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ACTIVITY/PROJECT SPECIFIC PROCEDURE



SP 12-29 493.10 ANALOG I/O AND DAS CALIBRATION BY COMPARISON METHOD Revision 0

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(printed name) (signature) (date)

1.0 Purpose and Scope

This procedure prescribes the Sandia National Laboratories (SNL) Waste Isolation Pilot Plant (WIPP) process for the calibration of the MTS test frame controller's (493.10) analog input/output (analog I/O) and data acquisition system (DAS) using the comparison method with a Fluke 341A DC Voltage Calibrator (Voltage Calibrator) and Keithley 2000 Multimeter (Keithley Meter) both calibrated by Sandia National Laboratories Primary Standards Laboratories (PSL).

Calibration of the 493.10 analog I/O and DAS will require a known DC signal be fed into each of the analog inputs. That signal will be saved in the data acquisition portion of the program and then fed back out of the 493.10 analog outputs into a Keithley meter. The readout on the Keithley meter will be manually recorded. This data will then be added to the spread sheet of the data recorded by the 493.10 data acquisition program. A temperature measurement device, Rotronic Hygrolog-D, will also be used to verify ambient temperature at time of calibration.

This document is not meant to substitute for the manufacturer's instruction manual's recommendations for 493.10 analog I/O DAS calibration. The user is responsible for reading and understanding the appropriate manuals for the items being calibrated and the equipment used.

Acronyms and definitions for terms used in this procedure may be found in the Glossary located at the Sandia National Laboratories (SNL) WIPP Online Documents web site.

2.0 Implementation Actions

2.1 Safety

The activities described in this SP shall conform to SNL Environmental Safety and Health Programs (ES&H). All activities described in this SP are subject to ES&H requirements governed by the WIPP Industrial Safety Program and the WIPP Industrial Hygiene Program.

As defined in ES&H 100 Corporate Policies, personnel will not be exposed to hazardous voltages. The voltage levels expected in the performance of this procedure should be 24 VDC or less.

Frame hydraulic power is not energized during this calibration procedure.

2.2 Responsibilities

The Principal Investigator (PI) and the Principal User, whose activities warrant the use of this procedure, shall be responsible for implementing the requirements of this procedure.

The Principal User is also responsible for assuring that the test system, Voltage calibrator and Keithley meter are in good working order.

The staff member performing the calibration is responsible for following the requirements of this procedure and shall verify that the latest revision of this procedure is being implemented.

If this procedure cannot be worked as written, the user has the responsibility to stop work and resolve all concerns with either the PI, Principal User or QA representative, as appropriate, prior to proceeding with the work.

2.3 Standards

The DC voltage output from the Fluke 341A DC Voltage Calibrator will be fed into each of the 493.10 analog inputs. The DC voltage output will be checked for accuracy using the Keithley 2000 Multimeter.

The temperature during calibration will be monitored using a temperature sensor (Rotronic Hygrolog-D). The voltage calibrator, meter and temperature sensor used during the performance of this procedure shall be calibrated and traceable to NIST through the Sandia Primary Standards laboratory in Albuquerque, NM or an approved supplier. The serial number and expiration dates of the standards will be recorded in the applicable scientific notebook or scientific notebook supplement (SNS) and the calibration data sheet. The Voltage Calibrator, temperature sensor and Keithley Meter shall not be used in the performance of this procedure if they are past their expiration date without prior approval of the PI or Principal User.

2.4 Frequency

The 493.10 analog I/O and DAS shall be calibrated at a frequency consistent with manufacturer's specifications or based on its performance history. If no baseline exists and the manufacturer has no specification, it will be calibrated annually (on twelve month intervals).

The PI or Principal User may elect to lengthen or shorten the calibration interval based on the results of previous calibrations and the stability of the equipment. Any deviations from the established calibration interval will be justified in the applicable scientific notebook/SNS.

