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**SANDIA NATIONAL LABORATORIES  
CIVILIAN RADIOACTIVE WASTE MANAGEMENT  
TECHNICAL PROCEDURE (TP)**

**TP-248**

**COLLECTION OF VIBRATING WIRE DATA USING A  
PORTABLE DATALOGGER OR A GK-403 READOUT BOX**

**Revision 02**

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00	9/22/95	Initial issue, effective
01	1/31/97	Minor improvements and, per DR YMP-96-D088, revision to clarify QA record classification and requirements.
02	4/20/04	Modified per QAIP 20-1, Revision 9, to address issues raised in CR2035, 3/9/04. Changed title to "Calibration of Vibrating Wire Data Using a Portable Datalogger or a GK-403 Readout Box"

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## **1.0 SCOPE**

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Sandia National Laboratories (SNL) is responsible for rock mechanics field experiments to monitor and characterize the Exploratory Studies Facility (ESF). These experiments include installing and monitoring instrumentation that measures the long-term in situ stability of rock units penetrated by ESF excavations.

This Technical Procedure (TP) applies to all Yucca Mountain Project (YMP) SNL personnel and contractors who will be trained and qualified to read, verify, and back up vibrating wire (VW) data using either a portable datalogger (PDL) containing a CR10 measurement and control module or using a GK-403 VW Readout Box.

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## **2.0 ACTIVITY OBJECTIVE**

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The objective of the activity described in this TP is to collect VW data from the various types of rock mechanics instrumentation in the ESF, including steel set strain gages, instrumented rock bolts, rock bolt load cells, multi-point borehole extensometers (MPBX) and single-point borehole extensometers (SPBX). This procedure defines the methods used for reading, verifying, and backing up this VW data.

Successful implementation of this procedure will result in appropriately collected, verified, and stored rock mechanics data.

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## **3.0 RESPONSIBILITIES**

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The Principal Investigator (PI) has responsibility for ensuring that all data collection activities performed as part of this procedure are in compliance with applicable SNL Quality Assurance Implementing Procedures (QAIPs) and YMP Quality Assurance (QA) procedures.

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## **4.0 QUALIFICATION PREREQUISITES**

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The Principal Investigator (PI) or PI designee is responsible for assuring and documenting that individuals assigned to conduct VW measurements have read, are trained to and have demonstrated proficiency in the use of this procedure before these individuals initiate work. The PI/PI designee is also responsible for verifying instrument and instrumentation performance in accordance with the requirements defined in TP-249, *Maintenance, Verification, and Rejection Criteria of Instrumentation*.

The following prerequisites are required when using this procedure:

- A current version of this procedure is available for use.

- Measuring and Test Equipment (M&TE) used shall have a current calibration.

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## 5.0 DEFINITIONS/ACRONYMS

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DAS	Data Acquisition System
ESF	Exploratory Studies Facility
M&TE	Measuring and Test Equipment
MPBX	Multi-Point Borehole Extensometer
PDL	Portable Data Logger
PHA	Preliminary Hazard Assessment
PI	Principal Investigator
QA	Quality Assurance
QAIP	Quality Assurance Implementing Procedure
RPC	Records Processing Center
SNL	Sandia National Laboratories
SPBX	Single-Point Borehole Extensometer
STN	Software Tracking Number
TDMS	Technical Data Management System
TP	Technical Procedure
VW	Vibrating Wire
VWSG	Vibrating Wire Strain Gage
YMP	Yucca Mountain Project

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## 6.0 VW DATA COLLECTION USING A PDL

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This section of the procedure only applies to the collection of data using the PDL (including a CR10) and the SNL field computer (a laptop PC). If the data is to be collected using the GK-403 VW Readout Box, proceed to section 7.0 of the procedure. Collecting VW data using a PDL involves the performance of four steps that must be performed in sequence:

1. Preparing to Collect VW Data using a PDL
2. Collecting and verifying the VW Data
3. Verifying VW Data Collected with a PDL
4. PDL Data Handling

### 6.1 Preparing to Collect VW Data using a PDL

Prior to performing this work, ensure you have the following items:

- PDL Performance Check Form (**PreTest** and **PostTest**) (Appendix A)
- PDL Data Acquisition Form (Appendix B)
- Fully charged PDL including a calibrated CR10
- Fully charged and calibrated GK-403 VW Readout Box

- Field computer loaded with a qualified version of PC208W software
- Backup field computer power supply
- VW test gage block
- Wristwatch and pen

#### 6.1.1 PDL Performance Check

The PDL Performance Check must be performed each day this PDL is used to collect VW data. The successful completion of the PDL Performance Check will demonstrate that the individual is proficient in the use of the PDL and the GK-403 VW Readout Box as described in this TP. The PDL Performance Check utilizes a single vibrating wire strain gage (VWSG) mounted onto a test block and configured to send strain data to 12 channels in the PDL. The following steps describe the PreTest and PostTest PDL Performance Check process:

1. Connect the red and black leads of the GK-403 VW Readout Box to the red and black leads of the VWSG test block.
2. Turn on the GK-403 VW Readout Box and set Display Mode selector to the E-Scale.
3. Read and record the GK-403 VW Readout Box  $\mu$ Strain value on the PDL Performance Check Form (Appendix A).
4. Calculate the  $\pm 2\%$  tolerance readings and record these  $\mu$ Strain values on the PDL Performance Check Form (Appendix A).
5. Disconnect the leads and turn off the GK-403 VW Readout Box power
6. Connect the multi-pin connector from the PDL to the VW test block multi-pin port.
7. Attach the serial port cable from the PDL serial port to the field computer serial port.
8. Turn on the power to the PDL.
9. Turn on the field computer, if needed set the field computer clock.
10. Select the “**PC208W**” icon on the field computer.
11. Select the “**CONNECT**” feature button on the toolbar to display the “**CR10 Datalogger Connection**” main menu.
12. Click the “**Connect**” button to connect the field computer to the PDL.

13. Click “**Set Datalogger CLK**” to synchronize the field computer clock and the PDL clock.
14. Check the “**Prompt for data file name,**” box.
15. Click “**Associate DLD Program**”.
16. Select the file “**agapito.dld**”.
17. Click “**OK**” and then “**Send**” to download “**agapito.dld**”, the CR10 datalogger control program, from the field computer to the CR10 datalogger in the PDL. The multiplexer in the PDL will start its sampling cycle. Record name, revision and issue date of control program on PDL Performance Check Form (Appendix A).
18. Click “**Numeric**” prompt to view the twelve VW data channels.
19. Record the twelve PDL  $\mu$ strain values on the PDL Performance Check Form (Appendix A).
20. If the twelve channels are not reading within the  $\pm 2\%$  tolerance determined and recorded in Step 4, report the suspect condition to the PI/PI designee before proceeding. Any conditions shall be processed in accordance with AP-16.1Q, Condition Reporting and Resolution.
21. Close “**Numeric**” window if all twelve channels are within tolerance.
22. Open the “**Ports/Flags**” prompt.
23. Click the **Flag #1** function key to store the data collected during the reading cycle in progress into the PDL memory. Press Flag #1 again to ensure reading of the data. Close “**Ports/Flags**” window.
24. Open the “**Collect**” prompt.
25. On the **Alternate Data Filename** menu, click “**Browse**”. Locate and open current fiscal year folder, example, C:\PC208W\FY2004.
26. Enter an eight character file name for the (\*.dat) file. The (\*) file name should include a four character date code and a four character station location/ID code, i.e. 0219vwt1.dat, where ‘0219’ is the date code for Feb 19, and ‘vwt1’ is the station location/ID code for Vibrating Wire Test 1.
27. Select “**OK**” to download stored data from the PDL to the field computer. Return to the main menu.

