Election Systems & Software
EVS6000
Environmental Test Plan for compliance with 2005 Voluntary Voting System Guidelines (VVSG)

Prepared by

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

Revision History

Date	Release	Author	Revision Summary
June 27, 2017	1.0	Darrick Forester	Initial Release
July 6, 2017	2.0	Darrick Forester	Updates from initial release
August 15, 2017	2.1	Jon Panek	Updated to include additional UUTs
December 12, 2017	2.2	Darrick Forester	Updates for EAC initial comments
December 20, 2017	2.3	Jon Panek	Updates for additional EAC comments

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1. Introduction

1.1 Overview

This test plan covers the environmental test requirements and methods for the ES&S EVS6000, hereafter known as the Unit Under Test (UUT), to the requirements as stated in Election Assistance Commission 2005 Voluntary Voting System Guidelines (VVSG).

1.2 Qualifications

The UUT supplied by ES&S is representative of product produced in their volume manufacturing process.

1.3 Client

Election Systems & Software
11208 John Galt Blvd
Omaha, NE 68137

1.4 Company Information

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1.5 Test Facility Location

NTS Environmental Lab
1601 Dry Creek Road, Ste 2000

1.6 Longmont, CO 80504

1.7 Reference Documents

- Election Assistance Commission: 2005 Voluntary Voting System Guidelines (EAC VVSG), 2005, Version 1.0, Volumes I and II.
- NIST Handbook 150-22. 2008.
- EAC Notice of Clarification 07-05: Voting System Test Laboratory (VSTL) responsibilities in the management and oversight of third party testing.
- EAC Decision on Request for Interpretation 2007-05 (COTS).
- EAC Decision on Request for Interpretation 2008-01 FINAL (temp and power variation tests).
- EAC Decision on Request for Interpretation 2009-06 (Temperature Power Variation) FINAL.041610.
- SLI Standard Lab Procedure SLP-VC-20: Engineering Change Evaluation and Reporting.
- SLI Standard Lab Procedure SLP-VC-23: Hardware Test Management.
- SLI Standard Lab Procedure SLP-VC-24: Subcontractor Laboratory Management.

2 Testing Summary

The following Table 1 shows the tests to be performed on the UUT.

Test	VVSG Reference	Test Specification
Non-Operating Environmental Tests		
Bench Handling Test • DS200 v1.2 • DS200 v1.3 • ExpressVote v1.0 • ExpressVote v2.1 • ExpressVote v2.1 w/ external QR barcode scanner • ExpressVote XL • ExpressTouch	V1, 4.1.7.1, V2, 4.6.2	MIL-STD-810D, Method 516.3, Procedure VI; See note below.
Vibration Test • DS200 v1.2 • DS200 v1.3 • ExpressVote v1.0 • ExpressVote v2.1 • ExpressVote v2.1 w/ external QR barcode scanner • ExpressVote XL • ExpressTouch	V1, 4.1.7.1, V2, 4.6.3	MIL-STD-810D, Method 514.3, Category 1- Basic Transportation, Common Carrier; See note below.
Low Temperature Test • DS200 v1.2 • DS200 v1.3 • DS450 • DS850 • ExpressVote v1.0 • ExpressVote v2.1 • ExpressVote v2.1 w/ external QR barcode scanner • ExpressVote XL • ExpressTouch	V1, 4.1.7.1, V2, 4.6.4	MIL-STD-810D, Methods 502.2, Procedure I-Storage; See note below.
High Temperature Test • DS200 v1.2 • DS200 v1.3 • DS450 • DS850 • ExpressVote v1.0 • ExpressVote v2.1 • ExpressVote v2.1 w/ external QR barcode scanner • ExpressVote XL • ExpressTouch	V1, 4.1.7.1, V2, 4.6.5	MIL-STD-810D, Methods 501.2, Procedure I-Storage See note below.
Humidity Test • DS200 v1.2 • DS200 v1.3 • DS450 • DS850 • ExpressVote v1.0 • ExpressVote v2.1 • ExpressVote v2.1 w/ external QR barcode scanner • ExpressVote XL	V1, 4.1.7.1, V2, 4.6.6	MIL-STD-810D, Method 507.2, Procedure I-Natural Hot-Humid; See note below.