2.5 Acceptance Criteria

The accuracy of the 493.10 analog I/O and DAS will be based on manufacturer's specifications or the requirements of the PI or Principal User. If the calibration of the 493.10 analog I/O and DAS deviates from the manufacturer's or PI's specifications the calibration will be identified as 'Limited'. All calibrations shall be performed with the ambient temperature between 20-30°C. The temperature shall also be stable, within +/-2°C during the calibration. If the temperature fluctuates beyond these values, abort the calibration and repeat when the temperature has stabilized.

2.6 Corrective Action

If the 493.10 analog I/O and/or DAS does not meet tolerances during the performance of this procedure it will be considered damaged, the faulty input and/or output channel shall be tagged and taken out of service until repaired. If during the performance of an As-Found calibration the input or output channel is found to be out of tolerance, a Corrective Action Request (CAR) will be issued to document the results and impacts related to the change in the 493.10 analog I/O and DAS performance. Corrective action could include evaluation and adjustment to any data collected by this channel, re-evaluation of the calibration interval, or an assessment of the process in which the instrument is being utilized. Results of all activities related to the out-of-tolerance condition will be summarized in the CAR.

2.7 As-Found Calibration / Verification

The calibration process includes the following general steps: (1) Perform an As-Found/As-Received Calibration at multiple data points (0V, 0.01V, 0.05V, 0.10V, 0.50V, 1V, 2V, 4V, 6V, 8V, 10V, 0V) along both the plus and negative voltage range; (2) Calibration uncertainty will be calculated using the error between the Voltage Calibrator, the voltage recorded in the data acquisition program and the measured signal from the analog output channels using a best straight line fit routine; (3) The resulting error will be compared with the established acceptance criteria (tolerances) to determine the adequacy of the calibration; and (4) Validate the calibration calculation per NP 9-1, *Analyses*. This calibration process and the equipment utilized are described below in greater detail;

2.7.1 Turn on the equipment to be used in the performance of this procedure, allow the equipment to warm-up a minimum of 20 minutes before starting the calibration.

2.7.2 Daisy chain the 493.10 analog inputs together using BNC cables and Ts. Plug the daisy chain into the Voltage Calibrator output.

Note: A calibration program may have to be created in the 493.10 MultiPurpose Testware (MPT) application software to record each analog input channel. See the MTS MultiPurpose Testware manual for details about setting up a program.

2.7.3 Set the Voltage Calibrator to 0 volts. Use the Keithley meter to check the output of the Voltage Calibrator. Record this reading.

2.7.4 Activate the MPT program to take a data point.

2.7.5 Use the Keithley meter to read the output of each of the analog output channels. Manually record each of these outputs.

2.7.6 Adjust the Voltage Calibrator to the next test value i.e. 0.01 volts DC.

2.7.7 Activate the MPT program to take a data point.

2.7.8 Use the Keithley meter to read the output of each of the analog output channels. Manually record each of these outputs.

2.7.9 Repeat steps 2.7.6 – 2.7.8 until all test data points have been reached and the corresponding analog outputs have been measured and recorded in the applicable scientific notebook/SNS and data sheet.

2.7.10 Calculate the performance of the 493.10 analog I/O and DAS using a product like Excel's Regression Analysis Tool to develop a best straight line fit equation for the calibration results. The calibration performance shall be equal to or better than the manufacturer's or PI's specifications. If the calibration does not meet specifications issue a Corrective Action Request (CAR). The unit can either be repaired or de-rated by assigning a 'Limited' calibration. Initiate a CAR per the requirements of NP 16-1, *Corrective Action*, to document the failure of the 493.10 analog I/O and DAS to meet the established acceptance criteria. If the 493.10 analog I/O and DAS channel has been repaired, repeat steps 2.7.1 - 2.7.9.

Note: The PI or Principal User may decide to accept an As-Found calibration that exceeds the stated acceptance criteria. The PI or Principal User will need to document this decision and any impact on data collected in the scientific notebook/SNS. Both the calibration tag and the applicable scientific notebook/SNS shall document the limited calibration.

