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CONE PENETREMOTER MOISTURE PROBE ACCEPTANCE TEST  
PROCEDURE

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# Cone Penetrometer Moisture Probe Acceptance Test Procedure

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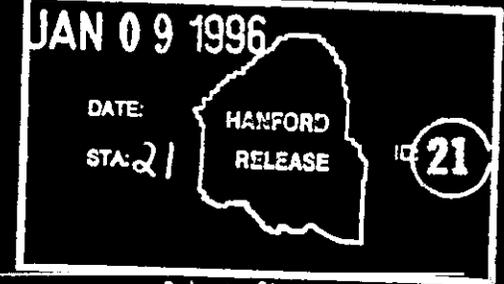
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Abstract:

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CONE PENETROMETER MOISTURE PROBE  
ACCEPTANCE TEST PROCEDURE

January 1995

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**CONE PENETROMETER MOISTURE PROBE  
ACCEPTANCE TEST PROCEDURE**

**1.0 INTRODUCTION**

**1.1 PURPOSE**

This procedure shall be used for acceptance testing of the Cone Penetrometer Moisture Probe (CPMP) system. The system includes the probe and detectors, the winch system, the NIM bin electronics, the thermistor, the laptop computer, Input/Output (I/O) interfaces, LabVIEW<sup>1</sup> application with automatic scanning features and the calibration chamber. This Acceptance Test Procedure (ATP) will cover the function of all the components, and demonstrate data flow through the system, winch functions, and detector and temperature sensor sub-system functions in accordance with the Functional Design Criteria (FDC) specified in WHC-SD-WM-FDC-047.

**1.2 SCOPE**

Completion of this test will verify that all applicable features of the CPMP system are operating as specified in WHC-SD-WM-FDC-047. The scope of the acceptance testing is as follows:

- Perform probe calibration using the calibration chamber and operating system.
- Perform manual moisture probe operations.
- Perform automatic moisture measurement.
- Perform surface moisture measurement using the near detector.
- Verify the accuracy of the temperature sensor.

**2.0 APPLICABLE/REQUIRED DOCUMENTS**

Science Applications International Corporation (SAIC) drawings:  
544200, Moisture Probe Assembly, CPMP

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<sup>1</sup> LabVIEW is a trademark of National Instruments.

544100, Cone Penetrometer Deployment System, CPMP

544010, Calibration Block

D714-A, Source Remover

### 3.0 TEST CONTROLS

#### 3.1 RESPONSIBILITIES

##### 3.1.1 Project Engineer

Project Engineer: G. N. Boechler/G. A. Barnes  
responsibilities include:

- Overall control of testing.
- Provide liaison with facility used for testing.
- Provide liaison with Quality Assurance (QA) for testing activities as required.
- Approve test procedure and final report.
- Overall testing responsibilities and assignment of responsibilities.
- Review test results and prepare/issue test report.
- Monitor testing for compliance with the test procedures.

##### 3.1.2 Test Performer

Test Performer: SAIC. Responsibilities include:

- Perform test in accordance with approved test procedure.
- Maintain a file of documented information pertinent to the tests.

##### 3.1.3 Quality Engineer

Quality Engineer: M. L. McElroy. Responsibilities include:

- Review and approve the test procedure and test report.
- Ensure that quality requirements are defined and satisfied for the test.

- Witness conductance of acceptance testing as required. Testing may proceed per this procedure without a QA engineer present.

#### 3.1.4 Quality Control Inspectors

Quality Control Inspectors: SAIC Quality Control

- Provide signature verification, as identified in this ATP.
- The QA engineer or project engineer may request QC witness of testing not specifically required in the test procedure.

The test performers and project engineers for this test procedure shall be documented in the acceptance test report.

