

VOLUNTARY VOTING SYSTEM GUIDELINES DOCUMENT COMPARE

SECTION 2

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Volume I, Section 2

Voting System Functional Capabilities

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2 Functional Capabilities

2.1 Scope

This section contains requirements detailing the functional capabilities required of a voting system. This section sets out precisely what it is that a voting system is required to do. In addition, this section sets forth the minimum actions a voting system must be able to perform to be eligible for certification.

For organizational purposes, functional capabilities are categorized by the phase of election activity in which they are required:

- ◆ Overall Capabilities: These functional capabilities apply throughout the election process. They include security, accuracy, integrity, system auditability, election management system, vote tabulation, ballot counters, telecommunications, and data retention.
- ◆ Pre-voting Capabilities: These functional capabilities are used to prepare the voting system for voting. They include ballot preparation, the preparation of election-specific software (including firmware), the production of ballots or ballot pages, the installation of ballots and ballot counting software (including firmware), and system and equipment tests.
- ◆ Voting Capabilities: These functional capabilities include all operations conducted at the polling place by voters and officials including the generation of status messages.
- ◆ Post-voting Capabilities: These functional capabilities apply after all votes have been cast. They include closing the polling place; obtaining reports by voting machine, polling place, and precinct; obtaining consolidated reports; and obtaining reports of audit trails.
- ◆ Maintenance, Transportation and Storage Capabilities: These capabilities are necessary to maintain, transport, and store voting system equipment.

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In recognition of the diversity of voting systems, the Guidelines apply specific requirements to specific technologies. Some of the Guidelines apply only if the system incorporates certain optional functions (for example, voting systems employing telecommunications to transmit voting data). For each functional capability, common

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requirements are specified. Where necessary, these are followed by requirements applicable to specific technologies (i.e., paper-based or DRE) or intended use (i.e., central or precinct count).

2.2 Overall System Capabilities

This section defines required functional capabilities that are system-wide in nature and not unique to pre-voting, voting, and post-voting operations. All voting systems shall provide the following functional capabilities:

♦ Security;

♦ Accuracy;

♦ Error recovery;

♦ Integrity;

♦ System auditability;

♦ Election management system;

♦ Accessibility;

♦ Vote tabulating;

♦ Ballot counters; and

♦ Data retention.

Voting systems may also include telecommunications components. Technical standards for these capabilities are described in Sections 3 through 6 of the Guidelines.

2.2.1 Security

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System security is achieved through a combination of technical capabilities and sound administrative practices. To ensure security, all systems shall:

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a. Provide security access controls that limit or detect access to critical system components to guard against loss of system integrity, availability, confidentiality, and accountability.

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b. Provide system functions that are executable only in the intended manner and order, and only under the intended conditions.

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c. Use the system's control logic to prevent a system function from executing if any preconditions to the function have not been met.

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d. Provide safeguards to protect against tampering during system repair, or interventions in system operations, in response to system failure.

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e. Provide security provisions that are compatible with the procedures and administrative tasks involved in equipment preparation, testing, and operation.

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f. If access to a system function is to be restricted or controlled, the system shall incorporate a means of implementing this capability.

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g. Provide documentation of mandatory administrative procedures for effective system security.

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2.2.2 Accuracy

Memory hardware, such as semiconductor devices and magnetic storage media, must be accurate. The design of equipment in all voting systems shall provide for the highest possible levels of protection against mechanical, thermal, and electromagnetic stresses that impact system accuracy. Section 3 provides additional information on susceptibility requirements.

2.2.2.1 Common Requirements

To ensure vote accuracy, all systems shall:

a. Record the election contests, candidates, and issues exactly as defined by election officials;

b. Record the appropriate options for casting and recording votes;

c. Record each vote precisely as indicated by the voter and be able to produce an accurate report of all votes cast;

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- d. Include control logic and data processing methods incorporating parity and check-sums (or equivalent error detection and correction methods) to demonstrate that the system has been designed for accuracy; and
- e. Provide software that monitors the overall quality of data read-write and transfer quality status, checking the number and types of errors that occur in any of the relevant operations on data and how they were corrected.

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2.2.2.2 DRE System Requirements

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As an additional means of ensuring accuracy in DRE systems, voting devices shall record and retain redundant copies of the original ballot image. A ballot image is an electronic record of all votes cast by the voter, including undervotes.

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2.2.3 Error Recovery

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To recover from a non-catastrophic failure of a device, or from any error or malfunction that is within the operator's ability to correct, the system shall provide the following capabilities:

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a. Restoration of the device to the operating condition existing immediately prior to the error or failure, without loss or corruption of voting data previously stored in the device;

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b. Resumption of normal operation following the correction of a failure in a memory component, or in a data processing component, including the central processing unit; and

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c. Recovery from any other external condition that causes equipment to become inoperable, provided that catastrophic electrical or mechanical damage due to external phenomena has not occurred.

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2.2.4 Integrity

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Integrity measures ensure the physical stability and function of the vote recording and counting processes.

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2.2.4.1 Common Requirements

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To ensure system integrity, all systems shall:

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- a. Protect, by a means compatible with these Guidelines, against a single point of failure that would prevent further voting at the polling place; Deleted: ...Standards... [61]
- b. Protect against the interruption of electrical power; Deleted: ...electronic... [62]
- c. Protect against generated or induced electromagnetic radiation; Deleted: ... [63]
- d. Protect against ambient temperature and humidity fluctuations; Deleted: ... [64]
- e. Protect against the failure of any data input or storage device; Deleted: ...