2.8 References

- MTS Flex Test GT - Operator Manual
- Fluke 341A DC Voltage Calibrator - Operator Manual
- Keithley 2000 Multimeter - Operator Manual
- Operating Procedure for the 0.1 MN (22KIP) MTS Load Frame, OP-6315-22
- Operating Procedure for the 1 MN (220KIP) Triaxial Testing System, OP-6315-220
- Operating Procedure for General Laboratory Activities, OP-6315-GLA
- ES&H100 Corporate Policies

3.0 Records

The following QA records, generated through implementation of this procedure, shall be prepared and submitted to the WIPP Records Center in accordance with NP 17-1 (Records):

QA Record

- Corrective Action Request (CAR), Form NP 16-1-1, if required
- Scientific Notebook or Scientific Notebook Supplement
- Calibration Data Sheet (See Appendix A)

4.0 Appendices

Appendix A: DAS Calibration Data Sheet

Appendix A

493.10 Analog I/O and DAS Calibration Data By Comparison Method

Date: 03/02/10

By: jhh 6735

For: 849 geolab

UUT Model #: 493.10
UUT S/N: 12345

Did UUT Meet Calibration Specifications? _____ Expiration Date _____
DC Voltage Source Model #: Fluke 341A , File SNL-xxxx, Exp. Xx/xx/xx
DC Voltage Source S/N: 12345
Meter Model #: Keithley 2000, File SNL-xxxx, Exp. Xx/xx/xx
Meter Model S/N: 12345

Temp 23.1C Temperature/Humidity Indicator Model #: Rotronic 8303 File SNL-6566785, Exp. 09/29/10
RH% 30.00% Temperature/Humidity Indicator S/N: 60189152/150013

Source Volts	Analog Input 1 Volts	Error % Reading	Analog Input 2 Volts	Error % Reading	Analog Input 3 Volts	Error % Reading	Analog Input 4 Volts	Error % Reading
0.000	-0.000		-0.001		-0.000		-0.000	
0.010	0.010	0.000	0.010	0.000	0.010	0.000	0.010	0.000
0.050	0.050	0.000	0.050	0.000	0.050	0.000	0.050	0.000
0.100	0.100	0.200	0.100	0.100	0.100	0.100	0.100	0.200
0.500	0.500	0.020	0.500	0.020	0.500	0.040	0.500	0.020
1.005	1.005	-0.020	1.004	-0.120	1.005	-0.020	1.005	-0.020
1.998	1.999	0.040	1.999	0.040	1.999	0.040	1.999	0.040
4.008	4.008	-0.005	4.007	-0.030	4.008	-0.005	4.008	-0.005
6.002	6.002	0.000	6.001	-0.017	6.003	0.017	6.002	0.000
8.005	8.004	-0.013	8.006	0.013	8.005	0.000	8.004	-0.013
10.002	10.002	0.000	10.001	-0.010	10.003	0.010	10.002	0.000
0	0		0		0		0	

Source Volts	Read Out 1 Volts	Error % Reading	Read Out 2 Volts	Error % Reading	Read Out 3 Volts	Error % Reading
0.00	0.001		0.001		0.001	
0.010	0.010	0.000	0.010	0.000	0.010	0.000
0.050	0.050	0.000	0.050	0.000	0.050	0.000
0.100	0.100	0.100	0.100	0.100	0.100	0.100
0.500	0.500	0.020	0.500	0.020	0.500	0.020
1.005	1.005	-0.020	1.005	-0.020	1.005	-0.020
1.998	1.998	-0.010	1.998	-0.010	1.998	-0.010
4.008	4.008	-0.005	4.008	-0.005	4.008	-0.005
6.002	6.002	0.000	6.002	0.000	6.002	0.000
8.005	8.005	0.000	8.005	0.000	8.005	0.000
10.002	10.002	0.000	10.002	0.000	10.002	0.000
0	0		0		0	

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