

VotingWorks

Environmental Hardware Test Plan

V4.1

VWS-24003-ELHTP-01

Prepared for:

Vendor Name	VotingWorks
Vendor System	VxSuite 4.0
EAC Application No.	VXS4

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***Accredited by the Election
Assistance Commission (EAC) for
Selected Voting System Test
Methods or Services***

Revision History

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TABLE OF CONTENTS

VOTINGWORKS	1
ENVIRONMENTAL HARDWARE TEST PLAN	1
1 INTRODUCTION	4
1.1 QUALIFICATIONS	4
1.2 HARDWARE TEST LAB FACILITY	4
1.3 REFERENCE DOCUMENTS	4
2 PRODUCT DESCRIPTION	5
2.1 EQUIPMENT UNDER TEST	5
2.2 PRODUCT INFORMATION	5
2.3 SUPPORT EQUIPMENT (SE)	6
2.4 EUT SOFTWARE / FIRMWARE	6
2.5 ACCESSORIES	6
3 ENVIRONMENTAL TEST REQUIREMENTS	7
3.1 TEST PROCEDURES	7
3.1.1 <i>Operating Environmental</i>	7
3.1.2 <i>Environmental Control – Transit and Storage</i>	7
3.2 DESIGN, CONSTRUCTION AND MAINTENANCE	7
3.2.1 <i>Physical Attributes</i>	7
3.2.2 <i>Additional Attributes</i>	7
3.3 NON-OPERATING ENVIRONMENTAL TEST	8
3.3.1 <i>Operational Status Check</i>	8
3.3.2 <i>Failure Criteria</i>	8
3.3.3 <i>Bench Handling Test</i>	8
3.3.4 <i>Transportation Vibration Test</i>	9
3.3.5 <i>Low Temperature Test</i>	9
3.3.6 <i>High Temperature Test</i>	9
3.4 OPERATING ENVIRONMENTAL TESTS	9
3.4.1 <i>Simulated Operation Diagnostic</i>	9
3.4.2 <i>Continuous Operation Test</i>	9
3.4.2.1 <i>Continuous Operation Test Approach</i>	10
3.4.3 <i>Reliability</i>	11
4 ENVIRONMENTAL TEST SUMMARY	12

1 INTRODUCTION

This test plan covers the environmental test requirements and methods for the **VotingWorks VxSuite 4.0**, hereafter known as the Equipment Under Test (EUT), to the requirements as stated in Election Assistance Commission Voluntary Voting System Guidelines Version 2.0 (EAC VVSG 2.0).

1.1 Qualifications

The EUT supplied by **VotingWorks** is representative of product produced in their volume manufacturing process.

1.2 Hardware Test Lab Facility

Element Materials Technology Denver-Longmont
1601 Dry Creek Drive
Longmont, CO 80503

1.3 Reference Documents

1. Election Assistance Commission Voluntary Voting System Guidelines 2.0
2. Election Assistance Commission Voluntary Voting System Guidelines (VVSG) v 2.0, Test Assertions v 1.3.
3. NIST Handbook 150-2020.
4. NIST Handbook 150-22-2021.
5. Election Assistance Commission Voting System Testing and Certification Program Manual, United States Election Assistance Commission, v 3.0
6. SLI Compliance VSTL Quality System Manual, Rev. 4.1 Aug. 14, 2023

2 Product Description

2.1 Equipment Under Test

Product / Model	Serial Number	Description	Qty
VxMark	MK-11-005	VxMark is an accessible ballot marking device (BMD). After Poll Worker assistance to get started, Voters use VxMark to mark, verify, and cast their ballot in visual-touch, audio-tactile, and limited dexterity interaction modes. PVR is stored in bin to be scanned later. VxMark does not produce cast-vote records (CVRs).	1
VxScan	SC-11-007	VxScan is used by voters to Scan ballots, displays instructions and accurate feedback to users visually and audibly, accepts user inputs on a touchscreen, rejects invalid ballots and double-sheet ballots, stores ballots securely in the ballot box. Poll Workers save cast-vote records (CVRs), print accurate reports before and after scanning ballots.	1
VxCentralScan	CS-11-006 and CS-11-008	VxCentralScan is used by officials for paper ballot scanning, contest resolution, and conversion of voter selection marks to electronic Cast Vote Records (CVRs). Continuous Operation – Varied Envir. Conditions Low / High Temp/Humidity – Testing Only	2