• ExpressTouch		
Operating Environmental Tests		
Temp / Power Variation • DS200 v1.2 • DS200 v1.3 • DS450 • DS850 • ExpressVote v1.0 • ExpressVote v2.1 • ExpressVote XL • ExpressTouch	V1, 4.1.7.1, V2, 4.7.1	This test is similar to the low temperature and high temperature tests of MIL-STD-810-D, Method 502.2 and Method 501.2. See RFI 2009-06; See note below.
Reliability Assessment • DS200 v1.2 • DS200 v1.3 • DS450 • DS850 • ExpressVote v1.0 • ExpressVote v2.1 • ExpressVote v2.1 w/ external QR barcode scanner • ExpressVote XL • ExpressTouch	V1, 4.3.3.4, V2, 4.7.2	See V1 4.3.3.4 for additional information.
Integrity • DS200 v1.2 • DS200 v1.3 • DS450 • DS850 • ExpressVote v1.0 • ExpressVote v2.1 • ExpressVote v2.1 w/ external QR barcode scanner • ExpressVote XL • ExpressTouch	V1, 2.1.4 (d)	Protect against ambient temperature and humidity fluctuations.

Table 1 Test Summary

Note: V1 4.1.7.1 Removable Storage Media; In voting systems that use storage media that can be removed from the system and transported to another location for readout and report generation, these media **shall** use devices with demonstrated error-free retention for a period of 22 months under the environmental conditions for operation and non-operation contained in Subsection 4.1.2. Examples of removable storage media include: programmable read-only memory (PROM), random access memory (RAM) with battery backup, magnetic media or optical media.

3 Product Description

3.1 Unit Under Test

Part No.	Serial No.	Description	Qty
DS200 v1.2	DS0113390585 DS0113390294 DS0113390620 DS0113350252	Precinct Tabulator on metal ballot box	4
DS200 v1.3	DS0316370542 DS0316370375 DS0316370373	Precinct Tabulator on plastic ballot box	3
DS450	DS4516053017 DS4516053018 DS4516053020 DS4516053019	Central Tabulator	4
DS850	DS8516080269 DS8517050300 DS8516080257	Central Tabulator	3
ExpressVote v1.0	EV0116360218 EV0114340047 EV0115371483	Precinct Universal Voting System	3
ExpressVote v2.1	EV0216310068 EV0216310071 EV0216310075	Precinct Universal Voting System	3
ExpressVote v2.1 w/ external QR barcode scanner	EV0216310068 EV0216310071 EV0216310075 EV0216310025	Precinct Universal Voting System	4
ExpressVote XL	XL0117040031 XL0117040034 XL0117040035	Precinct Tabulator	3
ExpressTouch	ET0117390032 ET0117390033 ET0117380008	DRE	3

3.2 Product Information

Description	Dimensions	Weight
DS200 v1.2	25” L x 22”W x 41” H (DS200/Metal Ballot Box)	121 lbs
DS200 v1.3	27” L x 24”W x 45” H (DS200/Plastic Ballot Box)	97 lbs
DS450	45”L x 20”W x 32”H 26”L x 48”W x 62”H unit, cart, accessories	137 lbs 415 lbs unit, cart, accessories
DS850	20.5”L x 41”W x 37”H 26”L x 48”W x 60”H unit, cart, accessories	200 lbs 500 lbs unit, cart, accessories
ExpressVote v1.0	Tabletop: 12”L x 20”W x 17”H ExpressVote/Booth: 32” W x 21.5”W x 58”H	Tabletop: 22 lbs ExpressVote/Booth: 45 lbs
ExpressVote v2.1	Tabletop: 12”L x 20”W x 17”H ExpressVote/Kiosk: 29.5”L x 23.75”W x 70.5”H	Tabletop: 22 lbs ExpressVote/Kiosk: 76 lbs
ExpressVote v2.1 w/ external QR barcode scanner	Tabletop: 12”L x 20”W x 17”H	Tabletop: 22 lbs
ExpressVote XL	45.5”W x 25”D x 73”H	296 lbs

