9.132 DATA RECORD SHEET 514

TEST 514 @-20°F(3RD. 100% CALIBRATION RATE TEST)															
	VOLTAGE										GAS PRESS	GAS FLOW	CHAM T/C	CELL T/C	TEST DIR. INIT
	T ₁ 15s	T ₂ 30s	T ₃ 45s	T ₄ 60s	T ₅ 75s	T ₆ 90s	T ₇ 105s	T ₈ 120s	T ₉ 870s	T ₁₀ 900s					
WEC 1															HNF-SD-WM-TRD-274, Rev. 0
SIG 1															
WEC 2															
SIG 2															
WEC 3															
SIG 3															
WEC 4															
SIG 4															
WEC 5															
SIG 5															

**TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE
WHITTAKER CELL**

9.133 DATA RECORD SHEET 521

TEST 521 0°F(30%, 60%, 90% CALIBRATION GAS)

	VOLTAGE @ 30% CAL. GAS			VOLTAGE @ 60% CAL. GAS			VOLTAGE @ 90% CAL. GAS			GAS PRESS	GAS FLOW	CHAMB T/C	CELL T/C	TEST DIR INIT
	T ₁ 120s	T ₂ 870s	T ₃ 900s	T ₁ 120s	T ₂ 870s	T ₃ 900s	T ₁ 120s	T ₂ 870s	T ₃ 900s					
WEC 1														
SIG 1														
WEC 2														
SIG 2														
WEC 3														
SIG 3														
WEC 4														
SIG 4														
WEC 5														
SIG 5														

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TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE
WHITTAKER CELL

9.134 DATA RECORD SHEET 522

TEST 522 @0°F(1ST. 100% CALIBRATION RATE TEST)

	VOLTAGE										GAS PRESS	GAS FLOW	CHAM T/C	CELL T/C	TEST DIR. INIT
	T ₁ 15s	T ₂ 30s	T ₃ 45s	T ₄ 60s	T ₅ 75s	T ₆ 90s	T ₇ 105s	T ₈ 120s	T ₉ 870s	T ₁₀ 900s					
WEC 1															HNF-SD-WM-TRP-274, Rev. D
SIG 1															
WEC 2															
SIG 2															
WEC 3															
SIG 3															
WEC 4															
SIG 4															
WEC 5															
SIG 5															

TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE
WHITTAKER CELL

9.135 DATA RECORD SHEET 523

TEST 523 80°F (2ND. 100% CALIBRATION RATE TEST)

	VOLTAGE										GAS PRESS	GAS FLOW	CHAM T/C	CELL T/C	TEST DIR. INIT
	T ₁ 15s	T ₂ 30s	T ₃ 45s	T ₄ 60s	T ₅ 75s	T ₆ 90s	T ₇ 105s	T ₈ 120s	T ₉ 870s	T ₁₀ 900s					
WEC 1															
SIG 1															
WEC 2															
SIG 2															
WEC 3															
SIG 3															
WEC 4															
SIG 4															
WEC 5															
SIG 5															

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TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE
WHITTAKER CELL

9.136 DATA RECORD SHEET 524

TEST 524 @0°F (3RD. 100% CALIBRATION RATE TEST)

	VOLTAGE										GAS PRESS	GAS FLOW	CHAM T/C	CELL T/C	TEST DIR. INIT
	T ₁ 15s	T ₂ 30s	T ₃ 45s	T ₄ 60s	T ₅ 75s	T ₆ 90s	T ₇ 105s	T ₈ 120s	T ₉ 870s	T ₁₀ 900s					
WEC 1															HNF-SD-WM-TRP-274, Rev. 0
SIG 1															
WEC 2															
SIG 2															
WEC 3															
SIG 3															
WEC 4															
SIG 4															
WEC 5															
SIG 5															

**TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE
WHITTAKER CELL**

9.137 DATA RECORD SHEET 531

TEST 531 +20°F(30%, 60%, 90% CALIBRATION GAS)

	VOLTAGE @ 30% CAL. GAS			VOLTAGE @ 60% CAL. GAS			VOLTAGE @ 90% CAL. GAS			GAS PRESS	GAS FLOW	CHAMB T/C	CELL T/C	TEST DIR INIT
	T ₁ 120s	T ₂ 870s	T ₃ 900s	T ₁ 120s	T ₂ 870s	T ₃ 900s	T ₁ 120s	T ₂ 870s	T ₃ 900s					
WEC 1														
SIG 1														
WEC 2														
SIG 2														
WEC 3														
SIG 3														
WEC 4														
SIG 4														
WEC 5														
SIG 5														

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TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE
WHITTAKER CELL

9.138 DATA RECORD SHEET 532

TEST 532 0+20°F (1ST. 100% CALIBRATION RATE TEST)

	VOLTAGE										GAS PRESS	GAS FLOW	CHAM T/C	CELL T/C	TEST DIR. INIT
	T ₁ 15s	T ₂ 30s	T ₃ 45s	T ₄ 60s	T ₅ 75s	T ₆ 90s	T ₇ 105s	T ₈ 120s	T ₉ 870s	T ₁₀ 900s					
WEC 1															HNF-SD-WM-TRP-274, Rev. 0
SIG 1															
WEC 2															
SIG 2															
WEC 3															
SIG 3															
WEC 4															
SIG 4															
WEC 5															
SIG 5															

TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE
WHITTAKER CELL

9.139 DATA RECORD SHEET 533

TEST 533 @+20°F (2ND. 100% CALIBRATION RATE TEST)

	VOLTAGE										GAS PRESS	GAS FLOW	CHAM T/C	CELL T/C	TEST DIR. INIT
	T ₁ 15s	T ₂ 30s	T ₃ 45s	T ₄ 60s	T ₅ 75s	T ₆ 90s	T ₇ 105s	T ₈ 120s	T ₉ 870s	T ₁₀ 900s					
WEC 1															
SIG 1															
WEC 2															
SIG 2															
WEC 3															
SIG 3															
WEC 4															
SIG 4															
WEC 5															
SIG 5															

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TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE
WHITTAKER CELL

9.140 DATA RECORD SHEET 534

TEST 534 @+20°F(3RD. 100% CALIBRATION RATE TEST)

	VOLTAGE										GAS PRESS	GAS FLOW	CHAM T/C	CELL T/C	TEST DIR. INIT
	T ₁ 15s	T ₂ 30s	T ₃ 45s	T ₄ 60s	T ₅ 75s	T ₆ 90s	T ₇ 105s	T ₈ 120s	T ₉ 870s	T ₁₀ 900s					
WEC 1															
SIG 1															
WEC 2															
SIG 2															
WEC 3															
SIG 3															
WEC 4															
SIG 4															
WEC 5															
SIG 5															

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TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE
WHITTAKER CELL

9.141 DATA RECORD SHEET 541

G.F. Vargo
1-28-97

F

F

F

TEST 541 +40°F(30%, 60%, 90% CALIBRATION GAS)

	VOLTAGE @ 30% CAL. GAS			VOLTAGE @ 60% CAL. GAS			VOLTAGE @ 90% CAL. GAS			GAS PRESS (PSIA)	GAS FLOW (CU FT HR)	CHAMB T/C (°F)	CELL T/C (°F)	TEST DIR INIT
	T ₁ 120s	T ₂ 870s	T ₃ 900s	T ₁ 120s	T ₂ 870s	T ₃ 900s	T ₁ 120s	T ₂ 870s	T ₃ 900s					
WEC 1														
SIG 1														
WEC 2														
SIG 2														
WEC 3														
SIG 3														
WEC 4														
SIG 4														
WEC 5	601 mV 888 mV 590 mV 888 mV	1.041 mV	1.036 mV	585 mV 1.071 mV 565 mV 1.059 mV	1.308 mV	1.311 mV	600 mV 1.488 mV 590 mV 1.473 mV	1.909 mV	1.921 mV	14.78	2	40	40	GFV 1-28-97
SIG 5		1.029 mV	1.025 mV		1.294 mV	1.308 mV		1.903 mV	1.914 mV	14.78	2	40	40	GFV 1-28-97

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HP DATA FILE

WEC 541 A - 30%
WEC 541 B - 60%
WEC 541 C - 90%

NOTES

1. UPPER PORTION OF T₁ BLOCK IS INITIAL VALUE.

TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE
WHITTAKER CELL

9.142 DATA RECORD SHEET 542

G.F. Vargo
1-28-97

TEST 542 @+40°F (1ST. 100% CALIBRATION RATE TEST)

	VOLTAGE										GAS PRESS (PSIA)	GAS FLOW (WFT/HR)	CHAM T/C (°F)	CELL T/C (°F)	TEST DIR. INIT
	T ₁ 15s	T ₂ 30s	T ₃ 45s	T ₄ 60s	T ₅ 75s	T ₆ 90s	T ₇ 105s	T ₈ 120s	T ₉ 870s	T ₁₀ 900s					
WEC 1															HNF-SD-WM-TRP-274, REV. 0
SIG 1															
WEC 2															
SIG 2															
WEC 3															
SIG 3															
WEC 4															
SIG 4															
WEC 5	.627mV .688mV	.968mV	1.209mV	1.363mV	1.479mV	1.557mV	1.623mV	1.669mV	2.070mV	2.070mV	14.8	2	40	40	
SIG 5	.624mV .683mV	.960mV	1.201mV	1.354mV	1.469mV	1.548mV	1.610mV	1.660mV	2.061mV	2.067mV	14.8	2	40	40	

HP DATA FILE

NOTES

WEC 542 - 1ST 100%

1. UPPER PORTION OF T₁ BLOCK IS INITIAL VALUE

TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE WHITTAKER CELL

9.143 DATA RECORD SHEET 543

G.F. Vargo Jr
1-28-97

TEST 543 @+40°F (2ND. 100% CALIBRATION RATE TEST)

	VOLTAGE										GAS PRESS (PSIA)	GAS FLOW (WET HR)	CHAM T/C (°F)	CELL T/C (°F)	TEST DIR. INIT
	T ₁ 15s	T ₂ 30s	T ₃ 45s	T ₄ 60s	T ₅ 75s	T ₆ 90s	T ₇ 105s	T ₈ 120s	T ₉ 870s	T ₁₀ 900s					
WEC 1															
SIG 1															
WEC 2															
SIG 2															
WEC 3															
SIG 3															
WEC 4															
SIG 4															
WEC 5	.657mV .730mV .658mV .719mV	.994mV	1.221mV	1.381mV	1.489mV	1.568mV	1.634mV	1.673mV	2.084mV	2.077mV	14.82	2	40	40	GFV 1-28-97
SIG 5		.984mV	1.217mV	1.379mV	1.486mV	1.566mV	1.624mV	1.668mV	2.079mV	2.077mV	14.82	2	40	40	GFV 1-28-97

HP DATA FILE

NOTES

WEC 543 - 2ND 100%

1. UPPER PORTION OF T₁ BLOCK IS INITIAL VALUE.

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TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE
WHITTAKER CELL

9.144 DATA RECORD SHEET 544

TEST 544 @+40°F(3RD. 100% CALIBRATION RATE TEST)

	VOLTAGE										GAS PRESS (PSIA)	GAS FLOW (CUB FT /HR)	CHAM T/C (°F)	CELL T/C (°F)	TEST DIR. INIT
	T ₁ 15s	T ₂ 30s	T ₃ 45s	T ₄ 60s	T ₅ 75s	T ₆ 90s	T ₇ 105s	T ₈ 120s	T ₉ 870s	T ₁₀ 900s					
WEC 1															HNF-SD-WM-TRP-274, REV. 0
SIG 1															
WEC 2															
SIG 2															
WEC 3															
SIG 3															
WEC 4															
SIG 4															
WEC 5	.671mV .739mV	.998mV	1.225mV	1.384mV	1.498mV	1.578mV	1.628mV	1.688mV			14.81	2	40	40	6FV 1-28-97
SIG 5	.669mV .729mV	.989mV	1.222mV	1.382mV	1.492mV	1.571mV	1.623mV	1.671mV			14.81	2	40	40	6FV 1-28-97

HP DATA FILE

WEC 544 - 3RD 100%

FILE ACCIDENTALLY ABORTED @ 810SECS
& RESTARTED UNDER FILE WEC 544B.