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- f. Protect against any attempt at improper data entry or retrieval; Deleted: ... [65]
- g. Record and report the date and time of normal and abnormal events; Deleted: ... [66]
- h. Maintain a permanent record of all original audit data that cannot be modified or overridden but may be augmented by designated authorized officials in order to adjust for errors or omissions (e.g. during the canvassing process.); Deleted: ...h. [67]
- i. Detect and record every event, including the occurrence of an error condition that the system cannot overcome, and time-dependent or programmed events that occur without the intervention of the voter or a polling place operator; and Deleted: ... [68]
- j. Include built-in measurement, self-test, and diagnostic software and hardware for detecting and reporting the system's status and degree of operability; Deleted: ... [69]

2.2.4.2 DRE Systems Requirements Deleted: ...Standards [70]

In addition to the common requirements, DRE systems shall: Deleted: standards... [71]

- a. Maintain a record of each ballot cast using a process and storage location that differs from the main vote detection, interpretation, processing, and reporting path; and Deleted: ...
- b. Provide a capability to retrieve ballot images in a form readable by humans. Deleted: ... [72]

2.2.5 System Audit This section describes the context and purpose of voting system audits and sets forth specific functional requirements. Additional technical audit requirements are set forth in Section 4. Deleted: ... [73]

2.2.5.1 System Audit Purpose and Context Deleted: ... [74]

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Election audit trails provide the supporting documentation for verifying the correctness of reported election results. They present a concrete, indestructible archival record of all system activity related to the vote tally, and are essential for public confidence in the accuracy of the tally, for recounts, and for evidence in the event of criminal or civil litigation.

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The following audit trail requirements are based on the premise that system-generated creation and maintenance of audit records reduces the chance of error associated with manually generated audit records. Because most audit capability is automatic, the

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system operator has less information to track and record, and is less likely to make mistakes or omissions.

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The sections that follow present operational requirements critical to acceptable performance and reconstruction of an election. Requirements for the content of audit records are described in Section 4.

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The requirements for all system types, both precinct and central count, are described in generic language. Because the actual implementation of specific characteristics may vary from system to system, it is the responsibility of the vendor to describe each system's characteristics in sufficient detail that test labs and system users can evaluate the adequacy of the system's audit trail. This description shall be incorporated in the System Operating Manual, which is part of the Technical Data Package (TDP).

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Documentation of items such as paper ballots delivered and collected, administrative procedures for system security, and maintenance performed on voting equipment are also part of the election audit trail, but are not covered in these technical standards. Useful guidance is provided by the Innovations in Election Administration #10, Ballot Security and Accountability, available on the EAC's webpage.

Deleted: Future volumes of the Standards will address these and other system operations practices. In the interim, useful

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2.2.5.2 Operational Requirements

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Audit records shall be prepared for all phases of election operations performed using devices controlled by the jurisdiction or its contractors. These records rely upon automated audit data acquisition and machine-generated reports, with manual input of some information. These records shall address the ballot preparation and election definition phase, system readiness tests, and voting and ballot-counting operations. The software shall activate the logging and reporting of audit data as described in the following sections.

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2.2.5.2.1 Time, Sequence, and Preservation of Audit Records

The timing and sequence of audit record entries is as important as the data contained in the record. All voting systems shall meet the following requirements for time, sequence and preservation of audit records:

a. Except where noted, systems shall provide the capability to create and maintain a real-time audit record. This capability records and provides the operator or precinct official with continuous updates on machine status. This information allows effective operator identification of an error condition requiring intervention, and contributes to the reconstruction of election-related events necessary for recounts or litigation.

b. All systems shall include a real-time clock as part of the system's hardware. The system shall maintain an absolute record of the time and date or a record relative to some event whose time and data are known and recorded.

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c. All audit record entries shall include the time-and-date stamp.

d. The audit record shall be active whenever the system is in an operating mode. This record shall be available at all times, though it need not be continually visible.

e. The generation of audit record entries shall not be terminated or altered by program control, or by the intervention of any person.
The physical security and integrity of the record shall be maintained at all times.

f. Once the system has been activated for any function, the system shall preserve the contents of the audit record during any interruption of power to the system until processing and data reporting have been completed.

g. The system shall be capable of printing a copy of the audit record. A separate printer is not required for the audit record, and the record may be produced on the standard system printer if all the following conditions are met:

- 1) The generation of audit trail records does not interfere with the production of output reports;
- 2) The entries can be identified so as to facilitate their recognition, segregation, and retention; and
- 3) The audit record entries are kept physically secure.

2.2.5.2.2 Error Messages

All voting systems shall meet the following requirements for error messages:

a. The system shall generate, store, and report to the user all error messages as they occur;

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- b. All error messages requiring intervention by an operator or precinct official shall be displayed or printed unambiguously in easily understood language text, or by means of other suitable visual indicators;
- c. When the system uses numerical error codes for trained technician maintenance or repair, the text corresponding to the code shall be self-contained, or affixed inside the unit device. This is intended to reduce inappropriate reactions to error conditions, and to allow for ready and effective problem correction;
- d. All error messages for which correction impacts vote recording or vote processing shall be written in a manner that is understandable to an election official who possesses training on system use and operation, but does not possess technical training on system servicing and repair;
- e. The message cue for all systems shall clearly state the action to be performed in the event that voter or operator response is required;
- f. System design shall ensure that erroneous responses will not lead to irreversible error; and

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- g. Nested error conditions shall be corrected in a controlled sequence such that system status shall be restored to the initial state existing before the first error occurred.

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2.2.5.2.3 Status Messages

The Guidelines provide latitude in software design so that vendors can consider various user processing and reporting needs. The jurisdiction may require some status and information messages to be displayed and reported in real-time. Messages that do not require operator intervention may be stored in memory to be recovered after ballot processing has been completed. The system shall display and report critical status messages using unambiguous indicators or English language text.