ExpressTouch	19.5”L x 19.5”W x 53.5”H	21 lbs

3.3 Support Equipment (SE)

Support Equipment (SE)			
Name	**Model No.**	**Serial No.**	**Description**
Dell S2810dn Laser Printer	0NW8WW	CN-0NW8WW-71971-59F-E206	DS450 report printer
OKI B431d Laser Printer	N222002A	AK59044965A0 AK59044972A0	DS850 report printer
OKI Microline 420 Printer	D22900A	AK66015378E0 AK5B019674E0 AK56031367E0	DS450 and DS850 report printer
UPS	APC Pro 1500	N/A	DS450 and DS850 UPS
Universal Voting Console (UVC)	2.0.0	UVC05170062	Detachable audio-tactile keypad and ADA support peripheral for use w/ExpressVote XL and ExpressTouch
QR Bar Code Scanner	N/A	N/A	Optional external barcode scanner provides the ability to read a barcode that automatically preloads voters’ contest choices via the Ballot Online application or automatically selects the voter’s correct ballot style.

3.4 AC Power Adapter

Product	Manufacturer	Model	Serial Number
DS200 v1.2	Wall Industries	P/N: DTAB0A21Y24ESS	PW73857349
DS200 v1.3	Wall Industries	P/N: DTEA11011C-ESS	Model: EA11011C-240
ExpressVote v1.0	MEGA	P/N: MDS160T-P240	MDS160T-P240-0618
ExpressVote v2.1	MEGA	P/N: MDS160T-P240	MDS160T-P240-0618

3.5 Accessories

Type	Model	Function
USB Media	N/A	Election Media, Results
Activation Cards w/Ballot Style	N/A	The Activation Cards with Ballot Style are the Cards that are inserted into the device to have the information read inside the machine. The ExpressVote reads the activation card with the ballot style barcode digitally. The bar code scanner only scans QR codes.
Test Ballots	N/A	Scanning
Ballot Box	N/A	Ballot Collection
Headphone	N/A	Audio
Rocker Switch	N/A	Two-position switch assistive technology that can assist voter’s who are unable to use the ExpressVote touch screen or the audio tactile

Type	Model	Function
		keypad.

3.6 Firmware

Type	Version	Description
DS200 v1.2	2.17.0.0	Election Firmware
DS200 v1.3	2.17.0.0	Election Firmware
DS450	3.1.0.0	Election Firmware
DS850	3.1.0.0	Election Firmware
ExpressVote v1.0	1.5.0.0	Election Firmware
ExpressVote v2.1	2.4.0.0	Election Firmware
ExpressVote v2.1 w/ external QR barcode scanner	2.4.0.0	Electtion Firmware
ExpressVote XL	1.0.0.0	Election Firmware
ExpressTouch	1.0.0.0	Election Firmware

3.7 Engineering Changes

Engineering Change (EC)#	Description
N/A	

4 Test Requirements

4.1 Test Procedures

4.1.1 Operating Environment

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.

4.1.2 Environmental Control - Transit and Storage

Equipment used for vote casting or for counting votes in a precinct count system, **shall** 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:

- High and low storage temperatures ranging from -4 to +140 degrees Fahrenheit, equivalent to MIL-STD-810D, Methods 501.2 and 502.2, Procedure I-Storage;
- Bench handling equivalent to the procedure of MIL-STD-810D, Method 516.3, Procedure VI;
- Vibration equivalent to the procedure of MIL-STD-810D, Method 514.3, Category 1- Basic Transportation, Common Carrier; and
- Uncontrolled humidity equivalent to the procedure of MIL-STD-810D, Method 507.2, Procedure I-Natural Hot-Humid.