NOTES

1. UPPER PORTION OF T₁ BLOCK IS INITIAL VALUE.
2. FILE ON COMPUTER WAS INADVERTANTLY ABORTED AND STARTED 30 SECS LATER AS WEC 544B

**TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE
WHITTAKER CELL**

9.145 DATA RECORD SHEET 551

TEST 551 +60°F(30%, 60%, 90% CALIBRATION GAS)

	VOLTAGE @ 30% CAL. GAS			VOLTAGE @ 60% CAL. GAS			VOLTAGE @ 90% CAL. GAS			GAS PRESS	GAS FLOW	CHAMB T/C	CELL T/C	TEST DIR INIT
	T ₁ 120s	T ₂ 870s	T ₃ 900s	T ₁ 120s	T ₂ 870s	T ₃ 900s	T ₁ 120s	T ₂ 870s	T ₃ 900s					
WEC 1														
SIG 1														
WEC 2														
SIG 2														
WEC 3														
SIG 3														
WEC 4														
SIG 4														
WEC 5														
SIG 5														

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TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE
WHITTAKER CELL

9.146 DATA RECORD SHEET 552

TEST 552 @+60°F(1ST. 100% CALIBRATION RATE TEST)															
	VOLTAGE										GAS PRESS	GAS FLOW	CHAM T/C	CELL T/C	TEST DIR. INIT
	T ₁ 15s	T ₂ 30s	T ₃ 45s	T ₄ 60s	T ₅ 75s	T ₆ 90s	T ₇ 105s	T ₈ 120s	T ₉ 870s	T ₁₀ 900s					
WEC 1															
SIG 1														HNF-SD-WM-TR-274, Rev. 0	
WEC 2															
SIG 2															
WEC 3															
SIG 3															
WEC 4															
SIG 4															
WEC 5															
SIG 5															

TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE
WHITTAKER CELL

9.147 DATA RECORD SHEET 553

TEST 553 @+60°F(2ND. 100% CALIBRATION RATE TEST)

	VOLTAGE										GAS PRESS	GAS FLOW	CHAM T/C	CELL T/C	TEST DIR. INIT
	T ₁ 15s	T ₂ 30s	T ₃ 45s	T ₄ 60s	T ₅ 75s	T ₆ 90s	T ₇ 105s	T ₈ 120s	T ₉ 870s	T ₁₀ 900s					
WEC 1															
SIG 1															
WEC 2															
SIG 2															
WEC 3															
SIG 3															
WEC 4															
SIG 4															
WEC 5															
SIG 5															

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TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE
WHITTAKER CELL

9.148 DATA RECORD SHEET 554

TEST 554 @+60°F(3RD. 100% CALIBRATION RATE TEST)															
	VOLTAGE										GAS PRESS	GAS FLOW	CHAM T/C	CELL T/C	TEST DIR. INIT
	T ₁ 15s	T ₂ 30s	T ₃ 45s	T ₄ 60s	T ₅ 75s	T ₆ 90s	T ₇ 105s	T ₈ 120s	T ₉ 870s	T ₁₀ 900s					
WEC 1														HNF-SD-WM-TRP-274, Rev. 0	
SIG 1															
WEC 2															
SIG 2															
WEC 3															
SIG 3															
WEC 4															
SIG 4															
WEC 5															
SIG 5															

**TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE
WHITTAKER CELL**

9.149 DATA RECORD SHEET 561

TEST 561 +80°F(30%, 60%, 90% CALIBRATION GAS)

	VOLTAGE @ 30% CAL. GAS			VOLTAGE @ 60% CAL. GAS			VOLTAGE @ 90% CAL. GAS			GAS PRESS	GAS FLOW	CHAMB T/C	CELL T/C	TEST DIR INIT
	T ₁ 120s	T ₂ 870s	T ₃ 900s	T ₁ 120s	T ₂ 870s	T ₃ 900s	T ₁ 120s	T ₂ 870s	T ₃ 900s					
WEC 1														
SIG 1														
WEC 2														
SIG 2														
WEC 3														
SIG 3														
WEC 4														
SIG 4														
WEC 5														
SIG 5														

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TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE
WHITTAKER CELL

9.150 DATA RECORD SHEET 562

60°F
GFV
1-29-97

T

GFV
1-29-97

TEST 562 @ 60°F (1ST. 100% CALIBRATION RATE TEST)

	VOLTAGE										GAS PRESS (PSIA)	GAS FLOW (WET FL)	CHAM T/C (°F)	CELL T/C (°F)	TEST DIR. INIT
	T ₁ 15s	T ₂ 30s	T ₃ 45s	T ₄ 60s	T ₅ 75s	T ₆ 90s	T ₇ 105s	T ₈ 120s	T ₉ 870s	T ₁₀ 900s					
WEC 1															HNF-SD-WM-TRP-274, Rev. 0
SIG 1															
WEC 2															
SIG 2															
WEC 3															
SIG 3															
WEC 4															
SIG 4															
WEC 5	345 mV 594 mV	1.022 mV	1.251 mV	1.378 mV	1.460 mV	1.518 mV	1.559 mV	1.593 mV	1.858 mV	1.858 mV	14.79	2	60	60	
SIG 5	341 mV 592 mV	1.016 mV	1.246 mV	1.375 mV	1.461 mV	1.544 mV	1.557 mV	1.589 mV	1.855 mV	1.854 mV	14.79	2	60	60	

HP DATA FILE

1.514 mV
GFV
1-29-97

WEC 562 - 1ST 100% @ 60°F

NOTES

1. UPPER PORTION OF T₁ BLOCK IS INITIAL VALUE.

TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE
WHITTAKER CELL

9.151 DATA RECORD SHEET 563

TEST 563 @+80°F (2ND. 100% CALIBRATION RATE TEST)

	VOLTAGE										GAS PRESS	GAS FLOW	CHAM T/C	CELL T/C	TEST DIR. INIT
	T ₁ 15s	T ₂ 30s	T ₃ 45s	T ₄ 60s	T ₅ 75s	T ₆ 90s	T ₇ 105s	T ₈ 120s	T ₉ 870s	T ₁₀ 900s					
WEC 1															
SIG 1															
WEC 2															
SIG 2															
WEC 3															
SIG 3															
WEC 4															
SIG 4															
WEC 5															
SIG 5															

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TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE
WHITTAKER CELL

9.152 DATA RECORD SHEET 564

TEST 564 @+80°F(3RD. 100% CALIBRATION RATE TEST)

	VOLTAGE										GAS PRESS	GAS FLOW	CHAM T/C	CELL T/C	TEST DIR. INIT
	T ₁ 15s	T ₂ 30s	T ₃ 45s	T ₄ 60s	T ₅ 75s	T ₆ 90s	T ₇ 105s	T ₈ 120s	T ₉ 870s	T ₁₀ 900s					
WEC 1															HNF-SD-WM-TRP-274, REV. 0
SIG 1															
WEC 2															
SIG 2															
WEC 3															
SIG 3															
WEC 4															
SIG 4															
WEC 5															
SIG 5															

TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE
WHITTAKER CELL

9.153 DATA RECORD SHEET 571

TEST 571 +100°F(30%, 60%, 90% CALIBRATION GAS)

	VOLTAGE @ 30% CAL. GAS			VOLTAGE @ 60% CAL. GAS			VOLTAGE @ 90% CAL. GAS			GAS PRESS	GAS FLOW	CHAMB T/C	CELL T/C	TEST DIR INIT
	T ₁ 120s	T ₂ 870s	T ₃ 900s	T ₁ 120s	T ₂ 870s	T ₃ 900s	T ₁ 120s	T ₂ 870s	T ₃ 900s					
WEC 1														
SIG 1														
WEC 2														
SIG 2														
WEC 3														
SIG 3														
WEC 4														
SIG 4														
WEC 5														
SIG 5														

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**TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE
WHITTAKER CELL**

9.154 DATA RECORD SHEET 572

70°F
GFV
1-29-97

TEST 572 @+100°F (1ST. 100% CALIBRATION RATE TEST)

	VOLTAGE										GAS PRESS (PSIA)	GAS FLOW (CU FT / HR)	CHAM T/C (°F)	CELL T/C (°F)	TEST DIR. INIT
	T ₁ 15s	T ₂ 30s	T ₃ 45s	T ₄ 60s	T ₅ 75s	T ₆ 90s	T ₇ 105s	T ₈ 120s	T ₉ 870s	T ₁₀ 900s					
WEC 1															HNF-SD-WM-TRP-274, Rev. 0
SIG 1															
WEC 2															
SIG 2															
WEC 3															
SIG 3															
WEC 4															
SIG 4															
WEC 5	1.282mV	1.042mV	1.257mV	1.372mV	1.438mV	1.492mV	1.529mV	1.557mV	1.787mV	1.782	14.74	2	70	70	
SIG 5	1.582mV	1.043mV	1.254mV	1.366mV	1.439mV	1.489mV	1.528mV	1.556mV	1.782mV	1.784mV	14.74	2	70	70	

HP DATA FILE

WEC 572 - 1st. 100% @ 70°F

NOTES

1. UPPER PORTION OF T₁ BLOCK IS INITIAL VALUE.

TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE
WHITTAKER CELL

9.155 DATA RECORD SHEET 573

TEST 573 @+100°F (2ND. 100% CALIBRATION RATE TEST)

	VOLTAGE										GAS PRESS	GAS FLOW	CHAM T/C	CELL T/C	TEST DIR. INIT
	T ₁ 15s	T ₂ 30s	T ₃ 45s	T ₄ 60s	T ₅ 75s	T ₆ 90s	T ₇ 105s	T ₈ 120s	T ₉ 870s	T ₁₀ 900s					
WEC 1															
SIG 1															
WEC 2															
SIG 2															
WEC 3															
SIG 3															
WEC 4															
SIG 4															
WEC 5															
SIG 5															

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TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE
WHITTAKER CELL

9.156 DATA RECORD SHEET 574

TEST 574 @+100°F (3RD. 100% CALIBRATION RATE TEST)