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The system need not display non-critical status messages at the time of occurrence. Systems may display non-critical status messages (i.e., those that do not require operator intervention) by means of numerical codes for subsequent interpretation and reporting as unambiguous text.

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Systems shall provide a capability for the status messages to become part of the real-time audit record. The system shall provide a capability for a jurisdiction to designate critical status messages.

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2.2.5.3 COTS General Purpose Computer System Requirements

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Further requirements must be applied to COTS operating systems to ensure completeness and integrity of audit data for election software. These operating systems are capable of executing multiple application programs simultaneously. These systems include both servers and workstations (or “PCs”), including the many varieties of UNIX and Linux, and those offered by Microsoft and Apple. Election software running on these COTS systems is vulnerable to unintended effects from other user sessions, applications, and utilities executing on the same platform at the same time as the election software.

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“Simultaneous processes” of concern include unauthorized network connections, unplanned user logins, and unintended execution or termination of operating system processes. An unauthorized network connection or unplanned user login can host unintended processes and user actions, such as the termination of operating system audit, the termination of election software processes, or the deletion of election software audit and logging data. The execution of an operating system process could be a full system scan at a time when that process would adversely affect the election software processes. Operating system processes improperly terminated could be system audit or malicious code detection.

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To counter these vulnerabilities, three operating system protections are required on all such systems on which election software is hosted. First, authentication shall be configured on the local terminal (display screen and keyboard) and on all external

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connection devices (“network cards” and “ports”). This ensures that only authorized and identified users affect the system while election software is running.

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Second, operating system audit shall be enabled for all session openings and closings, for all connection openings and closings, for all process executions and terminations, and for the alteration or deletion of any memory or file object. This ensures the accuracy and completeness of election data stored on the system. It also ensures the existence of an audit record of any person or process altering or deleting system data or election data.

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Third, the system shall be configured to execute only intended and necessary processes during the execution of election software. The system shall also be configured to halt election software processes upon the termination of any critical system process (such as system audit) during the execution of election software.

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2.2.6 Election Management System

The Election Management System (EMS) is used to prepare ballots and programs for use in casting and counting votes, and to consolidate, report, and display election results. An EMS shall generate and maintain a database, or one or more interactive databases, that enables election officials or their designees to perform the following functions:

- a. Define political subdivision boundaries and multiple election districts as indicated in the system documentation;
- b. Identify contests, candidates, and issues;
- c. Define ballot formats and appropriate voting options;
- d. Generate ballots and election-specific programs for vote recording and vote counting equipment;
- e. Install ballots and election-specific programs;
- f. Test that ballots and programs have been properly prepared and installed;
- g. Accumulate vote totals at multiple reporting levels as indicated in the system documentation;
- h. Generate the post-voting reports required by Section 2.5; and
- i. Process and produce audit reports of the data as indicated in Section 4.5.

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2.2.7 Human Factors

The importance of human factors in the design of voting systems has become increasingly apparent. It is not sufficient that the internal operation of these systems be correct; in addition, voters and poll workers must be able to use them effectively. There are some special difficulties in the design of usable and accessible voting systems:

- The voting task itself can be fairly complex; the voter may have to navigate an electronic ballot, choose multiple candidates in a single race or decide on abstrusely worded referenda.
- Voting is performed infrequently, so there is limited opportunity for voters and poll workers to gain familiarity with the process.
- Jurisdictions may change voting equipment, thus obviating whatever familiarity the voter might have acquired.
- Once the ballot has been cast by the voter, there is no provision for subsequent correction.
- Voting must be accessible to all eligible citizens, whatever their physical abilities, language skills, or experience with technology.

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The challenge, then, is to provide a voting system and voting environment that all voters can use comfortably, efficiently, and with justified confidence that they have cast their votes correctly. The requirements within this section are intended to serve that goal.

Although there are many detailed requirements, three broad principles motivate this section:

1. ALL ELIGIBLE VOTERS SHALL HAVE ACCESS TO THE VOTING PROCESS WITHOUT DISCRIMINATION.

The voting process shall be accessible to individuals with disabilities. Note that the voting process includes access to the polling place, instructions on how to vote, initiating the voting session, choosing candidates, getting help as needed, review of the ballot, VVPAT, if applicable, and final submission of the ballot.

2. EACH CAST BALLOT SHALL ACCURATELY CAPTURE THE SELECTIONS MADE BY THE VOTER.

The ballot shall be presented to the voter in a manner that is clear and usable. Voters should encounter no difficulty or confusion in recording their choices.

3. THE VOTING PROCESS SHALL PRESERVE THE SECRECY OF THE BALLOT

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The voting process shall preclude anyone else from determining the content of a voter's ballot, without the voter's cooperation. If such a determination is made against the wishes of the voter, then his or her privacy has been violated.

All the requirements within Section 2.2.7 have the purpose of improving the quality of interaction between voters and voting systems.

- Requirements that are likely to be relevant only to those with some disability are listed under Section 2.2.7.1, although they may also assist those not usually described as having a disability, e.g. voters with poor eyesight or somewhat limited dexterity.
- Requirements that are likely to be relevant only to those with limited English proficiency are listed in Section 2.2.7.2.
- Finally, requirements for general usability make up Section 2.2.7.3, and those for privacy, Section 2.2.7.4. Certain acronyms and terms are used extensively throughout Section 2.2.7.

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- CIF: Common Industry Format: format described in ANSI/INCITS 354-2001 "Common Industry Format (CIF) for Usability Test Reports."
- Acc-VS: Accessible Voting Station - the voting station equipped for individuals with disabilities referred to in HAVA 301 (a)(3)(B).
- ATI: Audio-Tactile Interface - a voter interface designed so as not to require visual reading of a ballot. Audio is used to convey information to the voter and sensitive tactile controls allow the voter to convey information to the voting system.
- ALVS: Alternative Language Voting Station - a voting station designed to be usable by voters who have limited English proficiency.