4.2 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.

4.2.1 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)

4.2.2 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

4.3 Non-Operating Environmental Tests

4.3.1 Data Retention Requirements

Electronic memory storage devices are required to retain their data for at least 22 months to meet the United States Code Title 42 requirements and various sections of the VVSG. The data retention capability of the devices will be verified by engineering analysis including a review of the manufacturer's specifications to ensure that it exceeds the requirement. In the absence of other information, such as field failures, the results of this analysis will be used to determine compliance with the 22 month retention requirement.

4.3.2 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.

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 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.

4.3.2.1 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.

4.3.3 Space Requirements

There is no restriction on space allowed for the installation of voting systems, except that the arrangement of these systems shall not impede performance of their duties by polling place officials, the orderly flow of voters through the polling place, or the ability for the voter to vote in private.

4.3.4 Bench Handling Test

The bench handling test simulates stresses faced during maintenance and repair of voting machines and ballot counters.

4.3.4.1 Applicability

All systems and components, regardless of type, shall meet the requirements of this test. This test is equivalent to the procedure of MIL-STD-810D, Method 516.3, and Procedure VI.

4.3.4.2 Procedure

Step 1: Place each piece of equipment on a level floor or table, as for normal operation or servicing.

Step 2: Make provision, if necessary, to restrain lateral movement of the equipment or its supports at one edge of the device. Vertical rotation about that edge shall not be restrained.

Step 3: Using that edge as a pivot, raise the opposite edge to an angle of 45 degrees, to a height of four inches above the surface, or until the point of balance has been reached, whichever occurs first.

Step 4: Release the elevated edge so that it may drop to the test surface without restraint.

Step 5: Repeat steps 3 and 4 for a total of six events.

Step 6: Repeat steps 2, 3, and 4 for the other base edges, for a total of 24 drops for each device.

4.3.5 Vibration Test

The vibration test simulates stresses faced during transport of voting machines and ballot counters between storage locations and polling places.

4.3.5.1 Applicability

All systems and components, regardless of type, shall meet the requirements of this test. This test is equivalent to the procedure of MIL-STD-810D, Method 514.3, Category 1- Basic Transportation, and Common Carrier.

4.3.5.2 Procedure

Step 1: Install the test item in its transit or combination case as prepared for transport.

Step 2: Attach instrumentation as required to measure the applied excitation.

Step 3: Mount the equipment on a vibration table with the axis of excitation along the vertical axis of the equipment.

Step 4: Apply excitation as shown in MIL-STD-810D, Method 514.3-1, “Basic transportation, common carrier, vertical axis”, with low frequency excitation cutoff at 10 Hz, for a period of 30 minutes.

Step 5: Repeat steps 2 and 3 for the transverse and longitudinal axes of the equipment with the excitation profiles shown in Figures 514.3-2 and 514.3-3, respectively. (Note: The total excitation period equals 90 minutes, with 30 minutes excitation along each axis.)

Step 6: Remove the test item from its transit or combination case and verify its continued operability.

4.3.6 Low Temperature Test

The low temperature test simulates stresses faced during storage of voting machines and ballot counters.

4.3.6.1 Applicability

All systems and components, regardless of type, shall meet the requirements of this test. This test is equivalent to the procedure of MIL-STD-810D, Method 502.2, and Procedure I-Storage. The minimum temperature shall be -4 degrees F.

4.3.6.2 Procedure

Step 1: Arrange the equipment as for storage. Install it in the test chamber.

Step 2: Lower the internal temperature of the chamber at any convenient rate, but not so rapidly as to cause condensation in the chamber, and in any case no more rapidly than 10 degrees F per minute, until an internal temperature of -4 degrees F has been reached.

Step 3: Allow the chamber temperature to stabilize. Maintain this temperature for a period of 4 hours after stabilization.