	VOLTAGE										GAS PRESS	GAS FLOW	CHAM T/C	CELL T/C	TEST DIR. INIT
	T ₁ 15s	T ₂ 30s	T ₃ 45s	T ₄ 60s	T ₅ 75s	T ₆ 90s	T ₇ 105s	T ₈ 120s	T ₉ 870s	T ₁₀ 900s					
WEC 1															HNF-SD-WM-TRF-274, Rev. 0
SIG 1															
WEC 2															
SIG 2															
WEC 3															
SIG 3															
WEC 4															
SIG 4															
WEC 5															
SIG 5															

TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE
WHITTAKER CELL

9.157 DATA RECORD SHEET 581

TEST 581 +120°F(30%, 60%, 90% CALIBRATION GAS)

	VOLTAGE @ 30% CAL. GAS			VOLTAGE @ 60% CAL. GAS			VOLTAGE @ 90% CAL. GAS			GAS PRESS	GAS FLOW	CHAMB T/C	CELL T/C	TEST DIR INIT
	T ₁ 120s	T ₂ 870s	T ₃ 900s	T ₁ 120s	T ₂ 870s	T ₃ 900s	T ₁ 120s	T ₂ 870s	T ₃ 900s					
WEC 1														
SIG 1														
WEC 2														
SIG 2														
WEC 3														
SIG 3														
WEC 4														
SIG 4														
WEC 5														
SIG 5														

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TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE
WHITTAKER CELL

9.158 DATA RECORD SHEET 582

TEST 582 @+120°F(1ST. 100% CALIBRATION RATE TEST)

	VOLTAGE										GAS PRESS	GAS FLOW	CHAM T/C	CELL T/C	TEST DIR. INIT
	T ₁ 15s	T ₂ 30s	T ₃ 45s	T ₄ 60s	T ₅ 75s	T ₆ 90s	T ₇ 105s	T ₈ 120s	T ₉ 870s	T ₁₀ 900s					
WEC 1															HNF-SD-WM-TRD-274, Rev. 0
SIG 1															
WEC 2															
SIG 2															
WEC 3															
SIG 3															
WEC 4															
SIG 4															
WEC 5															
SIG 5															

**TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE
WHITTAKER CELL**

9.159 DATA RECORD SHEET 583

TEST 583 0+120°F (2ND. 100% CALIBRATION RATE TEST)

	VOLTAGE										GAS PRESS	GAS FLOW	CHAM T/C	CELL T/C	TEST DIR. INIT
	T ₁ 15s	T ₂ 30s	T ₃ 45s	T ₄ 60s	T ₅ 75s	T ₆ 90s	T ₇ 105s	T ₈ 120s	T ₉ 870s	T ₁₀ 900s					
WEC 1															
SIG 1															
WEC 2															
SIG 2															
WEC 3															
SIG 3															
WEC 4															
SIG 4															
WEC 5															
SIG 5															

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TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE
WHITTAKER CELL

9.160 DATA RECORD SHEET 584

TEST 584 @+120°F (3RD. 100% CALIBRATION RATE TEST)

VOLTAGE

T₁₀
900s

T₉
870s

T₈
120s

T₇
105s

T₆
90s

T₅
75s

T₄
60s

T₃
45s

T₂
30s

T₁
15s

GAS
PRESS

GAS
FLOW

CHAM
T/C

CELL
T/C

TEST
DIR
INIT

MEC 1
SIG 1
MEC 2
SIG 2
MEC 3
SIG 3
MEC 4
SIG 4
MEC 5
SIG 5

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DOCUMENT NO.

TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE
WHITTAKER CELL

10.0 APPENDIX C: EXCEPTION RECORD

EXCEPTION NUMBER	STEP NUMBER	EXCEPTION DESCRIPTION	EXCEPTION RESOLUTION	RESOLUTION APPROVED BY:	DATE RESOLVED
1	6.1.4	SYSTEM WIRED TO NEW CONFIG. (W) ADDITION OF RELAY	ADDED ISOLATION RELAY BETWEEN WEL'S & ISP	G.F. Vargo K.S. Withers	1-25-97
2	7.4	INITIAL TEMP CHANGED TO +40°F PER INSTRUCTIONS J.R. ROBINSON 1-24-97	CHANGED INITIAL STARTING TEMPERATURE TO +40°F	G.F. Vargo	1-25-97
3	7.19- 7.22	ALLOWS GAS HEADER TO BE CHARGED WITH 30%/60%/90% GAS TO SOL VALVE	CHANGED PROCEDURE TO ALLOW CHARGING OF HEADER BETWEEN EACH TEST	G.F. Vargo	1-25-97
4	7.32	CHARGE PURGE TIME ON GAS HEADER FROM 15 MIN TO 2 MIN	CHANGED STEP 7.32 TIME FROM 15 MIN TO 2 MIN	G.F. Vargo	1-25-97
5	6.1.4	SYSTEM PIPING CHANGED MADE EACH WEL VENT INDEPENDANT	CHANGED PIPING CONFIGURATION BY MAKING EACH WEL VENT SEPERATE	G.F. Vargo	1-28-97

11.0 APPENDIX D: TEST RECORD

TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE
WHITTAKER CELL

1-24-97 CHARGE #1 MADE TO SYSTEM CONFIGURATION BY ADDING RELAY TO ISOLATE ALL WECs FROM THERMISC ISOLATOR. A.F. Vargo 1-24-97 SET ETL LOGBOOK HNF-1-3-1-pg.12
1-24-97 CHARGE #2 - CHARGED STARTING TEMP 0.0 + 40°F AS PER INSTRUCTIONS THERMISC
1-24-97 A.F. Vargo 1-24-97
CHARGE #3: AT STEP 7.19 CHARGED PROCEED TO CHARGE GAS HEAD TO SPECIFIC 30%/60%/10% GAS UP TO SELECTED VALUE & TO POPUP ABOUT CELL FOR 15 MINUTES AT 0.0. A.F. Vargo 1-24-97
1-24-97 CHARGE #4: CHARGED POPUP TIME AT STEP # 7.32 FROM 15 MIN TO 2 MIN. A.F. Vargo 1-24-97
1-28-97 CHARGE #5: CONFIGURED EACH WEC (1-5) NEXT TO BE SUBSEQUENT THIS REPEATS OP LIVE CELL FROM COMPENSATING OF LIVE CELL. A.F. Vargo 1-28-97
1-28-97 CELL VOLTAGES DISCONNECTED FROM ISB
WEC 1 - .039 MV WEC 2 - .015 MV WEC 3 - .025 MV WEC 4 - .025 MV
WEC 5 - .095 MV TEMPERATURE AT 45°F

WHITTAKER CELL

12.0 APPENDIX E: GAS BOTTLE RECORD

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DOCUMENT NO.

<p>TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE OF WHITTAKER CELL</p>

ATTACHMENT 1: FINAL PROCEDURE ACCEPTANCE SHEET

Completion of this procedure has demonstrated that:

- The Whittaker electrochemical cell(s), used on the Rotary Mode Core Sampling (RMCS) flammable gas interlock (FGI), to detect and quantify hydrogen gas, have been systematically tested between the temperature ranges of -20°F and $+120^{\circ}\text{F}$. Furthermore, as required by WHC-SD-WM-SAD-035, Section U.3.1 second bullet, a temperature range has been found that the Whittaker cell voltage output(s) have reached 90% of full scale output, in less than two(2) minutes, when subjected to 100% calibration gas (1% hydrogen). The temperature range is _____ $^{\circ}\text{F}$ $\pm 5^{\circ}\text{F}$ to _____ $^{\circ}\text{F}$ $\pm 5^{\circ}\text{F}$.
- A record of all noted deficiencies was kept on Appendix C, Exception Record, and all recorded exceptions have been resolved and the resolutions approved.

Approved by:

RMCS Exhauster Engineer, E.J. Waldo

Date

NHC Field Engineering Manager, J.S. Scofield

Date

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TEST PROCEDURE FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE OF WHITTAKER CELL

ATTACHMENT 2

TEST PLAN FOR MEASUREMENT OF PERFORMANCE
VS
TEMPERATURE OF WHITTAKER CELL

REFERENCE: HNF-SD-WM-TP-527, Rev 0

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JAN 17 1997

ENGINEERING DATA TRANSMITTAL

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1. EDT 619112

.. To: (Receiving Organization) DISTRIBUTION		3. From: (Originating Organization) REMOTE SENSING AND SAMPLING EQUIPMENT ENGINEERING		4. Related EDT No.: N/A	
5. Proj./Prog./Dept./Div.: CHARACTERIZATION		6. Cog. Engr.: E.J. Waldo		7. Purchase Order No.: N/A	
8. Originator Remarks: THIS DOCUMENT IS BEING TRANSMITTED FOR APPROVAL AND RELEASE		9. Equip./Component No.: N/A		10. System/Bldg./Facility: N/A	
11. Receiver Remarks: THIS IS NOT A DESIGN BASELINE DOC TEST CONTROL COPY 1/11/97		12. Major Assm. Dwg. No.: N/A		13. Permit/Permit Application No.: N/A	
				14. Required Response Date: 1/13/97	

15. DATA TRANSMITTED					(F)	(G)	(H)	(I)
(A) Item No.	(B) Document/Drawing No.	(C) Sheet No.	(D) Rev. No.	(E) Title or Description of Data Transmitted	Approval Designator	Reason for Transmittal	Originator Disposition	Receiver Disposition
1	HNF-SD-WM-TP-527	A11	0	TEST PLAN FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE OF WHITTAKER ELECTROCHEMICAL CELL	S,Q	1	1,2	

16. KEY					
Approval Designator (F)		Reason for Transmittal (G)		Disposition (H) & (I)	
E, S, Q, D or N/A (see WHC-CM-3-S, Sec.12.7)		1. Approval 2. Release 3. Information	4. Review 5. Post-Review 6. Dist. (Receipt Acknow. Required)	1. Approved 2. Approved w/comment 3. Disapproved w/comment	4. Reviewed no/comment 5. Reviewed w/comment 6. Receipt acknowledged

17. SIGNATURE/DISTRIBUTION (See Approval Designator for required signatures)									
(G)	(H)	(J) Name	(K) Signature	(L) Date	(M) MSIN	(J) Name	(K) Signature	(L) Date	(M) MSIN
1	/	Cog. Eng. E.J. Waldo	<i>E.J. Waldo</i>	1/13/97	57-12	Design Authority G.P. Janicek	<i>G.P. Janicek</i>	1/13/97	57-12
1	/	Cog. Mgr. J.S. Schofield	<i>J.S. Schofield</i>	1/13/97	57-12	Gas Char. T.S. Schneider	<i>T.S. Schneider</i>	1/13/97	57-12
1	/	QA M.L. McElroy	<i>M.L. McElroy</i>	1/13/97	57-07	Eng. Mgr. R.E. Raymond	<i>R.E. Raymond</i>	1/13/97	57-13
1	/	Safety H. Harvey	<i>H. Harvey</i>	1/13/97	57-07	305 Facility Mgr. M.J. [Signature]	<i>M.J. [Signature]</i>	1/13/97	57-13
1	/	305 Facility Eng. K.S. Witwer	<i>K.S. Witwer</i>	1/13/97	57-13	CB Bryan - CPO	<i>CB Bryan</i>	1/13/97	57-13
1	/	Eng. Author G. F. Vargo, Jr.	<i>G.F. Vargo</i>	1/13/97	57-13				
1	/	Eng. Author Mgr. C. E. Hanson	<i>C.E. Hanson</i>	1/13/97	57-13				