This section also uses common terms as defined in the updated Glossary. Note in particular, the distinctions among "voting system," "voting station," and "voting process."

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1. The voting process shall be accessible to voters with disabilities. As a minimum, every polling place shall have at least one voting station equipped for individuals with disabilities, as provided in HAVA 301 (a)(3)(B). A station so equipped is referred to herein as an accessible voting station (Acc-VS).

HAVA Section 301 (a)(3) reads in part:

"ACCESSIBILITY FOR INDIVIDUALS WITH DISABILITIES.--The voting system shall—

- (A) be accessible for individuals with disabilities, including nonvisual accessibility for the blind and visually impaired, in a manner that provides the same opportunity for access and participation (including privacy and independence) as for other voters;
- (B) satisfy the requirement of subparagraph (A) through the use of at least one direct recording electronic voting system or other voting system equipped for individuals with disabilities at each polling place;"

The requirements within Section 2.2.7.1 are intended to address this mandate. Ideally every voter would be able to vote independently and privately. As a practical matter, there may be a small number of voters whose disabilities are so severe that they will need personal assistance. Nonetheless, the requirements of this section are meant to make the voting system directly accessible to as many voters as possible.

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Note that this section does not replace requirements of other sections, but adds to them. In particular, the requirements of Section 2.2.7.3 on usability apply either to all voting stations or, in some cases, to all DRE voting stations. Many of these requirements support accessibility as well as general usability.

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Certain accessibility features that are likely to be useful to a wide range of voters are required on all voting stations, not just the Acc-VS. Finally, note that the Acc-VS is not necessarily a full-fledged DRE; for instance, an implementation may provide an ATI that generates an optiscan ballot.

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The outline for Section 2.2.7.1 is:

2.2.7.1 Accessibility

2.2.7.1.1 Voters with Disabilities - General

2.2.7.1.2 Vision

2.2.7.1.2.1 Partial Vision

2.2.7.1.2.2 Blind

2.2.7.1.3 Dexterity

2.2.7.1.4 Mobility

BEGIN EAC PAGE 2-13

2.2.7.1.5 Hearing

2.2.7.1.6 Speech

2.2.7.1.7 Cognitive

1. The voting process shall incorporate features that are applicable to several types of disability.

Discussion: These features span the disability categories within requirement # 2.2.7.1 (e.g. vision, dexterity).

1.1. When the provision of accessibility involves an alternative format for ballot presentation, then all the other information presented to voters in the case of non-disabled English-literate voters (including instructions, warnings, error and other messages, and ballot choices) shall also be presented in that alternative format.

VOLUNTARY VOTING SYSTEM GUIDELINES DOCUMENT COMPARE

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Discussion: This is a general principle to be followed for any alternative format presentation. Two particular cases, (a) audio formats and (b) non-English formats, are the subject of specific requirements in later sections.

1.2 An Acc-VS shall provide accessibility to voters using their own personal assistive devices.

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Discussion: Voters are not to be obliged to supply any special equipment in order to vote. This requirement does not preclude the Acc-VS from providing interfaces to assistive technology.

1.3 When the primary means of voter identification or authentication uses biometric measures that require a voter to possess particular biological characteristics, the voting process shall provide a secondary means that does not depend on those characteristics.

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BEGIN EAC PAGE 2-14

Discussion: For example, if fingerprints were used for identification, there would have to be another mechanism for voters without usable fingerprints.

2. The voting process shall be accessible to voters with visual disabilities.

Discussion: Note that all aspects of the voting process are to be accessible, not just the voting station.

2.1 The Acc-VS shall be accessible to disabled voters with partial vision.

2.1.1 The vendor should conduct summative usability tests on the Acc-VS using partially sighted subjects and report the test results to the voting system test lab according to the Common Industry Format (CIF). Voting System Vendor

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[Best Practice for Voting Officials] When the provision of accessibility involves an alternative format for ballot presentation, then all the other information presented to voters in the case of non-disabled English-literate voters (including instructions, warnings, messages, and ballot choices) is also presented in that alternative format. ... [100]

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VOLUNTARY VOTING SYSTEM GUIDELINES DOCUMENT COMPARE

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Discussion: This requirement is meant to encourage Acc-VS designers to conduct some realistic usability tests on the final product. For now, it is purely a documentation recommendation. Future revisions to the Guidelines will include requirements for usability testing to be conducted by the voting system test lab, with specific performance benchmarks.

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2.1.2 The Acc-VS and any voting station with an electronic image display shall be capable of showing all information in at least two type-font sizes, (a) 3.0-4.0 mm and (b) 6.3-9.0 mm, under control of the voter.

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Discussion: While larger font sizes may assist most voters with poor vision, certain disabilities such as tunnel vision are best addressed by smaller font sizes.

Deleted: It is anticipated that future versions of the VVSG will require font size to be under the independent control of the voter.

BEGIN EAC PAGE 2-14

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2.1.3 All voting stations using paper ballots should make provisions for voters with poor reading vision.

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Discussion: Possible solutions include: (a) providing paper ballots in at least two font sizes, 3.0-4.0mm and 6.3-9.0mm and (b) providing a magnifying device.

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2.1.4 An Acc-VS and any voting station with a black-and- white-only electronic image display shall be capable of showing all information in high contrast either by default or under the control of the voter or poll worker. High contrast is a figure-to-ground ambient contrast ratio for text and informational graphics of at least 6:1.