#### 3.2 TEST DATA

- 3.2.1 All test data, pertinent observations, and off-normal events shall be recorded on the test procedure, Section 6.0 of this ATP. If additional space is required, the data shall be recorded on an observation/results data sheet (provided in Appendix A) or equivalent.
- 3.2.2 Data recorded on the observation/results data sheets shall be formally documented in the Acceptance Test Report (ATR).
- 3.2.3 Changes to the test procedure are permitted. The test performer shall red ink changes with the concurrence of the WHC project engineer. Approvals will be documented by the WHC project engineer's initials on the redlined item. Lack of immediate redline approval does not constitute a test hold.

#### 3.3 TEST CONFIGURATION

- 3.3.1 The drawings and engineering documents which establish the process equipment test configuration are listed in Section 2.0.
- 3.3.2 Additional documents required to perform, document, or validate a test (sketches, calibration sheets, etc.) will be referenced in the ATR.

### 3.4 PROCEDURE CONTROL

3.4.1 A controlled test procedure package shall be used for testing and shall include the following:

- A single copy of this test procedure.
- Other information directly applicable to testing which is required.
- Functional Block Diagram.

### 3.5 RETEST PROCEDURE CONTROL

3.5.1 If retest is required, additional copies of applicable procedure sections or data sheets of this test procedure may be used or new procedures may be used.

3.5.2 The addition of procedure sections to be used for retest shall be added to the test procedure package, concurred with by the WHC QA representative, and formally released in the ATR.

3.5.3 Minor procedure changes such as editorial changes to a step, clarification of a step or steps, elimination or addition of a step or limited sequential changes of steps, shall be noted in the procedure by redline entries and noted in the exceptions sheet located in Appendix A giving the reason for the change.

### 3.6 OPEN ITEMS

Items and actions identified during the conduct of testing which require future resolution/completion shall be noted on comment sheets in appendix A. Identified open items shall subsequently be entered into the test completion report to assure final close-out.

### 3.7 TEST EQUIPMENT CONTROLS

It is the responsibility of SAIC to maintain calibration of all test equipment used for acceptance testing.

## 4.0 TEST FACILITY

Acceptance testing of the CPMP system will be conducted in the SAIC Campus Point E building high bay, San Diego, CA.

## 5.0 SAFETY

- Only the project engineer and/or their approved SAIC personnel shall operate the CPMP during performance of this ATP.
- Test personnel shall be briefed, prior to test performance, on the hazards unique to the CPMP equipment.
- SAIC is responsible for safety during acceptance testing.

### 5.1 EQUIPMENT PRECAUTIONS

- 5.1.1 The electrical supply service disconnect must be OFF when connecting or disconnecting any electrical equipment or cables.
- 5.1.2 Failure to hook up or remove the power and interconnecting cables in the sequence prescribed in this manual could result in generation of unacceptable equipment voltages and in electrical arcing or sparking.

## 6.0 TEST PROCEDURE

### 6.1 PREREQUISITES

Perform functional testing as follows:

- 6.1.1 Record additional observations on CPMP functional testing observation sheets (Appendix A), as required. Successful completion of the test is documented by the project engineer's signature on the master test procedure.

### 6.2 TEST SETUP

The CPMP shall be setup so that all operational functions that make moisture measurements (homing, calibrate, manual counting, full scan and surface scan) are tested in waste simulants.

- 6.2.1 Verify that the moisture content of the waste simulants used for this ATP have been verified and documented (Reference SAIC, PHASE 1 OF CONE PENETROMETER MOISTURE PROBE STUDY, FINAL REPORT, Rev. 1).

Verified by: \_\_\_\_\_  
Test Performer

### 6.3 SYSTEM STARTUP

6.3.1 Power up the NIM Bin, detector high voltage power supply, and the motor system.

6.3.2 Verify that power lights are illuminated:

Verified by: \_\_\_\_\_  
Test Performer

6.3.3 Press the computer's power switch to the ON position. The computer screen will display the LabView interface.

6.3.4 LabView starts, and an "Open VI" dialogue box will be displayed.

6.3.5 Move to the directory "c:\hanford\" and open the library "mprobe.llb"

6.3.6 Open the VI "Cone Pen Moisture Probe.vi". The "VI" front panel will appear.

### 6.4 SETUP MODE

6.4.1 From the front panel, click on SETUP

6.4.2 Note that Pen. Bottom, Start Depth, and End Depth are positions relative to the Pen. Top reference position (0.00 feet). In the dialogue box, enter the following information:

Tank Number: ZZ123

Riser Number: 99Z

Operator: (Enter the Test Performer)

Pen. Top: 0.00 (feet)

Pen. Bottom:- \_\_\_\_\_ (This will be the physical measurement, in feet, from penetrometer top to penetrometer bottom)

Start Depth:- \_\_\_\_\_ (Same as Pen. Bottom)

End Depth: -2.00 (feet)

Count Time: 30.00 (seconds)

Step Distance: 1.00 (inch)

- 6.4.3 Verify that LabView accepts and displays this information and also displays the correct date and time:

Verified by: \_\_\_\_\_  
Test Performer

- 6.4.4 Click on the button labeled "YES" to write to a data file.

- 6.4.5 Click on the button labeled "OK".

6.4.6 Verify that the SETUP display disappears and the FRONT PANEL is displayed:

Verified by: \_\_\_\_\_  
Test Performer

6.4.7 Click on the button labeled "START".

6.4.8 A dialog box will appear giving the opportunity to re-run SETUP. Click on NO.

6.4.9 Verify that a dialogue box appears stating that the CPMP must be "HOMED" before a full scan can be performed and that the "Set Home Position" window is automatically opened:

Verified by: \_\_\_\_\_  
Test Performer

## 6.5 HOMING

6.5.1 Position the moisture probe so that it can be lowered into a single drum of waste simulant that already has a cone penetrometer rod installed in it. The moisture content of the waste simulant should be approximately 20%wt. Record the documented moisture content of the waste simulant (by volume):

Moisture content: \_\_\_\_\_ %vol +/- \_\_\_\_\_ %vol

Dry simulant density: \_\_\_\_\_ g/cc

6.5.2 Use the UP or DOWN controls to move the probe into it's home position (For this ATP, the HOME position will be at the Pen. Top position).

6.5.3 In the dialogue box, enter the Home Position (This is the physical measurement from the end of the moisture probe to the top of the cone penetrometer).

6.5.4 Record the dimension entered above.

Home Position: + \_\_\_\_\_ ft.

6.5.5 Click on the SET HOME POSITION button to set the home position.

- 6.5.6 Verify that the HOME button has turned green indicating that Homing is complete.

Verified by: \_\_\_\_\_  
Test Performer

#### 6.6 MANUAL OPERATIONAL TESTS

- 6.6.1 Click on the MANUAL MODE button to display the "Manual Counting and Motion Control" display.
- 6.6.2 Click on and hold down the DOWN button to initiate movement of the probe and to continue the motion. After the probe has moved downward a couple of feet, release the DOWN button.
- 6.6.3 Verify that the moisture probe moves down, the probe position indicators display probe movement downward and the moisture probe stops when the DOWN button is released.

Verified by: \_\_\_\_\_  
Test Performer

- 6.6.4 Click on and hold down the UP button to initiate movement of the probe upward and to continue the motion. After the probe has moved upward a couple of feet, release the UP button.
- 6.6.5 Verify that the moisture probe moves up, the probe position indicators display probe movement upward and the moisture probe stops when the UP button is released.

Verified by: \_\_\_\_\_  
Test Performer

- 6.6.6 Set ABSOLUTE POSITION button to "Distance" rather than "Position". Enter the following motion control parameters in the appropriate data input boxes.

Distance: -2.00 (feet)  
Velocity: 4.00 (in/sec)

- 6.6.7 Click on the MOVE button.

- 6.6.8 Verify that the moisture probe moves down 2 ft +/- 1/4" in approximately 6 sec.

Verified by: \_\_\_\_\_  
Test Performer

- 6.6.9 Enter the following motion control parameters in the appropriate data input boxes.

Distance: +1.00 (feet)  
Velocity: 2.00 (in/sec)

- 6.6.10 Click on the MOVE button until the probe stops moving.