#### 6.1.2 Verifying Performance Check Data

1. Click the “**VIEW**” feature button on the **PC208W** toolbar.
2. Click on **File/Open** to locate data file to be verified.
3. From the **Open** menu, right click on the name of the data file to be verified and bring up the **Select** menu.
4. Select ‘**Properties**’ to view attributes of the selected data file.
5. Complete the PreTest or PostTest portion of the PDL Performance Check Form (Appendix A).
6. Check the “**Read Only**” attribute to write protect the data file.
7. Return to the **Open** menu. Click “**Open**” or double click on the file name.
8. Check “**I do not want an FSL file for this data file**” then click “**OK**” to view and verify that the data file has been successfully downloaded.
9. Exit **PC208W** and power down the field computer.
10. Disconnect the PDL from the VWSG block.
11. Disconnect the PDL serial port cable from the field computer.
12. If performing **PreTest**, leave the PDL *ON* until all field VW data have been collected.
13. If performing **PostTest**, turn the PDL *OFF*.

## 6.2 Collecting VW Data with a PDL

- 6.2.1 Locate the appropriate station to be monitored. Monitoring stations are located throughout the ESF and they have VW transducer leads routed to them.
- 6.2.2 If the monitoring station has been instrumented with a junction box, connect the multi-pin connector from the PDL to the junction box multi-pin port. Go to Step 6.2.4 .
- 6.2.3 If a junction box has not been installed at the monitoring station, connect the appropriate VW transducers to the corresponding pushpins on top of the PDL case.
- 6.2.4 Perform the following steps to collect data from the connected VW instruments.
  1. Attach the serial port cable from the PDL serial port to the field computer serial port.

2. Turn on the field computer.
3. Click on the “**PC208W**” icon.
4. Click the “**CONNECT**” feature button on the toolbar to display the “**CR10 Datalogger Connection**” menu, the field computer and PDL will automatically connect.
5. Verify clock synchronization of the field computer and the PDL.
6. Click “**Numeric**” to display the data channels. Identify by data channel number any over range indication (-99999) or unstable condition where the value fluctuates by 100 or more. Record the channel number in the **Comments** of the PDL Data Acquisition Form (Appendix B)
7. Close the “**Numeric**” window.
8. Open the “**Ports/Flags**” prompt.
9. Click the **Flag #1** function key to store the data collected during the reading cycle in progress into the PDL memory. Press Flag #1 again to ensure reading of the data. Close “**Ports/Flags**” window.
10. Open the “**Collect**” prompt. On the **Alternate Data Filename** menu, select “**Browse**”. Open current fiscal year folder, example, C:\PC208W\FY2004. Name the \*.dat file to include date and station location/ID codes, i.e. 02190020, where ‘0219’ is the date code for Feb 19 and ‘0020’ is the Steel Set ID number.
11. Click “**OK**” to download stored data from the PDL to the field computer. Return to the main menu.

### 6.3 Verifying VW Data Collected with a PDL

To view and to verify the field data file, perform the following steps:

1. Click the “**VIEW**” feature button on the **PC208W** toolbar.
2. Click on **File/Open** to locate data file to be verified.
3. From the **Open** menu, right click on the name of the data file to be verified and bring up the **Select** menu.
4. Select ‘**Properties**’ to view attributes of the selected data file.
5. Record the selected file information on the PDL VW Data Acquisition Form (Appendix B).

6. Check the '**Read Only**' attribute to write protect the data file.
7. Return to the **Open** menu. Click "**Open**" or double click on the file name.
8. Check "**I do not want an FSL file for this data file**", then click "**OK**" to view and verify that the data file has been successfully downloaded to the field computer.
9. Exit PC208W and power down the field computer.
10. Disconnect the PDL from the junction box.
11. Disconnect the PDL from the field computer.
12. Return to Section 6.3 at each station location to be monitored with the PDL.
13. At the completion of the day's data collection return to section 6.2 and perform the **PostTest** PDL Performance Check process.

#### 6.4 PDL Data Handling

Data transfers, data processing and data submittal to the TDMS will be performed in compliance with the requirements of AP-SV.1Q, *Control of the Electronic Management of Information*, and AP-SIII.3Q, *Submittal and Incorporation of Data to the Technical Data Management System*. Data transfers will be documented and verified using software on the *Software Baseline Report*. Data processing for conversion of the raw data to engineering units will use commercial Off-the-Shelf software programs (e.g., Microsoft Excel) and will utilize basic math calculations. These math calculations will be documented and verified as part of the TDMS data submittal package.