Step 4: Allow the internal temperature of the chamber to return to standard laboratory conditions, at a rate not exceeding 10 degrees F per minute.

Step 5: Allow the internal temperature of the equipment to stabilize at laboratory conditions before removing it from the chamber.

Step 6: Remove the equipment from the chamber and from its containers, and inspect the equipment for evidence of damage.

Step 7: Verify continued operability of the equipment.

4.3.7 High Temperature Test

The high temperature test simulates stresses faced during storage of voting machines and ballot counters.

4.3.7.1 Applicability

All systems and components, regardless of type, shall meet the requirements of this test. This test is equivalent to the procedure of MIL-STD-810D, Method 501.2, and Procedure I-Storage. The maximum temperature shall be 140 degrees F.

4.3.7.2 Procedure

Step 1: Arrange the equipment as for storage. Install it in the test chamber.

Step 2: Raise the internal temperature of the chamber at any convenient rate, but in any case no more rapidly than 10 degrees F per minute, until an internal temperature of 140 degrees F has been reached.

Step 3: Allow the chamber temperature to stabilize. Maintain this temperature for a period of 4 hours after stabilization.

Step 4: Allow the internal temperature of the chamber to return to standard laboratory conditions, at a rate not exceeding 10 degrees F per minute.

Step 5: Allow the internal temperature of the equipment to stabilize at laboratory conditions before removing it from the chamber.

Step 6: Remove the equipment from the chamber and from its containers, and inspect the equipment for evidence of damage.

Step 7: Verify continued operability of the equipment.

4.3.8 Humidity Test

The humidity test simulates stresses faced during storage of voting machines and ballot counters.

4.3.8.1 Applicability

All systems and components regardless of type shall meet the requirements of this test. This test is similar to the procedure of MIL-STD-810D, Method 507.2, Procedure I-Natural Hot-Humid. It is intended to evaluate the ability of the equipment to survive exposure to an uncontrolled temperature and humidity environment during storage. This test lasts for ten days.

4.3.8.2 Procedure

Step 1: Arrange the equipment as for storage. Install it in the test chamber.

Step 2 Adjust the chamber conditions to those given in MIL-STD-810D Table 507.2-I, for the time 0000 of the Hot Humid cycle (Cycle 1).

Step 3: Perform a 24-hour cycle with the time and temperature-humidity values specified in Figure 507.2-1, Cycle 1.

Step 4: Repeat Step 2 until 5, 24-hour cycles have been completed.

Step 5: Continue with the test commencing with the conditions specified for time = 0000 hours.

Step 6: At any convenient time in the interval between time = 120 hours and time = 124 hours, place the equipment in an operational configuration, and perform a complete operational status check as defined in Subsection 4.6.1.5.

Step 7: If the equipment satisfactorily completes the status check, continue with the sixth 24-hour cycle.

Step 8: Perform 4 additional 24-hour cycles, terminating the test at time = 240 hours.

Step 9: Remove the equipment from the test chamber and inspect it for any evidence of damage.

Step 10: Verify continued operability of the equipment.

4.4 Operating Environmental Tests

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

4.4.1 Simulated Operation Diagnostic

A diagnostic test routine is performed to exercise and diagnose failures from internal subsystems in the UUT. 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.

For DRE equipment, each loop may be very short. For paper ballot scanning devices, a recirculation ballot operation is typically used where the ballot is read, reversed to the input position and then read again. The test will loop continuously until manually interrupted.

4.4.2 Integrity

The UUT is subject to integrity verification based on the provisions of Volume I, Section 2.1.4 (d) to ensure system integrity, all system shall protect against ambient temperature and humidity fluctuations. The ambient temperature fluctuations are verified during the temperature and power variation test. The MIL-STD-810D, Method 507.2, Procedure I-Natural Hot-Humid is considered to be industry standard and is selected to verify humidity fluctuations.