- 6.6.11 Verify that the probe moves up 1 ft +/- 1/4" in approximately 6 sec.

Verified by: \_\_\_\_\_  
Test Performer

- 6.6.12 Click on the QUIT button to return to the front panel.

- 6.6.13 Click on the HOME button. Verify that the moisture probe moves up to the "HOME" position.

Verified by: \_\_\_\_\_  
Test Performer

## 6.7 TEMPERATURE SENSOR VERIFICATION

- 6.7.1 Click on the MANUAL MODE button to display the "Manual Counting and Motion Control" display.

- 6.7.2 Insert the temperature sensor section of the moisture probe (not the entire probe) and a calibrated temperature sensor into an oven. Set the oven temperature to 121°C (250°F). Click on the COUNT button. After the temperature sensor readouts stabilize, record the readings.

Moisture Probe Temperature  
(from FRONT PANEL display): \_\_\_\_\_

Calibrated Temperature Sensor: \_\_\_\_\_

- 6.7.3 Reduce the oven temperature to 40°C (104°F). After the temperature sensor readouts stabilize, record the

readings.

6.7.4 Moisture Probe Temperature  
(from FRONT PANEL display): \_\_\_\_\_  
Calibrated Temperature Sensor: \_\_\_\_\_

6.7.5 Insert the moisture probe into a cone penetrometer rod  
that is at approximately room temperature.

6.7.6 Record the time it takes the temperature sensor to  
stabilize:

Time: \_\_\_\_\_

6.7.7 Place the moisture probe and calibrated temperature  
sensor in ice water (place the probe's temperature  
sensor in a plastic bag to protect it from the water).  
After the temperature sensor readouts stabilize, record  
the readings.

Moisture Probe Temperature (from FRONT PANEL display):

Calibrated Temperature Sensor: \_\_\_\_\_

6.7.8 Verify that the three moisture probe temperature sensor  
measurements recorded above are within 1.1°C of the  
calibrated temperature sensor.

Verified by: \_\_\_\_\_  
Test Performer

6.7.9 Record the calibrated temperature sensor information  
below:

Calibration procedure used: \_\_\_\_\_

Calibration expiration date: \_\_\_\_\_

Verified by: \_\_\_\_\_  
SAIC Quality Control

## 6.8 MOISTURE PROBE CALIBRATION TESTS

6.8.1 Insert the moisture probe into the calibration block  
(SAIC Dwg 544010).

- 6.8.2 Open the swinging door of the calibration block and install the Cf-252 source into the moisture probe using the SOURCE REMOVER (SAIC Dwg D214-A).
- 6.8.3 Close the door of the calibration block.
- 6.8.4 From the front panel, click on the CALIBRATION button.
- 6.8.5 Click on OK to initiate calibration test.
- 6.8.6 After the "Done" light is illuminated (calibration will take 60 seconds), verify that "Near Count", "Far Count" and "Cal. Ratio" are within 2% of their corresponding Calibration data displayed and the "Cal. OK" light is illuminated.

Verified by: \_\_\_\_\_  
Test Performer

- 6.8.7 Remove the moisture probe from the calibration block.
- 6.8.8 Click on OK to initiate calibration test.
- 6.8.9 After the "Done" light is illuminated (calibration will take 60 seconds), verify that an error message is displayed indicating that the moisture probe is out of calibration.

Verified by: \_\_\_\_\_  
Test Performer

- 6.8.10 Insert the moisture probe into the calibration chamber and repeat step 6.8.5 and 6.8.7
- 6.8.11 Verify that the calibration data observed in steps 6.8.6, 6.8.9 and 6.8.10 can be retrieved from the PERMANENT CALIBRATION DATA FILE.

Verified by: \_\_\_\_\_  
Test Performer

## 6.9 SCAN TESTS

- 6.9.1 Use Manual Mode to lower the moisture probe just into the penetrometer. From the front panel, click on the SCAN button. When the SETUP dialog box appears, click

on the NO button. Verify that a dialogue box appears asking if the system is ready for the scan. Click on OK.