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## 7.0 VW DATA COLLECTION USING A GK-403 VW READOUT BOX

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This section only applies to the use of the GK-403 VW Readout Box for the collection of data. If data is to be collected using the PDL, proceed to Section 6.0 of this procedure. Collecting VW data using a GK-403 VW Readout Box involves the performance of the following three steps:

1. Preparing to collect VW Data using a GK-403 VW Readout Box
  2. Collecting VW Data with a GK-403 VW Readout Box
  3. GK-403 Data Handling
- 7.1 Preparing to Collect VW Data using a GK-403 VW Readout Box

Prior to performing this work, ensure that you have the following items:

- Fully charged and calibrated GK-403 VW Readout Box

- PDL
- MPBX/SPBX Manual Data Acquisition Form (Appendix C)
- VWSG Manual Data Acquisition Form (Appendix D)
- Wristwatch and pen

## 7.2 Collecting VW Data with a GK-403 VW Readout Box

7.2.1 Locate the appropriate station to be monitored. Monitoring stations are located throughout the ESF and they have VW transducer leads routed to them.

7.2.2 If the monitoring station has been instrumented with a junction box:

- Connect the multi-pin connector from the PDL to the junction box multi-pin connector.
- Connect the GK-403 VW Readout Box to the corresponding channel pushpins on top of the PDL case.
- Go to 7.2.4.

7.2.3 If the monitoring station has no junction box installed, connect the GK-403 Readout Box directly to the gage leads according to the gage wiring diagram.

7.2.4 Use the following steps to collect VW data with the GK-403 VW Readout Box :

1. Set the GK-403 VW Readout Box to the desired scale.
2. Turn on the GK-403 VW Readout Box.
3. Read the value and complete the MPBX/SPBX Manual Data Acquisition Form (Appendix C) or the VWSG Manual Data Acquisition Form (Appendix D) for each transducer at the monitoring station.
4. Turn off the GK-403 VW Readout Box.
5. Disconnect the GK-403 VW Readout Box from the PDL or the gage.
6. If used, disconnect the PDL from the junction box.
7. Repeat Section 7.2 at each station location to be monitored with the GK-403 VW Readout Box.

## 7.3 GK-403 Data Handling

All manual data acquisition forms shall be returned to the PI/PI designee. The PI is responsible for reviewing the records for accuracy and completeness. The raw data will be converted to engineering units using Off-the-shelf software programs (e.g., Microsoft Excel) utilizing basic math calculations. These calculations will be documented and verified as part of the TDMS data submittal package. Data transfer, processing and submittal of the data to the TDMS will be performed in compliance with the requirements of AP-SV.1Q and AP-SIII.3Q.

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## 8.0 RECORDS

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Records and record packages, including corrections and changes thereto, generated as a result of implementing this procedure will be prepared and submitted as QA records (QA:QA) to the RPC in accordance with AP-17.1Q, *Records Management*, and AP-SIII.3Q.

The QA records generated in this TP include, but are not limited to:

- PDL Performance Check Form (Appendix A)
- PDL Data Acquisition Form (Appendix B)
- MPBX/SPBX Manual Data Acquisition Form (Appendix C)
- VWSG Manual Data Acquisition Form (Appendix D)
- M&TE Calibration records
- Raw data and compiled data to document this work

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## 9.0 REFERENCES

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Preliminary Hazard Assessment 474315 for the Exploratory Studies Facility, Sandia National Laboratories, Albuquerque, NM.

AP-12.1Q, *Control of Measuring and Test Equipment and Calibration Standards*

AP-16.1Q, *Condition Reporting and Resolution*

AP-17.1Q, *Records Management*

AP-SIII.3Q, *Submittal and Incorporation of Data to the Technical Data Management System*

AP-SV.1Q, *Control of the Electronic Management of Information*

LP-SI.11Q-BSC, *Software Management*

QAIP 20-1, *Technical Procedures*

TP-249, *Maintenance, Verification, and Rejection Criteria of Instrumentation*

The most current version of reference procedures in place at the time of work performance will apply.