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VOLUNTARY VOTING SYSTEM GUIDELINES DOCUMENT COMPARE

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Discussion: It is anticipated that future revisions to the Guidelines will require contrast to be under the independent control of the voter.

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2.1.5. An Acc-VS with a color electronic image display shall allow the voter to adjust the color or the figure-to-ground ambient contrast ratio.

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Discussion: See NASED Technical Guide #1 in Appendix E for examples of how a voting station may meet this requirement by offering a limited number of discrete choices. In particular, it is not required that the station offer a continuous range of color or contrast values.

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2.1.6. On all voting stations, the default color coding shall maximize correct perception by voters and operators with color blindness.

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[Best Practice for Voting Officials]

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2.1.7 . On all voting stations,

2.1.7 On all voting stations, color coding shall not be used as the sole means of conveying information, indicating an action, prompting a response, or distinguishing a visual element.

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Discussion: This implies that although color can be used for emphasis, some other non-color mode must also be used to convey the information, such as a shape or text style. For example, red can be enclosed in an octagon shape.

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2.1.8 Buttons and controls on Acc-VS should be distinguishable by both shape and color.

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VOLUNTARY VOTING SYSTEM GUIDELINES DOCUMENT COMPARE

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Discussion: The redundant cues have been found to be helpful to those with partial vision.

2.1.9 Any voting station using an electronic image display ~~shall~~ provide synchronized audio output to convey the same information as that ~~which would be displayed~~ on the screen.

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2.2 The Acc-VS shall be accessible to voters who are blind.

Discussion: ~~Many~~ of the features under this requirement are also useful for voters with partial vision (see requirement 2.2.7.1.2.1) and for voters who cannot read English for other reasons (see requirement 2.2.7.2).

2.2.1 The vendor should conduct summative usability tests on the Acc-VS using subjects who are blind and report the test results to the ~~voting system test lab~~ according to the Common Industry Format (CIF). Voting System Vendor

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Deleted: Synchronized presentation of information in both visual and aural modes is a recommendation in this version of the VVSG, but it is anticipated that this will become a requirement in future versions. .

2.2 The Acc-VS shall be accessible to voters who are blind. .

Discussion: Of course, many

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Discussion: This requirement is meant to encourage Acc-VS designers to conduct some realistic usability tests on the final product. For now, it is purely a documentation recommendation. Future ~~revisions to the Guidelines~~ will include requirements for usability testing to be conducted by the ~~voting system test lab~~, with specific performance benchmarks.

2.2.2 The Acc-VS shall provide an audio-tactile interface (ATI) that supports the full functionality of a normal ballot interface, as specified in Section 2.4.

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Discussion: Note the necessity of both audio output and tactilely discernible controls for voter input. Full functionality includes at least:

- Instructions and feedback on initial activation of the ballot (such as insertion of a smart card), if this is normally performed by the voter on comparable voting stations.
- Instructions and feedback to the voter on how to operate the Acc-VS, including settings and options (e.g., volume control, repetition).
- Instructions and feedback for navigation of the ballot.
- Instructions and feedback for voter selections in races and referenda, including write-in candidates.
- Instructions and feedback on confirming and changing selections, and
- Instructions and feedback on final submission of ballot.

2.2.1 The ATI of the Acc-VS shall provide the same capabilities to vote and cast a ballot as are provided by the other voting stations or by the visual interface of the Acc-VS.

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BEGIN EAC PAGE 2-17

Discussion: For example, if a "normal" ballot supports voting a straight party ticket and then changing the choice in a single race, so must the ATI. This requirement is a special case of the more general requirement 2.2.7.1.1.1.

2.2.2.2 The ATI shall allow the voter to have any information provided by the system repeated.

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2.2.2.3 The ATI shall allow the voter to pause and resume the audio presentation.

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2.2.2.1

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VOLUNTARY VOTING SYSTEM GUIDELINES DOCUMENT COMPARE

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2.2.2.4 The ATI shall allow the voter to skip to the next contest or return to previous contests

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2.2.2.5 Discussion: This is analogous to the ability of sighted voters to move on to the next race once they have made a selection or to abstain from voting on a contest. The ATI shall allow the voter to skip over the reading of a referendum so as to be able to vote on it immediately.

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2.2.2.5

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Discussion: This is analogous to the ability of sighted voters to skip over the wording of a referendum on which

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they have already made a decision prior to the voting session (e.g. “Vote yes on proposition #123”). 2.2.3 All voting stations that provide audio presentation of the ballot shall conform to the following sub-requirements. Discussion: These requirements apply to all audio output, not just to the ATI of an Acc-VS.

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Deleted: It is anticipated that this recommendation will become a requirement in future versions of the VVSG.

2.2.3.1 The ATI shall provide its audio signal through an industry standard connector for private listening using a 3.5mm stereo headphone jack to allow voters to use their own audio assistive devices.

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2.2.3.1

2.2.3.2 When a voting station utilizes a telephone style handset/headset to provide audio information, it shall provide a wireless T-Coil coupling for assistive hearing devices so as to provide access to that information for voters with partial hearing. That coupling shall achieve at least a category T4 rating as defined by American National Standard for Methods of Measurement of Compatibility between Wireless Communications Devices and Hearing Aids, ANSI C63.19.

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2.2.3.3 No voting station shall cause electromagnetic interference with assistive hearing devices that would substantially degrade the performance of those devices. The station, considered as a wireless device (WD), shall achieve at least a category T4 rating as defined by American National Standard for Methods of Measurement of Compatibility between Wireless Communications Devices and Hearing Aids, ANSI C63.19.

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Discussion: "Hearing devices" include hearing aids and cochlear implants.