- 6.9.2 Verify that the moisture probe is lowered to the bottom of the penetrometer, stops and begins moisture scans at 1 inch intervals for 30 seconds each until the moisture probe is at the top of the penetrometer rod.

Verified by: \_\_\_\_\_  
Test Performer

- 6.9.3 Verify that the front panel display plots the correct moisture content (within 5%vol.) vs. depth and plots temperature vs. depth.

Verified by: \_\_\_\_\_  
Test Performer

- 6.9.4 Using a spreadsheet or graphics package, reproduce these plots from the data file and attach them to the master copy of this ATP.
- 6.9.5 Click on the HOME button to return the probe to the Home position.
- 6.9.6 Reposition the moisture probe over a double barrel that contains approximately 15%wt moisture content simulant in the bottom barrel and approximately 20%wt moisture content in the top barrel. Record the documented moisture contents (by volume):

Bottom barrel: \_\_\_\_\_%vol. +/- \_\_\_\_\_%vol.

Dry simulant Density: \_\_\_\_\_g/cc

Top barrel: \_\_\_\_\_%vol. +/- \_\_\_\_\_%vol.

Dry simulant Density: \_\_\_\_\_g/cc

- 6.9.7 Setup the moisture probe to perform a scan in the double barrel arrangement at 2 inch increments for 60 seconds each.
- 6.9.8 From the front panel, click on the SCAN button.
- 6.9.9 After the moisture probe starts the scan, click on the SUSPEND OPERATION button.
- 6.9.10 Verify that the moisture probe stops scanning.
- Verified by: \_\_\_\_\_  
Test Performer
- 6.9.11 Click on the SUSPEND OPERATION button.
- 6.9.12 Verify that the moisture probe continues with the scanning operation and scans at 2 inch intervals for 60

seconds each until the moisture probe is at the top of the penetrometer rod.

Verified by: \_\_\_\_\_  
Test Performer

- 6.9.13 Verify that the front panel display plots the correct moisture content (within 5%vol) vs. depth and plots temperature vs. depth.

Verified by: \_\_\_\_\_  
Test Performer

- 6.9.14 Using a spreadsheet or graphics package, reproduce these plots from the data file and attach them to the master copy of this ATP.

#### 6.10 MANUAL SCAN TESTS

- 6.10.1 From the front panel display, click on the MANUAL MODE button.
- 6.10.2 Click on the DOWN BUTTON to lower the moisture probe into the penetrometer rod (20%wt top barrel). When the moisture probe is approximately 2 ft into the penetrometer rod release the DOWN button.
- 6.10.3 Adjust the COUNT TIME to 30 seconds.
- 6.10.4 Click on the COUNT button.
- 6.10.5 Verify that the moisture probe performs a 30 second scan and that the measured moisture content is within 5%vol.

Verified by: \_\_\_\_\_  
Test Performer

- 6.10.6 Repeat steps 6.11.2 and 6.11.4 in simulants with approximately 15%wt and 50%wt moisture content. Record the documented moisture contents (by volume) of the simulants:

15%wt simulant: \_\_\_\_\_%vol. +/- \_\_\_\_\_%vol.

Dry simulant Density: \_\_\_\_\_g/cc

50%wt simulant: \_\_\_\_\_%vol. +/- \_\_\_\_\_%vol.

Dry simulant Density: \_\_\_\_\_g/cc

- 6.10.7 Verify that the moisture probe measures the moisture content of the 15%wt and 50%wt simulants to within 5%vol.

Verified by: \_\_\_\_\_  
Test Performer

- 6.10.6 Click on the QUIT button.

### 6.11 ELECTRICAL SYSTEM OPERATION TEST

- 6.11.1 Connect the outputs of two function generators directly into the inputs (channel 1 and channel 2) of the Tennelec TC512 counter/timer.

- 6.11.2 Adjust the function generator for a frequency of 10.46 Kilohertz.

- 6.11.3 Verify the function generator frequency using a calibrated oscilloscope.