18. Signature of Originator <i>G.F. Vargo</i> 1/13/97		19. Signature of Authorized Representative for Receiving Organization <i>J.S. Schofield</i> 1/14/97		20. Signature of Cognizant Manager <i>J.S. Schofield</i> 1/14/97		21. DOE APPROVAL (if required) Ctrl. No. N/A [] Approved [] Approved w/comments [] Disapproved w/comments	
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TEST CONTROL COPY

TEST PLAN FOR MEASUREMENT OF PERFORMANCE VS TEMPERATURE OF WHITTAKER ELECTROCHEMICAL CELL

G. F. Vargo, Jr.
SGN Eurisys Services Corporation, Richland, WA 99352
U.S. Department of Energy Contract DE-AC06-87RL10930
January 1997

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ACRONYMS AND ABBREVIATIONS

CPO	Characterization Project Operations
DUT	Device Under Test (Whittaker cell)
EDT	Engineering Data Transmittal
ETL	Engineering Test Laboratory
FGI	Flammable Gas Interlock
GCS	Gas Characterization System
GMS	Gas Monitoring System
NHC	Numatec Hanford Company
OSHA	Occupational Safety and Health Administration
PPM	Parts Per Million
RMCS	Rotary Mode Core Sampling
SHMS	Standard Hydrogen Monitoring System
RSSEE	Remote Sensing and Sampling Equipment Engineering
SD	Supporting Document
T/C	Thermocouple
WEC	Whittaker Electrochemical Cell

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TEST CONTROL COPY

TEST PLAN
FOR MEASUREMENT OF
PERFORMANCE VS TEMPERATURE
OF WHITTAKER
ELECTROCHEMICAL CELL

1.0 INTRODUCTION

The purpose of this test plan is to define the methodology used to test the performance of the WEC with changes in temperature. This cell is used on the FGI, for RMCS, to detect and quantify the presence of hydrogen gas concentration. Since, the WEC on the FGI is not mounted in a protected enclosure, recent calibration of the WEC has been degraded due to the cold weather.

This test will be performed using the guidelines as defined in EP-4.2, Section 2.2.1, "Development testing". The main purpose of the test is to resolve the engineering issues regarding the performance of the Whittaker cell through the range of temperatures that may be experienced during Hanford Site tank farm deployment. This test will not resolve issues of flow through the WEC. The parameters for the test will be the recommended parameters gained from the experience by the gas characterization team (GCT) while developing the GCSSs. The WECs configuration, inlet pressure, and flow rates will not be the same as used during actual use in the FGI system. The test parameters used are best suited to test the response of the WECs to the calibration gas at the test temperatures.

2.0 DESCRIPTION

The test will be conducted in the 305 ETL, in the 300 area of the Hanford Site, Richland, Washington, using the environmentally controlled test chamber. Five(5) WECs will be placed in the chamber, simultaneously, with the temperature cycled between -20°F and 120°F. Output will be checked at 20°F increments from -20°F to +120°F. All voltage outputs shall be recorded at two(2) minutes and at fifteen(15) minutes. The configuration of the WECs will be connected to the intrinsic voltage repeaters replicating the configuration of the FGI.

Each Whittaker cell/intrinsic barrier combination will be tested individually a minimum of three times. Only one cell at a time is connected to the carrier and calibration gas system. The 4(four) other cells will be in the chamber and at temperature but will be configured off-line. Each of the 5(five) WECs will be instrumented with a type K T/C that is individually displayed on a handheld digital thermometer.

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Using 20°F increments, the output voltage of the DUT and of the intrinsic voltage repeater will be measured, manually, using precision microvoltmeters and then recorded. Also, The T/C temperature output of the digital thermometer attached to the DUT, will be manually recorded. Furthermore, the output voltage, when subjected to three different calibration gas/carrier gas percentages of 30%, 60%, and 90%, will be manually recorded. These percentages will be achieved by adjustment of the gas percentage selector switch on the front of the gas divider. This instrument allows the test gas stream to be adjusted varied from 0-100% calibration gas. by the selector switch.

Also The response, or change in output voltage verses time when subjected to an instantaneous input of 100% calibration gas, will be manually recorded. Full scale output shall be defined as the WEC output at 15 minutes.

Other equipment used includes carrier gas bottles of nitrogen(100% pure) and calibration gas bottles of hydrogen(1% hydrogen, 99% others), a precision flow meter, pressure transducer, power supply, and a gas divider. will be used (Reference Figure(s) 1 and 2). The mixture of gas entering the environmental chamber will be equalized to the temperature of the chamber by passage through a 5-10 ft. helix copper coil before entering the DUT.

The instruments will be the same type of instruments as used in the 306 gas characterization laboratory and will be located outside of the test chamber.

The GCS team recommended test values of flow and pressure, by the GCS team, to be used in this test. The flow rates for the measurements in the test chamber will be set to 2cu ft./hr using the flowmeter. The pressure input to the DUT will be measured by a precision pressure transmitter to assure that the cell pressures are consistent during the test.

A T/C and calibrated readout device will be used as the verification instrument to verify the test temperature of the chamber. Furthermore, a computerized data logger will be monitoring and trending the test chamber temperature during all phases of testing.

"Test Procedure for Measurement of Performance vs Temperature of Whittaker Electrochemical Cell", HNF-SD-WM-TC-072, will define the test set-up and testing sequence. This will include the chamber configuration to insure proper venting of the balance and calibration gasses.

All readings will be recorded manually in Appendix B of "Test Procedure for Measurement of Performance vs Temperature of Whittaker Electrochemical Cell", HNF-SD-WM-TC-072.

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3.0 REQUIREMENTS

3.1 GENERAL REQUIREMENTS

3.1.1 TEST CONTROLS

This test shall be conducted under the guidelines set forth in this document. Furthermore, "Test Procedure for Measurement of Performance vs Temperature of Whittaker Electrochemical Cell", HNF-SD-WM-TC-072, shall define the sequence of operations.

3.1.1.1 RETEST REQUIREMENTS

Any portion of the test may be re-ran or re-started. However, no previously recorded data shall be destroyed and all data shall be included in the test report. Additionally, it shall be the policy of this test plan to start the test from the beginning of the test sequence and complete the test to the end of the test sequence. All activities for retest shall be at the approval of the test director.

3.1.1.2 DEVIATIONS FROM THE TEST PLAN/PROCEDURE

3.1.1.2.1 DEVIATIONS FROM THE TEST PLAN

Deviations are allowed to the test plan if they are approved by the test director, cognizant RMCS exhauster engineer, and the 305 ETL manager, or his designee. The cognizant RMCS exhauster engineer's approval may be acquired by telephone. Furthermore, any deviations/exceptions; and if approval was acquired by telephone, must be documented in Appendix C of the "Test Procedure for Measurement of Performance vs Temperature of Whittaker Electrochemical Cell", HNF-SD-WM-TC-072, and the test report.

3.1.1.2.2 DEVIATIONS FROM THE TEST PROCEDURE

Deviations are allowed to the test procedures if they are approved by the test director, cognizant RMCS exhauster engineer, and the 305 ETL manager, or his designee. This approval shall be documented by initialing of the test procedure, by the test director and cognizant engineer, at the appropriate place in the procedure. The cognizant RMCS exhauster engineer's approval may be acquired by telephone. However, this shall be noted next to the authorizing initials. Furthermore, any deviations/exceptions must be documented in Appendix C of the "Test Procedure for Measurement of Performance

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vs Temperature of Whittaker Electrochemical Cell", HNF-SD-WM-TC-072, and the test report.

3.1.1.3 MEASUREMENT AND TEST EQUIPMENT

All measurement and test equipment shall be in calibration with proof of calibration sticker affixed to the equipment. Furthermore, the sticker shall bear the date calibration expires as well as an authenticating signature or initial. The type, manufacturer, model, measurement and test equipment serial number, and calibration expiration date for each instrument and sensor used in this test shall be recorded in Appendix A of "Test Procedure for Measurement of Performance vs Temperature of Whittaker Electrochemical Cell", HNF-SD-WM-TC-072.

3.1.1.4 GAS BOTTLE RECORD

The pedigree of all gas bottles used in this test shall be documented in Appendix E of the "Test Procedure for Measurement of Performance vs Temperature of Whittaker Electrochemical Cell", HNF-SD-WM-TC-072. This shall include the manufacturer, date of manufacture, type of gas, and concentration in PPM. As part of the supporting documentation a copy of the manufacturers' specification tag/sheet, for any bottle used, shall be included in the test report.

3.1.1.5 TRAINING

Training shall be given to the testing personnel pertaining to the operation of the environmental chamber. This training shall be provided by the 305 ETL cognizant engineer or his representative. A record of the personnel shall be maintained, on file, by the 305 ETL cognizant engineer. A copy of this record shall be attached to the test report. No other training is required.

3.1.1.6 FACILITY IDENTIFICATION

The testing facility shall be the 305 ETL, 300 area, Hanford site, Richland, Washington. The environmental chamber is located in this facility.

3.1.1.7 SAFETY REQUIREMENTS

The 305 ETL cognizant engineer shall instruct the testing personnel, pertaining to safety, within the 305 ETL as well as safety practices pertaining to operation of the environmental chamber. All personnel, present

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during testing in the 305 ETL, shall abide by these requirements. These include:

- wearing of OSHA approved eye protection at all times
- wearing of OSHA approved hardhat protection when crane operations are overhead
- utilizing the "buddy system" when performing work in the facility.

3.1.1.8 PERSONNEL IDENTIFICATION

The key personnel identified for the performance of this task are as follows:

- Test responsible engineering manager: C. E. Hanson
- 305 ETL responsible manager: M. J. Schliebe
- Cognizant RMCS exhaustor engineer: E. J. Waldo/J. D. Robinson
- Cognizant 305 ETL engineer: K. S. Witwer
- Test Director: G. F. Vargo, Jr.

Other support personnel shall be supplied, as necessary, from 305 ETL or RSSEE.

3.1.1.9 APPROVAL DESIGNATORS

As a minimum, this test plan shall be approved by Lockheed Martin Hanford Company Design Authority, Quality Assurance, Industrial Safety, Numatec Hanford 305 ETL engineer, and technical peer review. The personnel assigned for the peer review shall be as designated by the cognizant RMCS exhaustor engineer. They include the NHC Cognizant Engineer and Cognizant Manager. These approvals and reviews shall be authenticated by signature on the EDT for this plan.

3.1.1.10 TEST PROCEDURES/REVISIONS

"Test Procedure for Measurement of Performance vs Temperature of Whittaker Electrochemical Cell", HNF-SD-WM-TC-072, defines the test sequence and test order. It is the intent of this plan that the test procedure be followed to complete the test under the test criteria defined in Section 5. However, the test setup, sequence, or test order may be changed with the approval of the cognizant RMCS exhaustor engineer, the test director, and the 305 ETL manager, or his designee. See Section 3.1.1.2

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4.0 ORGANIZATIONAL RESPONSIBILITIES

4.1 OVERALL CUSTOMER

The overall customer for this test is the Lockheed Martin Hanford Characterization Project CPO. The responsible engineering organization, for RMCS, is Lockheed Numatec Hanford Company. The exhauster, and supporting flammable gas interlock, supports RMCS.