2.2 Product Information

Description	Dimensions	Weight
VxMark	30" x 18" x 12"	50
VxScan	19.2" x 12.8" x 6.9"	27.5
VxCentralScan	15" x 11" x 6"	10.5 lbs

2.3 Support Equipment (SE)

Product / Model	Serial Number	Description	Qty
VxAdmin	AD-11-008	VxAdmin is used by officials to create election cards, input CVRs, vote tabulation and reporting of elections.	1
Smart Cards	N/A	Programable Smart Cards for election	3
Headphones	N/A	Optional Attachment to the VxMark for user with visual impairments	2
Sip and Puff	7855	Optional Attachment to the VxMark for user with dexterity impairments	2
Ballot Box	BB-01-004	Purpose made, plastic, collapsible ballot box for use with VxScan	1
RICOH fi-8170	CE4AJ33753	Scanner	1
RICOH fi-819PRB	CFAAH04162	Imprinter	1
RICOH fi-7600	AUKDH01915	Scanner	1
RICOH fi-760PRB	AVGA000534	Imprinter	1
APC	OB2408L35863, OB2409L07909, OB2408L49020, OB2408L43247	UPS for VxMark, VxCentralScan, VxAdmin	4

2.4 EUT Software / Firmware

Type	Version	Description
VotingWorks Software (all)	V4.0.1	Election software for operational status check.

2.5 Accessories

Type	Model	Function
Test Ballots	N/A	Pre-mark Test Ballots
SanDisk 64G USB	N/A	Load election definitions, record CVRs and audit logs.

3 Environmental Test Requirements

3.1 Test Procedures

3.1.1 Operating Environmental

Equipment used for election management activities or vote counting (including both precinct and central count systems) shall be capable of operation in temperatures ranging from 50 to 95 degrees Fahrenheit.

3.1.2 Environmental Control – Transit and Storage

Equipment used for vote casting or for counting votes in a precinct count system, MUST meet these specific minimum performance standards that simulate exposure to physical shock and vibration associated with handling and transportation by surface and air common carriers, and to temperature conditions associated with delivery and storage in an uncontrolled warehouse environment:

2.7-D – Ability to support maintenance and repair physical environment conditions – non-operating.

2.7-E – Ability to support transport and storage physical environment conditions – non-operating.

2.7-F – Ability to support storage temperatures in physical environment non-operating.

3.2 Design, Construction and Maintenance

This covers voting system materials, construction workmanship, and specific design characteristics important to the successful operation and efficient maintenance of the voting system.

3.2.1 Physical Attributes

The following physical attributes will be examined to assess reliability:

- a. Presence of labels and the identification of test points
- b. Provision of built-in test and diagnostic circuitry or physical indicators of condition
- c. Presence of labels and alarms related to failures.
- d. Presence of features that allow non-technicians to perform routine maintenance tasks (such as update of the system database)

3.2.2 Additional Attributes

The following additional attributes will be considered to assess system maintainability:

- a. Ease of detecting that equipment has failed by a non-technician.
- b. Ease of diagnosing problems by a trained technician
- c. Low false alarm rates (i.e., indications of problems that do not exist)
- d. Ease of access to components for replacement
- e. Ease with which adjustment and alignment can be performed

- f. Ease with which database updates can be performed by a non-technician
- g. Adjust, align, tune or service components

3.3 Non-Operating Environmental Test

3.3.1 Operational Status Check

When all tests, inspections, repairs, and adjustments have been completed, normal operation **shall** be verified by conducting an operational status check.

During this process, all equipment shall be operated in a manner and under environmental conditions that simulate election use to verify the functional status of the system. Prior to the conduct of each of the environmental hardware non-operating tests, a supplemental test shall be made to determine that the operational state of the equipment is within acceptable performance limits.

An operational status check shall be performed prior to and after each test to fully exercise the EUT and ensure that no damage has occurred as a result of the test.