Verified by: \_\_\_\_\_  
Test Performer

- 6.11.4 Record Oscilloscope calibration information:

Oscilloscope calibration expiration: \_\_\_\_\_

Verified by: \_\_\_\_\_  
SAIC QC

- 6.11.5 Click on the START button to perform a MANUAL scan for 30 seconds.

- 6.11.6 When the manual scan is complete, verify that the NEAR DETECTOR and FAR DETECTOR count readings are 313,800 +/- 2000.

Verified by: \_\_\_\_\_  
Test Performer

- 6.11.7 Disconnect the function generators from the Tennelec TC512 counter/timer.

**6.12 SURFACE SCAN TESTS**

- 6.12.1 Fill the 20%wt and 30%wt (approximate) double barrel arrangement to the top with water.
- 6.12.2 Enter the Setup Menu and enter a 0.5 inch Step Distance and a 60 sec Count Time. Select SURFACE SCAN. Exit the Setup Menu.
- 6.12.3 Position the moisture probe over the 20%wt and 30%wt double barrel arrangement.
- 6.12.4 From the front panel, initiate the surface scan.

- 6.12.5 Verify that the surface scan data (near counts vs depth) is plotted on the front panel.

Verified by: \_\_\_\_\_  
Test Performer

- 6.12.6 Using a spreadsheet graphics package, verify that the surface level is indicated within +/- .25 inches and the surface moisture content (by volume and weight) is calculated to within 3%wt and 5%vol. Reproduce these surface plots and attach them to the master copy of this ATP.

Verified by: \_\_\_\_\_  
Test Performer

- 6.12.7 Position the moisture probe over a barrel with approximately 30%wt moisture content waste simulant. Record the documented moisture content (by volume) of the waste simulant:

Moisture content: \_\_\_\_\_% +/- \_\_\_\_\_%

Dry simulant Density: \_\_\_\_\_g/cc

- 6.12.8 From the front panel, initiate the surface scan.

- 6.12.9 Prior to the end of the surface scan, enter the following comment into the comment box in the front panel: "CPMP FINAL ACCEPTANCE TEST"

- 6.12.10 Verify that the surface scan data (near counts vs depth) is plotted on the front panel.

Verified by: \_\_\_\_\_  
Test Performer

- 6.12.11 Using a spreadsheet graphics package, verify that the surface level is indicated within +/- .25 inches and the surface moisture content (by volume and weight) is calculated to within 3%wt and 5%vol. Reproduce these surface plots and all raw data for the ATP and attach them to the master copy of this ATP.

Verified by: \_\_\_\_\_  
Test Performer

- 6.12.12 Verify that the data file contains the comment entered in step 6.12.9 and that all data points contain a "Time Stamp".

Verified by: \_\_\_\_\_  
Test Performer

### 6.13 E-STOP TESTS

- 6.13.1 Setup the moisture probe for a scan in one of the test barrels. Start the scan from the front panel. During the scan, press the STOP BUTTON on the front panel.

- 6.13.2 Verify that the motion is stopped.

Verified by: \_\_\_\_\_  
Test Performer

- 6.13.3 Setup the moisture probe for a scan in one of the test barrels. Start the scan from the front panel. During the scan, press the manual red Emergency Stop Button.

- 6.13.4 Verify that the motion is stopped.

Verified by: \_\_\_\_\_  
Test Performer

### 6.14 TERMINATION OF OPERATION

- 6.14.1 Press the "Exit" button. This will return the user to the windows\* interface.

- 6.14.2 Select "Exit Windows" from the file menu.

- 6.14.3 Choose OK to quit Windows.

- 6.14.4 Insert a 3-1/2" diskette into drive "A:"

- 6.14.5 At the DOS prompt (C:\>) type: copy c:\data\mm-dd-yy\\*. \* a:.. This will copy all files that were created for this ATP to the diskette.

- 6.14.6 Attach a hardcopy of the files to the MASTER COPY of this ATP.

- 6.14.7 Press the power button to turn-off the computer.

WHC-SD-WM-ATP-145  
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**APPENDIX A**