Characterization Project Cognizant Manager: M. A. Payne
Program Manager(NHC): R. E. Raymond

4.2 REMOTE SENSING AND SAMPLING EQUIPMENT ENGINEERING (RSSEE)

The RSSEE organization will be responsible for the test. This includes the generation of the test plan, test procedures, test report, execution of the test in the 305 ETL, and interface with the 305 ETL engineering and management personnel.

Manager: C. E. Hanson
Test Director: G. F. Vargo, Jr.
Cognizant RMCS exhauster engineer(alternate): J. D. Robinson
Supporting Personnel: As Required

4.2.1 TEST DIRECTOR

The test director will be responsible for all interface to perform the test. This includes the generation of the test plan, test procedures, test report, minutes of the pre-test meeting in the 305 ETL minutes of the design review, expediter for all document signature reviews/approvals, execution and direction of the test, and all signature and log entries to the procedure.

4.3 NUMATEC HANFORD COMPANY (NHC) GAS CHARACTERIZATION

NHC will be responsible to assist RSSEE in the preparation of the test plan, test procedures, and the test setup. Additionally, NHC will be available as consultants in the matters of gas characterization and analysis.

Manager: W. C. Miller
Supporting Engineer: T. C. Schneider

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4.4 NUMATEC HANFORD COMPANY (NHC) 305 ETL

NHC is the custodian of the 305 ETL. They will be responsible to assist RSSEE in the preparation of the test plan, test procedures, assist the test director in the execution of the test, 305 ETL building safety training and orientation, technician support, and the test setup. This will include the supplying of T/Cs for the WECs and test instrumentation.

Manager:	M. J. Schliebe
Facility Cognizant Engineer:	K. S. Witwer

4.5 NUMATEC HANFORD COMPANY (NHC) FIELD ENGINEERING

NHC field engineering will be responsible for use of the FGI in the field. The cognizant RMCS exhauster engineer will be from this organization.

Manager:	J. S. Schofield
Cognizant RMCS Exhauster Engineer:	E. J. Waldo

4.5.1 COGNIZANT RMCS EXHAUSTER ENGINEER

The cognizant RMCS exhauster engineer will have the overall responsibility of the test. has the overall technical responsibility for the exhauster field equipment. For this testing he will have signature approval of all test documentation and test changes or deviations. designator authority for peer reviewers, and the final authority on any aspects of the test.

An alternate cognizant RMCS exhauster may be used. This engineer will be supplied from Remote Sensing and Sampling Equipment Engineering (RSSEE).

5.0 CRITERIA

This equipment is intended to operate in the temperature range of 10°F to 100°F. However, for purposes of this test, the temperature range beyond the expected temperature range of operation shall be incorporated.

5.1 TEST CRITERIA

- The test apparatus configuration shall be such that the test pressure at the WEC under test shall remain within +/- 2" W.C., of atmospheric pressure, during the test.
- Voltage output of WEC(s) shall be linear at the three(3) different hydrogen gas concentrations. Output will be checked at 20°F increments from -20°F to +120°F. All voltage outputs shall be recorded at two(2)

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minutes and at fifteen(15) minutes.

- Voltage output of WEC(s), when instantaneously subjected to 100% calibration gas (1% hydrogen), shall reach 90% of full scale output voltage in less than two(2) minutes. after checking at 20°F increments from -20°F to +120°F. The voltage outputs/inputs shall be recorded at two(2) minutes and at fifteen(15) minutes.
- Voltage output verses voltage input of the intrinsic isolating voltage repeater(s) 9323/10-10-11 shall be the same value (+/- .1%) after checking at 20°F increments from -20°F to +120°F. The voltage outputs/inputs shall be recorded at two(2) minutes and at fifteen(15) minutes.
- Voltage output from the WEC(s) shall be repeatable within +/-10%, for a repetition of the same test. At a minimum three(3) identical tests shall be performed on each WEC.
- The WEC output at 14 minutes 30 seconds shall be 99.9% of the WEC output at 15 minutes.

In the event that these criteria cannot be met at all temperatures the same criteria shall be used to identify that temperature range, within +/- 5°F, that will allow each WEC to meet acceptance criteria.

5.2 ACCEPTANCE CRITERIA

The WEC under test, when instantaneously subjected to 100% calibration gas (1% hydrogen), shall have a response time requirement of reaching 90% of full scale output voltage in less than two(2) minutes at all temperatures tested. Reference SAD-035, Section V.31 second bullet. See Section 9.0 of this document.

While operating in the temperature range determined by these test results the criteria in Section 5.1, the WEC shall reach 90% of full-scale output within two minutes, as required by WHC-SD-WM-SAD-035.

6.0 TEST REVIEWS

After the test plan and test procedures have been generated and released a meeting will be held to review the plan, procedures, design, safety, quality assurance (QA), setup, and overall test configuration before initiation of the test. Meeting minutes will document the results. These minutes will be included in the test report.

During the test execution there will be two(2) technical peer, QA, and safety reviews that will be visits to the test location in the 305 ETL. The

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results of these reviews will be entered in Appendix D of the "Test Procedure for Measurement of Performance vs Temperature of Whittaker Electrochemical Cell", HNF-SD-WM-TC-072 by the test director. These reviews will be selected at random and spaced accordingly (See attached schedule), to ensure that the execution of the test is in accordance with the plan and the procedures. The personnel to perform these reviews will be identified by the cognizant RMCS exhaustor engineer during the pretest meeting.

7.0 TEST DOCUMENTATION

The documentation for this test will consist of the following:

- Test plan
- Test procedures
- Test report

The test procedure will contain a Test Log (Appendix D) that will log events pertaining to the test. This section will substitute for the keeping of a separate test log. Entries to this section will be entered only by the test director.

8.0 SCHEDULE

See APPENDIX A.

ref HNF-SD-WM-TP-527
Rev 0

9.0 REFERENCES

WHC-CM-6-1, *Standard Engineering Practices, EP-4.2, Testing Requirements*, Westinghouse Hanford Company, Richland, Washington, July 31, 1996.

WHC-SD-WM-SAD-035, *A Safety Assessment of Rotary Mode Core Sampling in Flammable Gas Single Shell Tanks*, Rev 0A, Los Alamos National Laboratory, Los Alamos, New Mexico, August 1996.

ref HNF-SD-WM-TP-527
Rev 0

FIGURE 1

WHITTAKER CELL TEMPERATURE TEST
PIPING CONFIGURATION

ref HNF-SD-WM-TP-527
Rev 0

APPENDIX A

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HNF-SD-WM-TRP-274
Rev 0

8.5 ATTACHMENT 5: SUPPORTING DOCUMENTATION

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HANFORD JOB HAZARD ANALYSIS CHECKLIST

Page 1 of 3

Prepared By Keith S. Witwer

Date 01/20/97

Area 300

Bldg. 305

Scope/Description: Measurement of Performance Vs. Temperature of Whittaker Electro-chemical Cell. (Using Russells Environmental Chamber) Per attached Test Plan HNF-SD-WM-TP-527 and Test Procedure HNF-SD-WM-TC-072

☒ New☐ Revised

Emergency Contact Person(s):

Primary: Keith S. Witwer - Numatec Hanford Co.

Secondary: Eric Nelson - Industrial Safety contact- Fluor Daniel Hanford, Inc

Emergency Radio/Phone Number: 911

JHA Number (not required):

JHA-97-001

Specific Work Location(s): 305 Building North High Bay; In and around Environmental Chamber

KNOWN OR POTENTIAL HAZARDS

	Yes	No	✓	•	Reference	Yes	No	✓	•	Reference
1. Radiation Area Work		X	✓	•			X	✓	•	
2. Hazardous Waste Operations		X	✓	•		X		✓	•	JHA SHT 2
3. Confined Space Entry		X	✓	•			X	✓	•	
4. Cutting/Welding		X		•			X		•	
5. Roof Work		X		•			X	✓	•	
6. Fall Hazards (> = 10')		X		•			X	✓	•	
7. Excavation/Trenching		X		•			X		•	
8. Asbestos Inspection Report		X		•			X		•	
9. Hazardous Materials		X	✓	•			X		•	
					✓ = Formal training required.					
					• = Items then require a permit/form/report.					

Other Hazards

Yes No

Control Measures

1. Temperature Extremes	X		Extreme temperatures (-20 to 120 F) limited to Env. Chamber
2. Noise		X	
3. Insufficient Lighting		X	
4. Animals/Insects		X	
5. Process Chemicals/Steam		X	
6. Dust		X	
7. Flammable/Combustible Materials		X	
8. Ladders		X	
9. Wet/Slippery Floors or Surfaces		X	
10. Uneven Terrain		X	
11. Adjacent Water Hazard		X	
12. Vehicle Traffic		X	
13. Heavy Equipment		X	
14. Rigging Operation		X	
15. Manual Lifting		X	
16. Power Tools		X	
17. Pinch Points	X		Insure hands clear of Env. Chamber door when closing
18. Falling Objects		X	
19. Sharp Objects		X	
20. Overhead Obstructions	X		Use caution when opening or working around Env. Chamber door
21. Site Control (Signs/Barricades)		X	
22. Remote Work Area		X	
23. Other (see JHA Sht. 2):	X		Pressurized Gas Cylinders - Proper Procedures.

MINIMUM DRESS REQUIREMENTS: LAB COAT, LEATHER GLOVES IF TOUCHING HOT/COLD ITEMS IN CHAMBER

☒ If further evaluation of the job steps, associated hazards, or safety measures need to be performed, continue job hazard analysis on page 2.☐ If work activities will, or are likely to result in employee exposure greater than or equal to the OSHA substance-specific medical surveillance criteria (in the absence of such criteria, use the lower of one-half the OSHA PEL or one-half the ACGIH), complete Site Form A-6001-951 (Potential Exposure Hazards).