4.4.3 Temperature and Power Variation Tests

This test is similar to the low temperature and high temperature tests of MIL-STD-810-D, Method 502.2 and Method 501.2, with test conditions that correspond to the requirements of the performance standards. This procedure tests system operation under various environmental conditions for at least 163 hours. During 48 hours of this operating time, the device shall be in a test chamber. For the remaining hours, the equipment shall be operated at room temperature. The system shall be powered for the entire period of this test; the power may be disconnected only if necessary for removal of the system from the test chamber.

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.

Other functionality of the ES&S EVS 6000 will be verified as well, such as any available data quality tests, error logging as well as audit log reports.

The criteria reviewed for this requirement will include:

- The vote data reports generated every 4th hour on devices and Count.
- Error reports generated
- Audit log reports generated
- Any anomalies will be researched in order to determine if it is explainable or is a test failure.

Each operating cycle shall consist of processing the number of ballots indicated above.

Step 1: Arrange the equipment in the test chamber. Connect as required and provide for power, control, and data service through enclosure wall.

Step 2: Set the supply voltage at 117 voltage alternating current.

Step 3: Power the equipment, and perform an operational status check as in Section 4.6.1.5.

Step 4: Set the chamber temperature to 50 degrees F, observing precautions against thermal shock and condensation.

Step 5: Begin 24 hour cycle.

Step 6: At T=4 hrs, lower the supply voltage to 105 vac.

Step 7: At T=8 hrs, raise the supply voltage to 129 vac.

Step 8: At T=11:30 hrs, return the supply voltage to 117 vac and return the chamber temperature to lab ambient, observing precautions against thermal shock and condensation.

Step 9: At T=12:00 hrs, raise the chamber temperature to 95 degrees Fahrenheit.

Step 10: Repeat Steps 5 through 8, with temperature at 95 degrees Fahrenheit, complete at T=24 hrs.

Step 11: Set the chamber temperature at 50 degrees Fahrenheit as in Step 4.

Step 12: Repeat the 24 hour cycle as in Steps 5-10, complete at T=48 hrs.

Step 13: After completing the second 24 hour cycle, disconnect power from the system and remove it from the chamber if needed.

Step 14: Reconnect the system as in Step 2, and continue testing for the remaining period of operating time.

Note: Requires 24-hr continuous coverage / support from the hardware test lab for the duration of Temperature / Power Variation Test. Support from the hardware test lab includes monitoring and setting voltage meter when required base off test plan requirements.

4.4.3.1 Test Approach

Test configuration:

- *3 - DS200 v1.2, duration = 64 hours (48 + 16 hrs) for each unit under test*
- *3 - DS200 v1.3, duration = 64 hours (48 + 16 hrs) for each unit under test*
- *3 - ExpressVote v1.0, duration = 64 hours (48 + 16 hrs) for each unit under test*
- *3 - ExpressVote v2.1, duration = 64 hours (48 + 16 hrs) for each unit under test*
- *3 - ExpressVote XL, duration = 64 hours (48 + 16 hrs) for each unit under test*
- *3 - ExpressTouch, duration = 64 hours (48 + 16 hrs) for each unit under test*
- *3 - DS450, duration = 64 hours (48 + 16 hrs) for each unit under test*
- *3 - DS850, duration = 64 hours (48 + 16 hrs) for each unit under test*

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

- DS200 v1.2 / v1.3 – scan 105 ballots every hour.
- ExpressVote v1.0 - mark/vote 45 ballots every hour.
- ExpressVote v2.1 - mark/vote 45 ballots every hour.
- ExpressVote XL - mark/vote 100 ballots every hour.
- ExpressTouch - mark/vote 105 ballots every hour using an automatic test pattern.

- ExpressVote v2.1 – mark/vote 100 ballots * every hour.

  ***** Pre-marked by a BMD (ExpressVote 1.0 or 2.1)
  * Generated and scanned by the ExpressVote 2.1
    - Generated via on-screen marking, and
    - Generated via QR code scanning

Central Count

The Central Count systems consist scanners and COTS workstations.