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2.2.3.4 A sanitized headphone or handset should be made available to each voter.

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Discussion: This requirement can be achieved in various ways, including the use of "throwaway" headphones, or of sanitary coverings.

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2.2.3.5 The voting station shall set the initial volume for each voter between 40 and 50 dB SPL.

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[Best Practice for Voting Officials] A sanitized
headphone or handset is made available to
each voter.
2.2.3.5

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Discussion: A voter does not "inherit" the volume as set by the previous user of the voting station.

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2.2.3.6 The voting station shall provide a volume control with an adjustable amplification from a minimum of 20dB SPL up to a maximum of 105 dB SPL, in increments no greater than 20dB.

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2.2.3.7 The audio system shall be able to reproduce frequencies over the audible speech range of 315 Hz to 10KHz.

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2.2.3.8 The audio system should provide information via recorded human speech, rather than synthesized speech.

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Discussion: Most users prefer real speech over synthesized speech.

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2.2.3.9 The audio system should allow voters to control, within reasonable limits, the rate of speech.

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Discussion: Many blind voters are accustomed to interacting with accelerated speech.

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2.2.4 If the normal procedure is to have voters initialize the activation of the ballot, the Acc-VS shall provide features that enable voters who are blind to perform this activation.

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Discussion: For example, smart cards might provide tactile cues so as to allow correct insertion.

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2.2.5 If the normal procedure is for voters to submit their own ballots, then the Acc-VS shall provide features that enable voters who are blind to perform this submission. Voting System Vendor

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Discussion: For example, if voters normally feed their own optiscan ballots into a reader, blind voters should also be able to do so.

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[Best Practice for Voting Officials] If the normal procedure is for voters to submit their own ballots, then the voting process provides features that enable voters who are blind to perform this submission. .

2.2.6 If the normal procedure includes VVPAT, the Acc-VS should provide features that enable voters who are blind to perform this verification. If a state requires the paper record produced by the VVPAT to be the official ballot, then the Acc-VS shall provide features that enable visually impaired voters to review the paper record.

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Discussion: For example, the Acc-VS might provide an automated reader for the paper record that converts the contents of the paper into audio output.

2.2.7 All mechanically operated controls or keys on an Acc-VS shall be tactilely discernible without activating those controls or keys.

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2.2.8 On an Acc-VS, the status of all locking or toggle controls or keys (such as the "shift" key) shall be visually discernible, and discernible either through touch or sound.

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3. The voting process shall be accessible to voters who lack fine motor control or the use of their hands.

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VOLUNTARY VOTING SYSTEM GUIDELINES DOCUMENT COMPARE

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3.1 The vendor should conduct summative usability tests on the Acc-VS with subjects lacking fine motor control and report the test results to the appropriate testing authority according to the Common Industry Format (CIF).

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Discussion: This requirement is meant to encourage Acc-VS designers to conduct some realistic usability tests on the final product. For now, it is purely a documentation recommendation. Future versions of the VVSG will include requirements for usability testing to be conducted by the testing authority with specific performance benchmarks.

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3.2 All keys and controls on the Acc-VS shall be operable with one hand and shall not require tight grasping, pinching, or twisting of the wrist. The force required to activate controls and keys shall be no greater 5 lbs. (22.2 N).

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Discussion: Controls are to be operable without excessive force.

3.3 The Acc-VS controls shall not require direct bodily contact or for the body to be part of any electrical circuit.

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Discussion: This requirement ensures that controls are operable by individuals using prosthetic devices.

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3.4 The Acc-VS should provide a mechanism to enable non-manual input that is functionally equivalent to tactile input.

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Discussion: This recommendation ensures that the Acc-VS is operable by individuals who do not have the use of their hands. All the functionality of the Acc-VS (e.g., straight party voting, write-in candidates) that is available through the other forms of input, such as tactile, must also be available through the input mechanism if it is provided by the Acc-VS.

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3.5 If the normal procedure is for voters to submit their own ballots, then the Acc-VS should provide features that enable voters who lack fine motor control or the use of their hands to perform this submission.

4. The voting process shall be accessible to voters who use mobility aids, including wheelchairs.

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4.1 The Acc-VS shall provide a clear floor space of 30 inches (760 mm) minimum by 48 inches (1220 mm) minimum for a stationary mobility aid. The clear floor space shall be level with no slope exceeding 1:48 and positioned for a forward approach or a parallel approach.

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4.2 All controls, keys, audio jacks and any other part of the Acc-VS necessary for the voter to operate the voting system shall be within reach as specified under the following sub-requirements.

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Discussion: All dimensions are given in inches. To convert to millimeters, multiply by 25.4 and then round to the nearest multiple of 5. Note that these sub-requirements have meaningful application mainly to controls in a fixed location. A hand-held tethered control panel is another acceptable way of providing reachable controls.

[Best Practice for Voting Officials] All controls, keys, audio jacks and any other part of the Acc-VS necessary for the voter to operate the voting system are within the reach regions as specified in the VVSG Volume I, Section

4.2.1 If the Acc-VS has a forward approach with no forward reach obstruction then the high reach shall be 48 inches maximum and the low reach shall be 15 inches minimum. See Figure 2.2.7.1-1.

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VOLUNTARY VOTING SYSTEM GUIDELINES DOCUMENT COMPARE

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4.2.2 If the Acc-VS has a forward approach with a forward reach obstruction, the following sub-requirements apply. See Figure 2.2.7.1-2.

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4.2.2.1.1 The forward obstruction shall be no greater than 25 inches in depth, its top no higher than 34 inches and its bottom surface no lower than 27 inches.

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4.2.2.2 If the obstruction is no more than 20 inches in depth, then the maximum high reach shall be 48 inches, otherwise it shall be 44 inches.