### PDL Performance Check Form

Date:			PreTest			Date:			PostTest		
	μStrain Reading	Comments	*Reader Initials		μStrain Reading	Comments	*Reader Initials		μStrain Reading	Comments	*Reader Initials
GK-403 (E-Scale)				GK-403 (E-Scale)							
GK-403 +2%				GK-403 +2%							
GK403 -2%				GK-403 -2%							
PDL CH #1-LOF				PDL CH #1-LOF							
PDL CH #2-LOP				PDL CH #2-LOP							
PDL CH #3-LIF				PDL CH #3-LIF							
PDL CH #4-LIP				PDL CH #4-LIP							
PDL CH #5-COF				PDL CH #5-COF							
PDL CH #6-COP				PDL CH #6-COP							
PDL CH #7-CIF				PDL CH #7-CIF							
PDL CH #8-CIP				PDL CH #8-CIP							
PDL CH #9-ROF				PDL CH #9-ROF							
PDL CH #10-ROP				PDL CH #10-ROP							
PDL CH #11-RIF				PDL CH #11-RIF							
PDL CH #12-RIP				PDL CH #12-RIP							

File Name: \_\_\_\_\_ File Size (bytes): \_\_\_\_\_ Time: \_\_\_\_\_

File Name: \_\_\_\_\_ File Size (bytes): \_\_\_\_\_ Time: \_\_\_\_\_

GK-403 ID: \_\_\_\_\_ GK-403 Recall Date: \_\_\_\_\_  
 CR10 ID: \_\_\_\_\_ CR10 Recall Date: \_\_\_\_\_  
 PC208 W Version #: 3.2 PC208W STN: 10739-3.2-00  
 CR10 Control Software: Agapito.pdf Rev/Date: Rev A, 01/13/95

VWSG ID		
SS Section	Vertical Position	Horizontal Position
(L)eft	(O)utside	(F)ace
(C)rown	(I)nside	(P)ortal
(R)ight		

**\*Reader initials above indicate that the individual has read and can demonstrate proficiency in the use of the latest version of TP-248.**



***PDL VW Data Acquisition Form***

	Station Location (M)	Station ID	Data File Name	Date Data File Created	Time Data File Created	File Size (byte)	CR10		Comments	*Reader Initials
							ID	Recall Date		
1.										
2.										
3.										
4.										
5.										
6.										
7.										
8.										
9.										
10.										
11.										
12.										
13.										
14.										
15.										
16.										
17.										

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### MPBX/SPBX Manual Data Acquisition Form

Date	Time	Station ID	VW Type	Gage Orientation	GK-403 Scale	GK-403 Reading				Comments	GK-403 ID	Recall Date	*Reader Initials
						Anchor 1	Anchor 2	Anchor 3	Temp				
							NA	NA					
							NA	NA					
							NA	NA					
							NA	NA					
							NA	NA					
							NA	NA					
							NA	NA					

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### VWSG Manual Data Acquisition Form

Date	Time	Station ID		VW Type	Orientation	GK-403 Scale	GK-403 $\mu$ Strain	Comments	GK-403 ID	GK-403 Recall Date	*Reader Initials
		Location (m)	Steel Set #								
				VWSG	CH #1-LOF	E					
				VWSG	CH #2-LOP	E					
				VWSG	CH #3-LIF	E					
				VWSG	CH #4-LIP	E					
				VWSG	CH #5-COF	E					
				VWSG	CH #6-COP	E					
				VWSG	CH #7-CIF	E					
				VWSG	CH #8-CIP	E					
				VWSG	CH #9-ROF	E					
				VWSG	CH #10-ROP	E					
				VWSG	CH #11-RIF	E					
				VWSG	CH #12-RIP	E					

VWSG ID		
SS Section	Vertical Position	Horizontal Position
(L)eft	(O)utside	(F)ace
(C)rown	(I)nside	(P)ortal
(R)ight		

**\*Reader initials above indicate that the individual has read and can demonstrate proficiency in the use of the latest version of TP-248**