The following procedures **shall** be followed to verify the equipment status:

Step 1: Arrange the system for normal operation.

Step 2: Turn on power and allow the system to reach the recommended operating temperature.

Step 3: Perform any servicing, and make any adjustments necessary, to achieve operational status.

Step 4: Operate the equipment in all modes, demonstrating all functions and features that would be used during election operations.

Step 5: Verify that all system functions have been correctly executed.

3.3.2 Failure Criteria

Upon completion of each non-operating test, the system hardware shall be subject to functional testing to verify continued operability. If any portion of the voting machine or precinct counter hardware fails to remain fully functional, the testing will be suspended until the failure is identified and corrected by the manufacturer. The system will then be subject to a retest.

3.3.3 Bench Handling Test

2.7-D – Ability to support maintenance and repair physical environment conditions – non-operating

The bench handling test simulates stresses faced during maintenance and repair of voting machines and ballot counters. All systems and components, regardless of type, **shall** meet the requirements of this test. This test is equivalent to the procedure of MIL-STD-810H, Method 516.8, Procedure VI.

3.3.4 Transportation Vibration Test

2.7-E – Ability to support transport and storage physical environment conditions - non-operating

The vibration test simulates stresses faced during transport of voting machines and ballot counters between storage locations and polling places. All systems and components, regardless of type, shall meet the requirements of this test. This test is equivalent to the procedures of MIL-STD-810H, Method 514.8, Procedure I – General Vibration, Transportation.

3.3.5 Low Temperature Test

2.7-F – Ability to support storage temperatures in physical environment – non-operating

The low temperature test simulates stresses faced during storage of voting machines and ballot counters. All systems and components, regardless of type, **shall** meet the requirements of this test. This test is equivalent to the procedures of MIL-STD-810H, Methods 502.7, Procedure I-Storage. The minimum temperature shall be -4 degrees F. Relative humidity **MUST** test the ranges of 25% to 55%.

3.3.6 High Temperature Test

2.7-F – Ability to support storage temperatures in physical environment – non-operating

The High temperature test simulates stresses faced during storage of voting machines and ballot counters. All systems and components, regardless of type, **shall** meet the requirements of this test. This test is equivalent to the procedures of MIL-STD-810H, Methods 501.7, Procedure I-Storage. The maximum temperature shall be 140 degrees F. Relative humidity **MUST** test the ranges of 25% to 55%.

3.4 Operating Environmental Tests

This section addresses a range of tests for all voting system equipment, including equipment for both precinct count systems.

3.4.1 Simulated Operation Diagnostic

A diagnostic test routine is performed to exercise and diagnose failures from internal subsystems in the EUT. The test performs various operations including writing and reading to storage devices and printing to internal printers. The diagnostic can be looped continuously and will halt if an error is detected while performing an operation.

3.4.2 Continuous Operation Test

2.7-C – Continuous operation – varied environmental conditions

Continuous Operation – Varied Environmental Conditions Low / High Temp / Humidity
The voting system **MUST** withstand continuous operational testing performed in accordance with the high and low temperature specifications of MIL-STD-810-H,

Methods 501.7 and 502.7, Procedure II – Operation, cyclic temperature, and humidity exposure.

- The duration of the test MUST be for 104 consecutive hours.
- Continuous operation means exercising ballot-counting cycles, which vary by system type, for 15 minutes of each hour, and at the maximum rate calculated from the manufacturer's documented throughput rates.
- Temperatures MUST range from 50 to 95 degrees for 72 hours of operation.
- Relative humidity MUST range from 25% to 55% for 72 hours of operation.
- Every 12 hours, the humidity and temperature MUST shift between the two extremes.
- The 50-degree Fahrenheit temperature MUST be tested in parallel with 25% humidity and the 95-degree Fahrenheit temperature MUST be tested in parallel with 55% humidity.
- Temperature and humidity MUST be at normal conditions for 32 hours of operation.
- The interval between reports MUST be no more than once per 4 hours of continuous operation.

Operation shall consist of ballot-counting cycles, which vary with system type. An output report need not be generated after each counting cycle. The interval between reports, however, should be no more than 4 hours to keep to a practical minimum the time between the occurrence of a failure or data error and its detection.