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4.2.2.3 Space under the obstruction between the finish floor or ground and 9 inches (230 mm) above the finish floor or ground shall be considered toe clearance and shall comply with the following sub-requirements.

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A. Toe clearance shall extend 25 inches (635 mm) maximum under the obstruction.

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B. The minimum toe clearance under the obstruction shall be either 17 inches (430 mm) or the depth required to reach over the obstruction to operate the Acc-VS, whichever is greater.

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C. Toe clearance shall be 30 inches (760 mm) wide minimum.

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4.2.2.3 Space under the obstruction between 9 inches (230 mm) and 27 inches (685 mm) above the finish floor or ground shall be considered knee clearance and shall comply with the following sub-requirements.

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A. Knee clearance shall extend 25 inches (635 mm) maximum under the obstruction at 9 inches (230 mm) above the finish floor or ground.

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B. The minimum knee clearance at 9 inches (230 mm) above the finish floor or ground shall be either 11 inches (280 mm) or 6 inches less than the toe clearance, whichever is greater.

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C. Between 9 inches (230 mm) and 27 inches (685 mm) above the finish floor or ground, the knee clearance shall be permitted to reduce at a rate of 1 inch (25 mm) in depth for each 6 inches (150 mm) in height.

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Discussion: It follows that the minimum knee clearance at 27 inches above the finish floor or ground shall be 3 inches less than the minimum knee clearance at 9 inches above the floor.

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D. Knee clearance shall be 30 inches (760 mm) wide minimum.

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4.2.3 If the Acc-VS has a parallel approach with no side reach obstruction then the maximum high reach shall be 48 inches and the minimum low reach shall be 15 inches. See Figure 2.2.7.1-3.

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4.2.4 If the Acc-VS has a parallel approach with a side reach obstruction, the following sub-requirements apply. See Figure 2.2.7.1-4.

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4.2.4.1 The side obstruction shall be no greater than 24 inches in depth and its top no higher than 34 inches.

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4.2.4.1

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4.2.4.2 If the obstruction is no more than 10 inches in depth, then the maximum high reach shall be 48 inches, otherwise it shall be 46 inches.

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Discussion: Since this is a parallel approach, no clearance under the obstruction is required.

4.2.5 All labels, displays, controls, keys, audio jacks, and any other part of the Acc-VS necessary for the voter to operate the voting system shall be easily legible and visible to a voter in a wheelchair with normal eyesight (no worse than 20/40, corrected) who is in an appropriate position and orientation with respect to the Acc-VS.

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Discussion: There are a number of factors that could make relevant parts of the Acc-VS difficult to see: small lettering, controls and labels tilted at an awkward angle from the voter's viewpoint, glare from overhead lighting, etc.

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5. The voting process shall be accessible to voters with hearing disabilities.

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5.1 The Acc-VS shall incorporate the features listed under requirement 2.2.7.1.2.2.3 (audio presentation) to provide accessibility to voters with hearing disabilities.

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Discussion: Note especially the requirements for volume initialization and control.

5.2 If a voting station provides sound cues as a method to alert the voter, the tone shall be accompanied by a visual cue.

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Discussion: For instance, the station might beep if the voter attempts to overvote. If so, there would have to be an equivalent visual cue, such as the appearance of an icon, or a blinking element.

[Best Practice for Voting Officials] The Acc-VS incorporates the features listed in the VVSG Volume I, Section 2.2.7.1.2.2.3 (audio presentation) to provide accessibility to voters with hearing disabilities.

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6. The voting process shall be accessible to voters with speech disabilities.

6.1 No voting station shall require voter speech for its operation.

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Discussion: This does not preclude a voting station from offering speech input as an option, but speech must not be the only means of input. 7. The voting process should be accessible to voters with cognitive disabilities.

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Discussion: At present there are no design features specifically aimed at helping those with cognitive disabilities. Section 2.2.7.1.2.1.9, the synchronization of audio with the screen in a DRE, is helpful for some cognitive disabilities such as dyslexia. Section 2.2.7.3.3 also contains some relevant guidelines.

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[Best Practice for Voting Officials] The voting process is made accessible to voters with cognitive disabilities.

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Figures for Accessibility

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2. The voting process shall be accessible to voters who are not fully literate in English. This requirement may be satisfied by providing voting stations in a polling place that accommodate those without a full command of English. See HAVA 301 (a)(4) and 241 (b)(5). Such a facility is referred to herein as an alternative language voting station (ALVS).

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HAVA Section 301 (a)(4) reads:

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“ALTERNATIVE LANGUAGE ACCESSIBILITY.--The voting system shall provide alternative language accessibility pursuant to the requirements of section 203 of the Voting Rights Act of 1965 (42 U.S.C. 1973aa-1a).”

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The requirements within Section 2.2.7.2 are intended to address this mandate. Ideally every voter would be able to vote independently and privately, regardless of language. As a practical matter, alternative language access is mandated under the Voting Rights Act of 1975, subject to certain thresholds, e.g. if the language group exceeds 5% of the voting age citizens.

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VOLUNTARY VOTING SYSTEM GUIDELINES DOCUMENT COMPARE

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Note that the provision of an audio interface for people with visual disabilities as described in Section 2.2.7.1 may also assist voters who speak English, but are unable to read it.

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The outline for section 2.2.7.2 is:

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2.2.7.2. Alternative Languages

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2.2.7.2.1 Complete Information

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2.2.7.2.2 Spelling of Names

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2.2.7.2.3 Literate Voters

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2.2.7.2.4 Illiterate Voters

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1. All the information presented in the normal case of English-literate voters (including instructions, warnings, error and other messages, and ballot choices) shall also be presented by the ALVS, whether the language is written or spoken.