Test duration is for 64 continuous hours. Only the first 48 hours is required to be in temperature/power variation phase of the test.

Test Configuration = 64 hours (minimum total hours for the statistical model)

3 - DS450 mid-range scanner and tabulator

3 - DS850 high-speed scanner and tabulator

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

- 300 pre-marked ballots will be scanned every hour. Then same 300 ballots with be use in each of the scanner workstations. After each hour ballots will be retired.

SLI will generate reports as needed until the testing cycle is complete. SLI personnel will audit ballots once per hour until testing is completed.

Reports generated will be:

- Election Summary Results
- Precinct Summary Results

4.4.4 Reliability Test

The accredited test lab shall test for reliability based on the provisions of Volume I, Section 4 for the acceptable Mean Time Between Failure (MBTF). The MBTF shall be measured during the conduct of other system performance tests specified in this section, and shall be at least 163 hours. Appendix C of VVSG Vol. II provides further details of the calculation for this testing period.

The “cause for failure” is only limited by the functions being performed by the scanner while in use, as partially denoted by the criteria “Loss of one or more functions“, while this list attempts to cover all potential points of failure, if an issue occurs outside of this list will still be reviewed. For this test, the criteria will be defined as any function observed to have failed from its intended purpose, during the conduction of the test. E.g., for the scanner, scanning ballots (physically moving them in and out of the scanner), the screen remains on and active, counters are active, printer continues to function.

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

a. USB ports not writing media
b. AutoBallot (USB Bar Code Scanner) port not functioning
c. Thermal printer not printing
d. Tablet display does not function
e. Static Audio not playing
f. Device does not power on or off properly

g. Device reports do not print
h. Loss of ATI functionality
i. Media fails
j. Media data is corrupted
k. Error logging is incorrect
l. Audit logging is incorrect
m. Battery becomes damaged
n. Loss of Poll Worker functionality
o. Loss of LED functionality
p. Operational Status check registers a failure Access
q. Any “Devices Tests” fail post testing
r. Any other unexpected action that deviates from device documentation

1. *Loss of one or more functions.*
2. *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 of the first failure criteria.*
3. **Criteria 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.*

5 Handling Hardware Anomalies and Incidents

5.1 Hardware Test Anomalies

An anomaly with the subcontractor's test equipment or a procedural misstep can cause a test to fail. For any suspected test equipment issue or procedural error, analysis will be performed and the decision whether to continue testing based on the severity of the anomaly will be appropriately tracked. The subcontractor test lab will issue a corrective action to address any test equipment and/or procedure errors. This is part of the hardware test subcontractor's quality system process that allows the hardware test lab to train all personnel, repair/calibrate equipment, and prevent any recurrence.

5.2 Hardware Incident Process

For every test failure of any voting system component at the hardware test lab, the lab completes a data sheet (per their laboratory procedures and templates) and immediately informs the SLI Hardware Specialist. This can be communicated in the daily status update, with the data sheet attached.

- Failure Analysis: Once a failure has occurred, the SLI Hardware Specialist will be involved with the subcontractor test lab(s) to identify the hardware discrepancy in the device. The results of the analysis will be documented and tracked in the discrepancy reporting tool used for the test campaign. The analysis will focus on the failure, what caused the failure, the severity (minor or major), and possible impacts to other testing.
- Mitigation: The SLI Hardware Specialist monitors any work done by the manufacturer, with the full understanding of what is occurring and why.
    - The Manufacturer will document what work is done and the SLI Hardware Specialist will sign off on or can stop the work at any time.
    - The Hardware Specialist will determine the number of "minor" fixes the manufacturer can incorporate without a re-start of the test.
    - Any modification to the equipment is followed up with the related manufacturer EC(s). All related ECs must be entered into the hardware test report and the certification test report.

When issues are identified during hardware environmental testing, they result in discrepancies. Discrepancies are tracked in the discrepancy reporting tool.