APPROVALS

Supervisor, Person in Charge MICHAEL J. SCHLIEBE

Industrial Safety/Hygiene ERIC NELSON

(Signature(s))

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MEETING AGENDA

Engineering Testing Laboratory

305 Building, 300 Area

Richland, WA 99352

Meeting Description Pre Job Meeting for Whittaker Cell Temperature TestingResults Desired Insure attendees are aware of hazards, control points, site safety info, etc.Date 01/24/97

Time _____

Location ETL Conference Room

Scheduled Time			Actual Time		
Start	Stop	Total Hours	Start	Stop	Total Hours
10:15			10:15	10:45	.5
Persons Attending					
1	George Vargo				
2	Jim Robinson				
3	Ron Bafus				
4	Tom Schneider				
5	Keith Witwer - Numatec Hanford				
6					
7					
8					
9					
10					
Items To Be Discussed					
1	Site Emergency Contact Telephone Numbers				✓
2	Site Emergency Egress Route				✓
3	Location of Eye Wash Station				✓
4	Necessary PPE				✓
5	Location of Fire Extinguisher				✓
6	Description of Work to be done				✓
7	Description of Work Area				✓
8	Discussion of Cleanup				✓
9	Questions?				✓
10					
11					
Materials Needed			Person Responsible		
1	JHA ✓		K Witwer		
2	Pre-Job Signoff Sheet ✓		K. Witwer		
3	305 Emergency Response Board ✓		K. Witwer		
4	Test Plan ✓		George Vargo		
5	Test Procedure ✓		George Vargo		
6					

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Page 2 of 2

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WESTINGHOUSE STANDARDS LABORATORY PHYSICAL AND ELECTRICAL REPORT

CUSTODIAN/ADDRESS JORDAN SR L6-13 INSTRUMENT		STANDARDS CODE NUMBER 752-67-11-004		NEW MODIFY ☒	REFERENCE NUMBER 406439
DATA ACQUIS SYSTEM H-P 3497A CONTROL UNIT		SERIAL NUMBER 2511A02694	PROPERTY NUMBER WB96051	RECALL STATUS 1 ACTIVE 2 NONRECALL 3 SUSPENDED 1 4 DELETED 5 PM 6 NONDATA M&T	ORGANIZATION CODE WB00000
SENDER K WITWER 6-3019	ROOM N/A	BUILDING 305	SERVICE DEPARTMENT 4	RECALL CYCLE 360	WORK ORDER N2224
INSTRUMENT SPECIFICATIONS SEE TOLERANCE COLUMN		COMMENTS		DATE RECEIVED 970116	TOLERANCE HISTORY IIII
STANDARD(S) USED IN CALIBRATION TRACEABLE TO NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY OR NATIONALLY RECOGNIZED STANDARDS		4:1 RATIO Y ☒ N ☐		DATE RECEIVED 970116	TOLERANCE AS RECEIVED
EXPIRATION DATE 002-14-01-036 7/25/97		EXPIRATION DATE		CO ID 8	SD WE
REMARKS (WP-16)		TRAINING HOURS 1.0		CALIBRATION HOURS 3.0	
PROCEDURE NUMBER WHC-67-11-3497A(12-82)		REPAIR HOURS		OTHER HOURS	
		ENG/ADMIN HOURS		MATERIALS	
		TOTAL CHARGE = (\$150 x SUM OF HOURS) + MATERIAL		DATE CALIBRATED 1/16/97	
		DATE DUE 1/16/98		AMBIENT TEMPERATURE - 24.4	

INFORMATION ONLY

RUSH

APPROVED BY

CALIBRATED BY

Hanford Operations and
Engineering Contractor
for the United States
Department of Energy

Westinghouse Hanford Company
Subsidiary of Westinghouse
Electric Corporation
Box 1970, Richland, WA 99352

PAGE

1 OF 3

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PROCEDURE NAME - 16 WHC-67-11-3497A(12-82)	STANDARDS CODE NUMBER 752-67-11-004	REFERENCE NUMBER 406439
---	--	----------------------------

DATA SHEET

DMM RANGE AND DISPLAY	STANDARD READING	DMM READING		ONE YEAR TOLERANCE
		AS FOUND	FINAL	
.1V 5½ DIGIT	.100000	.100001	SAME	± 18 μ V
1.0V	1.00000	1.00005		± 160 μ V
10.0V	1.1111	1.11116		± .3 mV
	2.2222	2.2222		± .4 mV
	3.3333	3.3334		± .6 mV
	4.4444	4.4445		± .8 mV
	5.5555	5.5557		± .9 mV
	6.6666	6.6668		± 1.1 mV
	7.7777	7.7779		± 1.3 mV
	8.8888	8.8891		± 1.4 mV
	9.9999	10.0002		± 1.6 mV
	10.0000	10.0003		± 1.6 mV
100.0V	50.000	50.002		± 8.0 mV
	100.000	100.003		± 16.0 mV
	-100.000	-100.003		± 16.0 mV
	-50.000	-50.002		± 8.0 mV
AUTO RANGE	50.000	50.002		± 8.0 mV
	5.0000	5.0002		± .8 mV
	.50000	.50003		± 80 μ V
	.050000	.049999		± 10 μ V
10V 4½ DIGIT	9.000	9.000		± 3.0 mV
10V 3½ DIGIT	9.00	9.00	↓	± 20 mV

APPROVED BY	CALIBRATED BY	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> WHC STD LAB 42 </div>	Page 2 of 3
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3 of 3

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HNF-SD-WM-TRP-274, Rev. 0.

NorLAB

A DIVISION OF NORCO, INC.

Calibration Gases & Equipment**CERTIFICATE OF ANALYSIS**

Norco
 Kennewick Warehouse
 102 E. Columbia Dr.
 Kennewick, WA 99336-0000

Date: March 4, 1996

Cylinder Number: TWC041277

PO Number: None.

Norco Order Number: 720091-00

Component	Reported Concentration	Requested Concentration
-----------	------------------------	-------------------------

Hydrogen	0.999%	1%
Air	Balance	

Analysis +/- 2%

Lot #: 6-062-100

Approved: _____

John Mettinger
 John Mettinger
 Senior Lab Technician

Date	1-20-97	# of pages	1
From	R. Bunch		
Co.			
Phone #			
Fax #	376-4945		
Post-it Fax Note	7671		
To	KENNICK WAREHOUSE		
Co./Dept.			
Phone #			
Fax #	376-2873		

1121 W. Amity, Boise, ID 83705

Phone (208) 336-1643 • Fax (208) 384-1720 • Watts 1-800-657-6672

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HNF-SD-WM-TRP-274, Rev. 0

PROCEDURE NAME 216	STANDARDS CODE NUMBER	REFERENCE NUMBER
WHC-5-RMT-305ICA REV.3 30PSIA	355-80-02-056	400762

DATA SHEET

[illegible]

APPROVED BY <i>D. J. Nelson</i>	5-10-96	CALIBRATED BY <i>W. E. S. L. S.</i>	21	Page <i>2</i> of <i>2</i>
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WESTINGHOUSE STANDARDS LABORATORY PHYSICAL AND ELECTRICAL REPORT																																			
CUSTODIAN/ADDRESS JORDAN SR L6-13 INSTRUMENT		STANDARDS CODE NUMBER 750-28-13-005																																	
ROTOMETER W&T NPXQ-143 0-6 SCFH		SERIAL NUMBER ROOM N/A 305	PROPERTY NUMBER N/A SERVICE DEPARTMENT B9 45 1289																																
SENDER K WITWER 6-3019		COMMENTS SN#32E093SSXX2	RECALL STATUS 1 ACTIVE 2 NONRECALL 3 SUSPENDED 4 DELETED 5 PM 6 NONDATA M&T																																
INSTRUMENT SPECIFICATIONS 1/- 10% FS		DATE RECEIVED 360 970123	REFERENCE NUMBER 406670 WORK ORDER E51549 TOLERANCE HISTORY AS RECEIVED IN OUT NA FAILED																																
STANDARD(S) USED IN CALIBRATION TRACEABLE TO NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY OR NATIONALLY RECOGNIZED STANDARDS 002-28-06 007 2-197		EXPIRATION DATE 2-1-97																																	
REMARKS Standard Conditions - 760mm Hg 70°F		TRAINING HOURS 15																																	
PROCEDURE NUMBER WHC-9-LOW FLOW REV. 1		CALIBRATION HOURS REPAIR HOURS OTHER HOURS ENG/ADMIN HOURS 44																																	
		MATERIALS TOTAL CHARGE = (\$150 x SUM OF HOURS) + MATERIAL DATE/CALIBRATED DATE DUE 1/23/97 1/23/98																																	
		AMBIENT TEMPERATURE - 23°C																																	
<table border="1"> <thead> <tr> <th>TEST POINTS</th> <th>AS FOUND</th> <th>FINAL</th> <th>TOL.</th> </tr> </thead> <tbody> <tr> <td>W-T</td> <td></td> <td>Standard</td> <td></td> </tr> <tr> <td>1. SCFH</td> <td>1.17</td> <td>SCFH</td> <td>Same</td> </tr> <tr> <td>2.</td> <td>2.26</td> <td>"</td> <td></td> </tr> <tr> <td>3.</td> <td>3.34</td> <td>"</td> <td></td> </tr> <tr> <td>4.</td> <td>4.22</td> <td>"</td> <td></td> </tr> <tr> <td>5.</td> <td>5.33</td> <td>"</td> <td></td> </tr> <tr> <td>6.</td> <td>5.76</td> <td>"</td> <td></td> </tr> </tbody> </table>				TEST POINTS	AS FOUND	FINAL	TOL.	W-T		Standard		1. SCFH	1.17	SCFH	Same	2.	2.26	"		3.	3.34	"		4.	4.22	"		5.	5.33	"		6.	5.76	"	
TEST POINTS	AS FOUND	FINAL	TOL.																																
W-T		Standard																																	
1. SCFH	1.17	SCFH	Same																																
2.	2.26	"																																	
3.	3.34	"																																	
4.	4.22	"																																	
5.	5.33	"																																	
6.	5.76	"																																	
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APPROVED BY	CALIBRATED BY	Hanford Operations and Westinghouse Hanford Company	PAGE																																
M. Monahan 1/23/97	A 21	the State of Washington Department of Energy Box 1700 Richland, WA 99352	1 OF 1																																

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WESTINGHOUSE STANDARDS LABORATORY PHYSICAL AND ELECTRICAL REPORT

CUSTODIAN/ADDRESS JORDAN SR L6-13	STANDARDS CODE NUMBER 804-78-02-003		NEW MODIFY	REFERENCE NUMBER 406255
INSTRUMENT HERMOCOUPLE TYPE K 6 EACH	SERIAL NUMBER N/A	PROPERTY NUMBER N/A	ORGANIZATION CODE W8C921	WORK ORDER E51549
SENDER K WITWER 6-3019	ROOM N/A	BUILDING 305	RECALL STATUS 1 ACTIVE 2 NONRECALL 3 SUSPENDED 4 DELETED 5 PM 6 NONDATA M&TE	RECALL CYCLE 360
INSTRUMENT SPECIFICATIONS	COMMENTS 50-150F BUNCH "A"		DATE RECEIVED 970109	TOLERANCE HISTORY NF TOLERANCE AS RECEIVED 1 IN 2 OUT 3 NA 4 FAILED

STANDARD(S) USED IN CALIBRATION TRACEABLE TO NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY OR NATIONALLY RECOGNIZED STANDARDS		EXPIRATION DATE 4:1 RATIO Y ☒ N ☐	
002-79-03-001 4/29/97		EXPIRATION DATE	
002-79-06-036 3/12/97			
REMARKS		TRAINING HOURS	
		CALIBRATION HOURS 6.6	
		REPAIR HOURS	
		OTHER HOURS	
		ENG/ADMIN HOURS 44	
		MATERIALS	
		TOTAL CHARGE = (\$125 x SUM OF HOURS) + MATERIALS	
		DATE CALIBRATED 1/13/97 DATE DUE 1/13/98	

PROCEDURE NUMBER WHC-4-TC-CAL REV.3 AMBIENT TEMPERATURE = 23.7°C

SERIAL NUMBER	STANDARD °C	AS FOUND °C	SERIAL NUMBER	STANDARD °C	AS FOUND °C
# 466	-21.89	-23.9	# 466	51.64	51.8
# 467	-21.88	-22.1	# 467	51.64	51.7
# 469	-21.89	-22.3	# 469	51.63	51.6
# 470	-21.89	-23.6	# 470	51.63	51.6
# 473	-21.89	-22.7	# 473	51.64	51.7
# N/C	-21.88	-22.2	# N/C	51.64	51.6
# 466	0.22	-0.1	# 466	93.56	94.3
# 467	0.23	-0.1	# 467	93.57	94.1
# 469	0.22	-0.2	# 469	93.57	93.8
# 470	0.30	-0.1	# 470	93.55	94.0
# 473	0.27	-0.1	# 473	93.54	94.1
# N/C	0.28	-0.1	# N/C	93.52	93.6
# 466	24.35	24.2			
# 467	24.33	24.1			
# 469	24.31	24.1			
# 470	24.29	24.1			
# 473	24.24	24.1			
# N/C	24.25	24.1			
INFORMATION ONLY					

APPROVED BY	CALIBRATED BY		Hanford Operations and Engineering Contractor for the United States Department of Energy Westinghouse Hanford Company Sub Office of Westinghouse Electric Corporation Box 160, Richland, WA 99352	PAGE 1 OF 1
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CUST.
P/N: _____ REV _____
ER 114D038-10
P/N: _____ REV L

CUSTOMER PO# WW7-XDV-81724
H2 DETECTOR

DESCRIPTION
ASSEMBLY.