Test Ballots per Counting Cycle

- Precinct count systems 100 ballots/hour
- Central count systems 300 ballots/hour

The recommended pattern of votes is one chosen to facilitate visual recognition of the reported totals; this pattern shall exercise all possible voting locations. System features such as data quality tests, error logging, and audit reports shall be enabled during the test. Each operating cycle shall consist of processing the number of ballots indicated above.

Note: Requires 24-hr continuous coverage / support from the hardware test lab for the duration of Continuous Operation Test. Support from the hardware test lab includes monitoring temperate and humidity levels when required base off test plan requirements.

3.4.2.1 Continuous Operation Test Approach

Test election with two contests with four candidates each, and two propositions will be used.

Per test ballots counting cycle requirement, test will be conducted as such:

VotingWorks VxMark (Polling Place BMD)

- **Print and mark 10 ballots every hour.**
- **10 voted ballots are then scanned on VxCentralScans for tabulation.**

VotingWorks VxScan

- **Scan 100 pre-marked ballots every hour.**

VotingWorks VxCentralScan

1 – VxCentralScan / fi-8170 high speed scanner

- **Scan 305 pre-marked test ballots every hour. This includes scanning ballots from VxMark**
- **VxMark – 5 ballots every hour.**

1 – VxCentralScan / fi-7600 high speed scanner

- **Scan 305 pre-marked test ballots every hour. This includes scanning ballots from VxMark**
- **VxMark – 5 ballots every hour.**

VotingWorks VxAdmin (outside the Test Chamber)

- **CVRs from VxScan and VxCentralScan loaded every 4 hours**
- **Report printed every 4 hours**

The test will be conducted to run in 4 hour cycles such that each cycle is concluded with the generation of a report that details the vote data cast during that period.

Additional steps to reduce the change of misreads include cleaning the scanners within the cleaning process/periods that VotingWorks declares. The scanner will be cleaned every 8 hours which requires the scanners to be powered off during cleaning per the manufacturer's specifications.

When required SLI personnel will audit ballots once per hour until testing is completed.

3.4.3 Reliability

2.7-A – Assessment of reliability

The voting system's reliability must be assessed using a combination of evidence items gathered during the entire course of testing, including:

1. Continuous operation of the voting system under typical environmental conditions.
2. Continuous operation of the voting system under varied environmental conditions across defined ranges.
3. Resistance of the voting system to electrical surges, interference, and loss of power.

The failure rate benchmark for reliability, the need to protect against a single point of failure, and the need for systems to withstand the failure of input and storage devices.

A failure is defined as any event which results in either:

1. **Criterion A:** Loss of one or more functions.

2. **Criterion B:** Degradation of performance such that the device is unable to perform its intended function for longer than 10 seconds; will look for degradation of performance of the device, as opposed to actual functionality failure covered under the first failure criterion.
3. **Criterion C:** COTS and support equipment may have temporary loss of function or degradation of performance, the correction of which requires operator intervention or system reset.

4 Environmental Test Summary

The following Table shows the tests to be performed on the EUT.

Test	Test Specification	VVSG 2.0	Comments
Non-Operating Environmental Tests			
Bench Handling	MIL-STD-810H, Method 516.8, Procedure VI.	2.7-D	N/A: VxCentralScan
Vibration	MIL-STD-810H, Method 514.8, Procedure I – General Vibration, Transportation.	2.7-E	N/A: VxCentralScan
Low Temperature	MIL-STD-810H, Method 502.7, Procedure I-Storage, cyclic temperature.	2.7-F-1	N/A: VxCentralScan
High Temperature	MIL-STD-810H, Method 501.7, Procedure I-Storage, cyclic temperature.	2.7-F-1	N/A: VxCentralScan
Operating Environmental Tests			
Continuous Operation – Varied Envir. Conditions Low / High Temp/Humidity	MIL-STD-810-H, Methods 501.7 and 502.7, Procedure II – Operation, cyclic temperature, and humidity exposure.	2.7-B, C	All products
Reliability Assessment	Assessment of reliability.	2.7-A	

End of ENV Hardware Test Plan