S/N 3187HSDA9601

REMARKS:

5144-1.1

ER S/O: 74371

ER W/O: _____

REMARKS:

E-2180

CUST.
P/N: _____ REV _____
ER 114D038-10
P/N: _____ REV L

CUSTOMER PO# WW7-XDV-81724

DESCRIPTION H2 DETECTOR ASSEMBLY.

S/N 3209HSDA9601

JAN 26 1996

REMARKS:

ER S/O: 5144-1.1

ER W/O: 74422

REMARKS:

E-2180

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CUST. _____
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 ER 114D038-10 REV. L
 P/N: _____
 CUMER PO# MW7-XDV-81724
 H2 DETECTOR
 DESCRIPTION _____
 ASSEMBLY JAN 2 5 1996
 S/N 3189HSDA9601
 REMARKS _____
 5144-1.1
 ER S/O: 74371
 ER W/O: _____
 REMARKS: _____

E-2180

CUST. _____
 P/N: _____ REV. _____
 ER 1090020-2 REV. K
 P/N: _____
 CUMER PO# _____
 H2 SST Sensor
 DESCRIPTION _____
 S/N AS 12 35
 1-23-96
 REMARKS: _____
 5144-1.1
 ER S/O: _____
 ER W/O: 73231
 REMARKS: _____

E-2180

CUST. _____
 P/N: _____ REV. _____
 ER 114D038-10 REV. L
 P/N: _____
 CUMER PO# MW7-XDV-81724
 H2 DETECTOR ASSEMBLY
 DESCRIPTION _____
 S/N 3210HSDA9601
 JAN 2 6 1996
 REMARKS: _____
 5144-1.1
 ER S/O: _____
 ER W/O: 74422
 REMARKS: _____

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- Provides Both Galvanically Isolated and Intrinsically Safe Connections for one Thermocouple or Pulse Input Transducer
- Measurement Ranges $\pm 100\text{mV}$, $\pm 1\text{V}$, $\pm 10\text{V}$
- Accepts Frequency Inputs up to 2.5kHz
- Provides Open-Circuit Monitoring
- LED Indication for Unit Supply and Open-Circuit Condition
- Meets Latest Electromagnetic Compatibility Standards
- Reverse Polarity Protection
- 35mm DIN Rail or Surface Mount
- Approvals to Worldwide Standards

Operational Description

The Type 9323 mV Isolating Repeater provides both galvanically isolated and intrinsically safe connections for one thermocouple or pulse input transducer installed in a hazardous location. It transmits DC or AC voltage signals 1:1 to the output.

The switched mode power section 1 generates the galvanically isolated supply voltages for the intrinsically safe input circuit and the nonintrinsically safe output circuit. A green LED indicates when power is on and the internal fuse is intact.

The voltage applied to the IS input 2 is transmitted with galvanic isolation via signal matching circuit 3 and DC/DC converter 4 to output amplifier 5. The voltage polarity is maintained.

With units having open circuit monitoring for the voltage generating transducers, the current generator 6 feeds a constant current through the transducers connected to the intrinsically safe input. When there is an open circuit, the red LED 7 comes on. Output amplifier 5 reacts to the open circuit condition with an excessive positive output signal, which can be evaluated in the control system as a fault.

Ordering Information

9323/10-10-10	$\pm 100\text{ mV}$ input signal
9323/10-10-11	$\pm 100\text{ mV}$ input signal with open-circuit monitoring
9323/10-20-10	$\pm 1\text{ V}$ input signal
9323/10-30-10	$\pm 10\text{ V}$ voltage input signal or

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REQUISITION

EMERGENCY

Page 1 of 1 Date: 1-

A 32028		Buyer's Signature:		REQUISITION		Page 1 of 1		Date: 1-					
strom		Payroll No. 95392		MSIN: H5-09		Area: RCHN		Phone: 6-8959		Need Date: 2-4-97		Associated Documents/End Use: Characterization	
er		Bldg./Room: 305		Area: 300		Phone: 6-3019		QA/QC Requirements Receipt Inspection, Items: N/A		RMCS) Rotary Mode Sampling Imp Equip.			
Approved By		Date		MSIN		Phone		Location: N/A		Source Inspection Req: ☐ Yes ☒ No		Program Code: 1N4HH2	
per CE Hanson		1-28-97		S7-12		6-4810		QA Review of Proposal: ☐ Yes ☒ No		Item		Co ID	
JP.		1-28-97		H5-09		6-5387		Org. Code		Cost Element		Charge Code	
Per Telson		1-28-97		L7-10		3-9886		80000		110		E51549	
1-27-97		S7-23		3-2666		ALL		W		100%			
Control		ers		1-27-97		S7-23		3-2666					
Unit of Measure		Stock Number/Description/Specification						SSC/AD		QA Clauses		Unit Price	
EA		10,000 PPM Hydrogen, Balance Air +/- 2%						N/A		N/A			
		analytical accuracy, "K" Size Bottle, Rented.											
		Gas Shall be Certified Master Gas. Analytical											
		certifications required.											
LOT		MSDS for Line Item 1.											
		SUGGESTED VENDOR: NORCO											
		102 E. Columbia Drive											
		Kennewick, WA 99336											
		(509) 582-6404											
		ATTN: Greg Tuttle											
		Cell Phone: (509) 531-0338											
one)		Vendor Name:						Confirm To:		Phone:			
tevens Dr., Richland, Washington, 99352		Vendor Code:						Zip:					
, 200 East, Richland, Washington, 99352		Promised Date:											
Location		Route Code:		FOB Point:		Payment Terms:		Ship Via:					
LSSA	OO	B of A	RSS	BPR	QVAR	DATA	SBSA	DBSA	BCA	GOV P.	PAT	SLR	
N	C	D	E	F	G	H	I	J	K	L	M	N	

White - Purchasing Other copies distribute as required

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REV _____
 90020-2 REV K
 PO#: _____
 ON H2 SST Sensor
 S/N HS1238
1-23-96
5144-1.1
73231

KS:

-2180

CUST. _____
 P/N: _____ REV _____
 ER _____
 P/N: 114D038-10 REV L
 CUSTOMER PO#: WWT-XPV-81724
H2 DETECTOR
 DESCRIPTION _____
ASSEMBLY. JAN 25 1996
S/N 3189HSDA9601

REMARKS: _____
5144-1.1
 ER S/O: 74371
 ER W/O: _____
 REMARKS: _____

E-2180

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REV _____

038-10 REV L

WW7-XDV-81724

H2 DETECTOR ASSEMBLY.

210HSDA9601

N 2 6 1996

5144-1.1

74422

CUST. _____

P/N: _____ REV _____

ER 114D038-10 REV L

P/N: _____

CUSTOMER PO# WW7-XDV-81724

H2 DETECTOR

DESCRIPTION _____

ASSEMBLY.

S/N 3187HSDA9601

REMARKS:

5144-1.1

ER S/O: 74371

ER W/O: _____

REMARKS:

E-2180

CUST. _____

P/N: _____

ER 114D038-10

P/N: _____

CUSTOMER PO# WW7-XDV-81

DESCRIPTION H2 DETECTOR

S/N 3209HSDA9601

JAN 2 6 1996

REMARKS:

ER S/O: 5144-1.1

ER W/O: 74422

REMARKS:

E-2180

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Scott Specialty Gases

CERTIFICATE OF ANALYSIS

WESTINGHOUSE HANFORD

PO No WGKXYU409472

CAS Reg. Component No	Component	Certified Analysis
1333-74-0	HYDROGEN	3.00 PCT/M
7727-37-9	NITROGEN	BAL

Analytical Accuracy $\pm 2\%$

Project No 09-21513
Cylinder No. 1C3409
Item No. 09022342 4A

Grade CERTIFIED MASTER GAS

Reorder/Service Contact

(510)659-0162 FREMONT

CA 94538

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ANALYSIS OF TEMPERATURE EFFECTS ON WHITTAKER CELL CALIBRATION

Assumptions

1. This analysis is based on the actual values from Whittaker Cells #2 and #4 for zero gas and 10,000 ppm H₂ gas.
2. The input of the Newport meter on the FGI will be scaled for zero gas and 10,000 ppm H₂ after 15 minutes.
3. The output of the Newport meter on the FGI will be scaled for:
 4 mA = 0 ppm H₂
 20 mA = 10,000 ppm H₂

Scenario #1

Whittaker Cell #2 calibrated at 70° F.

After scaling the Newport the following values would apply at 70° F:

Gas Concentration (ppm H ₂)	Whittaker Output (mV)	Newport Display (ppm)	Newport Output (mA)	PLC Display (ppm)
0	0.239	0	4.00	0
10,000	1.760	10,000	20.00	10,000

The following straight line equations may be used to calculate the Newport and PLC responses for other Whittaker Output values given the scaling of the Newport provided above.

$$\text{Newport Display} = 6575 * (\text{Whittaker Output}) - 1571$$

$$\text{Newport Output} = 10.52 * (\text{Whittaker Output}) + 1.49$$

$$\text{PLC Display} = 6575 * (\text{Whittaker Output}) - 1571$$

The actual gas concentration at which the FGI will trip it's 5,000 ppm alarm can be interpolated from the Newport Display values corresponding to 0 and 10,000 ppm H₂ at the given temperature.

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The responses of the FGI system at varying temperatures are shown below:

Temp. (°F)	Gas Conc. (ppm H ₂)	Whittaker Output (mV)	Newport Display (ppm)	Newport Output (mA)	PLC Display (ppm)	Actual Gas Conc. at 5,000 ppm alarm trip.
60	0	0.312	480	4.77	480	4,479
	10,000	1.847	10,572	20*	10,000*	
70	0	0.239	0	4.00	0	5,000
	10,000	1.760	10,000	20.00	10,000	
80	0	0.190	-322	4*	0*	5,533
	10,000	1.653	9,297	18.87	9,297	
100	0	0.136	-677	4*	0*	6,000
	10,000	1.575	8784	18.05	8,784	

* = Limited by 4 - 20 mA output capability of Newport Meter.

Conclusion: If the Whittaker were calibrated at 70° F, it is acceptable to operate the RMCS truck at a Whittaker temperature between 60° F and 70° F.

Scenario #2

Whittaker Cell #2 calibrated at 80° F.

After scaling the Newport the following values would apply at 80° F:

Gas Concentration (ppm H ₂)	Whittaker Output (mV)	Newport Display (ppm)	Newport Output (mA)	PLC Display (ppm)
0	0.190	0	4.00	0
10,000	1.653	10,000	20.00	10,000

The following straight line equations may be used to calculate the Newport and PLC responses for other Whittaker Output values given the scaling of the Newport provided above.

$$\text{Newport Display} = 6835 * (\text{Whittaker Output}) - 1299$$

$$\text{Newport Output} = 10.94 * (\text{Whittaker Output}) + 1.92$$

$$\text{PLC Display} = 6835 * (\text{Whittaker Output}) - 1299$$

The actual gas concentration at which the FGI will trip it's 5,000 ppm alarm can be interpolated from the Newport Display values corresponding to 0 and 10,000 ppm H₂ at the given temperature.

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The responses of the FGI system at varying temperatures are shown below:

Temp. (°F)	Gas Conc. (ppm H ₂)	Whittaker Output (mV)	Newport Display (ppm)	Newport Output (mA)	PLC Display (ppm)	Actual Gas Conc. at 5,000 ppm alarm trip.
60	0	0.312	834	5.33	834	3,971
	10,000	1.847	11,326	20*	10,000*	
70	0	0.239	335	4.54	335	4,487
	10,000	1.760	10,731	20*	10,000*	
80	0	0.190	0	4.00	0	5,000
	10,000	1.653	10,000	20.00	10,000	
100	0	0.136	-369	4*	0*	5,459
	10,000	1.575	9467	19.15	9,467	

* = Limited by 4 - 20 mA output capability of Newport Meter.

Conclusion: If the Whittaker were calibrated at 80° F, it is acceptable to operate the RMCS truck at a Whittaker temperature between 60° F and 80° F, however it is likely that the SAD-035 limit of $\leq 1,000$ ppm prior to sampling will not be achievable below 70° F.

Scenario #3

Whittaker Cell #2 calibrated at 100° F.

After scaling the Newport the following values would apply at 100° F:

Gas Concentration (ppm H ₂)	Whittaker Output (mV)	Newport Display (ppm)	Newport Output (mA)	PLC Display (ppm)
0	0.136	0	4.00	0
10,000	1.575	10,000	20.00	10,000

The following straight line equations may be used to calculate the Newport and PLC responses for other Whittaker Output values given the scaling of the Newport provided above.

$$\text{Newport Display} = 6949 * (\text{Whittaker Output}) - 945$$

$$\text{Newport Output} = 11.12 * (\text{Whittaker Output}) + 2.49$$

$$\text{PLC Display} = 6949 * (\text{Whittaker Output}) - 945$$

The actual gas concentration at which the FGI will trip it's 5,000 ppm alarm can be interpolated from the Newport Display values corresponding to 0 and 10,000 ppm H₂ at the given temperature.

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The responses of the FGI system at varying temperatures are shown below:

Temp. (°F)	Gas Conc. (ppm H ₂)	Whittaker Output (mV)	Newport Display (ppm)	Newport Output (mA)	PLC Display (ppm)	Actual Gas Conc. at 5,000 ppm alarm trip.
60	0	0.312	1223	5.96	1223	3,541
	10,000	1.847	11,890	20*	10,000*	
70	0	0.239	716	5.15	716	4,053
	10,000	1.760	11,286	20*	10,000*	
80	0	0.190	375	4.60	375	4,549
	10,000	1.653	10,542	20*	10,000*	
100	0	0.136	0	4.00	0	5,000
	10,000	1.575	10,000	20.00	10,000	

* = Limited by 4 – 20 mA output capability of Newport Meter.

Conclusion: If the Whittaker were calibrated at 100° F, it is acceptable to operate the RMCS truck at a Whittaker temperature between 60° F and 100° F, however it is likely that the SAD-035 limit of $\leq 1,000$ ppm prior to sampling will not be achievable below 80° F.

Scenario #4

Whittaker Cell #4 calibrated at 70° F.

After scaling the Newport the following values would apply at 70° F:

Gas Concentration (ppm H ₂)	Whittaker Output (mV)	Newport Display (ppm)	Newport Output (mA)	PLC Display (ppm)
0	0.242	0	4.00	0
10,000	1.834	10,000	20.00	10,000

The following straight line equations may be used to calculate the Newport and PLC responses for other Whittaker Output values given the scaling of the Newport provided above.

$$\text{Newport Display} = 6281 * (\text{Whittaker Output}) - 1520$$

$$\text{Newport Output} = 10.05 * (\text{Whittaker Output}) + 1.57$$

$$\text{PLC Display} = 6281 * (\text{Whittaker Output}) - 1520$$

The actual gas concentration at which the FGI will trip it's 5,000 ppm alarm can be interpolated from the Newport Display values corresponding to 0 and 10,000 ppm H₂ at the given temperature.

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The responses of the FGI system at varying temperatures are shown below:

Temp. (°F)	Gas Conc. (ppm H ₂)	Whittaker Output (mV)	Newport Display (ppm)	Newport Output (mA)	PLC Display (ppm)	Actual Gas Conc. at 5,000 ppm alarm trip.
60	0	0.312	440	4.70	440	4,405
	10,000	1.960	10,791	20*	10,000*	
70	0	0.242	0	4.00	0	5,000
	10,000	1.834	10,000	20.00	10,000	
80	0	0.192	-314	4*	0*	5,685
	10,000	1.680	9,033	18.45	9,033	
100	0	0.164	-490	4*	0*	5,870
	10,000	1.653	8863	18.18	8,863	

* = Limited by 4 - 20 mA output capability of Newport Meter.

Conclusion: If the Whittaker were calibrated at 70° F, it is acceptable to operate the RMCS truck at a Whittaker temperature between 60° F and 70° F.

Scenario #5

Whittaker Cell #4 calibrated at 80° F.

After scaling the Newport the following values would apply at 80° F:

Gas Concentration (ppm H ₂)	Whittaker Output (mV)	Newport Display (ppm)	Newport Output (mA)	PLC Display (ppm)
0	0.192	0	4.00	0
10,000	1.680	10,000	20.00	10,000

The following straight line equations may be used to calculate the Newport and PLC responses for other Whittaker Output values given the scaling of the Newport provided above.

$$\text{Newport Display} = 6720 * (\text{Whittaker Output}) - 1290$$

$$\text{Newport Output} = 10.75 * (\text{Whittaker Output}) + 1.94$$

$$\text{PLC Display} = 6720 * (\text{Whittaker Output}) - 1290$$

The actual gas concentration at which the FGI will trip it's 5,000 ppm alarm can be interpolated from the Newport Display values corresponding to 0 and 10,000 ppm H₂ at the given temperature.

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The responses of the FGI system at varying temperatures are shown below:

Temp. (°F)	Gas Conc. (ppm H ₂)	Whittaker Output (mV)	Newport Display (ppm)	Newport Output (mA)	PLC Display (ppm)	Actual Gas Conc. at 5,000 ppm alarm trip.
60	0	0.312	806	5.29	806	3,787
	10,000	1.960	11,882	20*	10,000*	
70	0	0.242	336	4.54	336	4,359
	10,000	1.834	11,035	20*	10,000*	
80	0	0.192	0	4.00	0	5,000
	10,000	1.680	10,000	20.00	10,000	
100	0	0.164	-188	4*	0*	5,184
	10,000	1.653	9819	19.71	9,819	

* = Limited by 4 – 20 mA output capability of Newport Meter.

Conclusion: If the Whittaker were calibrated at 80° F, it is acceptable to operate the RMCS truck at a Whittaker temperature between 60° F and 80° F, however it is likely that the SAD-035 limit of $\leq 1,000$ ppm prior to sampling will not be achievable below 70° F.

Scenario #6

Whittaker Cell #4 calibrated at 100° F.

After scaling the Newport the following values would apply at 100° F:

Gas Concentration (ppm H ₂)	Whittaker Output (mV)	Newport Display (ppm)	Newport Output (mA)	PLC Display (ppm)
0	0.164	0	4.00	0
10,000	1.653	10,000	20.00	10,000

The following straight line equations may be used to calculate the Newport and PLC responses for other Whittaker Output values given the scaling of the Newport provided above.

$$\text{Newport Display} = 6716 * (\text{Whittaker Output}) - 1101$$

$$\text{Newport Output} = 10.75 * (\text{Whittaker Output}) + 2.24$$

$$\text{PLC Display} = 6716 * (\text{Whittaker Output}) - 1101$$

The actual gas concentration at which the FGI will trip it's 5,000 ppm alarm can be interpolated from the Newport Display values corresponding to 0 and 10,000 ppm H₂ at the given temperature.

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The responses of the FGI system at varying temperatures are shown below:

Temp. (°F)	Gas Conc. (ppm H ₂)	Whittaker Output (mV)	Newport Display (ppm)	Newport Output (mA)	PLC Display (ppm)	Actual Gas Conc. at 5,000 ppm alarm trip.
60	0	0.312	994	5.59	994	3,619
	10,000	1.960	12,062	20*	10,000*	
70	0	0.242	524	4.84	524	4,186
	10,000	1.834	11,216	20*	10,000*	
80	0	0.192	188	4.30	188	4,815
	10,000	1.680	10,181	20*	10,000*	
100	0	0.164	0	4.00	0	5,000
	10,000	1.653	10,000	20.00	10,000	

* = Limited by 4 - 20 mA output capability of Newport Meter.

Conclusion: If the Whittaker were calibrated at 100° F, it is acceptable to operate the RMCS truck at a Whittaker temperature between 60° F and 100° F, however it is likely that the SAD-035 limit of $\leq 1,000$ ppm prior to sampling will not be achievable below 80° F.

Summary

If the Whittaker cell is calibrated between 70° F and 100° F the RMCS truck may be operated at a Whittaker temperature between 60° F and the temperature the calibration was performed at. If the Whittaker cell is calibrated between 70° F and 80° F, the SAD-035 limit of $\leq 1,000$ ppm prior to sampling will likely not be achievable at a Whittaker temperature below 10° F less than the calibration temperature. If the Whittaker cell is calibrated at 100° F, the SAD-035 limit of $\leq 1,000$ ppm prior to sampling will likely not be achievable below 80° F. The best option, if the Whittaker temperature can be maintained above 80° F during operation, is to calibrate the Whittaker at 100° F since this will maximize the operating temperature range.

Analysis Performed by: Eric Waldo 2/12/97

Reviewed by: [Signature] 2/12/97

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