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Discussion: This is in keeping with general requirement 2.2.7.1.1.1.

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BEGIN EAC PAGE 2-30

2. Regardless of the language, candidate names shall be displayed or pronounced in English on all ballots. For written languages that do not use Roman characters (e.g. Chinese, Japanese, Korean, Arabic), the ballot shall include transliteration of candidate names into the relevant language.

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3. For literate voters, the ALVS shall provide printed or displayed instructions, messages, and ballots in their preferred language, consistent with state and Federal law.

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VOLUNTARY VOTING SYSTEM GUIDELINES DOCUMENT COMPARE

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3.1 The vendor should conduct summative usability tests on the ALVS with literate subjects who neither speak nor read English and report the test results according to the Common Industry Format (CIF).

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Discussion: This requirement is meant to encourage Acc-VS designers to conduct some realistic usability tests on the final product. For now, it is purely a documentation recommendation. Future revisions to the Guidelines will include requirements for usability testing to be conducted by voting system test lab, with specific performance benchmarks.

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4. For illiterate voters, the ALVS shall provide spoken instructions and ballots in the preferred language of the voter, consistent with state and Federal law. The requirements and sub-requirements of 2.2.7.1.2.2.2 (Acc-VS/ATI) shall apply to this mode of interaction.

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Discussion: Note that some languages have no widely accepted written form.

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BEGIN EAC PAGE 2-31

3. The voting process shall provide a high level of usability to the voters. Accordingly, voters shall be able to negotiate the process effectively, efficiently, and comfortably.

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Discussion: The mandatory Voting System Standards codified in HAVA relate to the interaction between the voter and the voting system. HAVA Section 301 begins:

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"SEC. 301. VOTING SYSTEMS STANDARDS.

Deleted:

a. Requirements.--Each voting system used in an election for Federal office shall meet the following requirements:

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1. In general.--

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VOLUNTARY VOTING SYSTEM GUIDELINES DOCUMENT COMPARE

SECTION 2

A. Except as provided in subparagraph (B), the voting system (including any lever voting system, optical scanning voting system, or direct recording electronic system) shall--

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i. Permit the voter to verify (in a private and independent manner) the votes selected by the voter on the ballot before the ballot is cast and counted;

Deleted: [REDACTED]

ii. Provide the voter with the opportunity (in a private and independent manner) to change the ballot or correct any error before the ballot is cast and counted (including the opportunity to correct the error through the issuance of a replacement ballot if the voter was otherwise unable to change the ballot or correct any error); and

Deleted: [REDACTED]

iii. If the voter selects votes for more than one candidate for a single office—

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I. Notify the voter that the voter has selected more than one candidate for a single office on the ballot;

Deleted: [REDACTED]

II. Notify the voter before the ballot is cast and counted of the effect of casting multiple votes for the office; and

Deleted: [REDACTED]

III. Provide the voter with the opportunity to correct the ballot before the ballot is cast and counted.

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B. A State or jurisdiction that uses a paper ballot voting system, a punch card voting system, or a central count voting system (including mail-in absentee ballots and mail-in ballots), may meet the requirements of subparagraph (A)(iii) by—

Deleted: [REDACTED]

i. Establishing a voter education program specific to that voting system that notifies each voter of the effect of casting multiple votes for an office; and

Deleted: [REDACTED]

BEGIN EAC PAGE 2-32

Deleted: [REDACTED]

ii. Providing the voter with instructions on how to correct the ballot before it is cast and counted (including instructions on how to correct the error through the issuance of a replacement ballot if the voter was otherwise unable to change the ballot or correct any error).

Deleted: [REDACTED]

C. The voting system shall ensure that any notification required under this paragraph preserves the privacy of the voter and the confidentiality of the ballot."

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The requirements of this section supplement these basic HAVA mandates and also HAVA's support for improved usability (see Section 243 and Section 221 (e)(2)(D)).

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VOTING AND USABILITY

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VOLUNTARY VOTING SYSTEM GUIDELINES DOCUMENT COMPARE SECTION 2

Usability is defined generally as a measure of the effectiveness, efficiency, and satisfaction achieved by a specified set of users with a given product in the performance of specified tasks. In the context of voting, the primary users are the voters (but also poll workers), the product is the voting system, and the task is the correct representation of one's choices in the election. Additional requirements for task performance are independence and privacy: the voter should normally be able to complete the voting task without assistance from others (although the voting system itself may offer help), and the voter's choices should be private (see Section 2.2.7.4). Aside from its intrinsic undesirability, lack of independence or privacy may adversely affect effectiveness (e.g. by possibly inhibiting the voter's free choice) and efficiency (e.g. by slowing down the process).

Among the "bottom-line" metrics for usability are:

- low error rate for marking the ballot (the voter's intention is correctly conveyed to and represented within the voting system),
- efficient operation (time required to vote is not excessive), and
- satisfaction (voter experience is safe, comfortable, free of stress, and instills confidence).

These criteria define the core of good voting system usability. The purpose of the detailed requirements listed below is to help voting systems meet the core criteria.

METHODOLOGY FOR REQUIREMENTS. It is the intention of the TGDC that in future revisions to the Guidelines, usability will be addressed by high-level performance-based requirements. That is, the requirements will directly address metrics for effectiveness (e.g. correct capture of voter intentions), efficiency (e.g. time taken to vote), and satisfaction. Until the supporting research is completed, however, the

BEGIN EAC PAGE 2-33

contents of this subsection are limited to a somewhat basic set of widely accepted design requirements and lower-level performance requirements. The reasons for this approach are:

- These are to serve as interim requirements, pending the issuance of high-level performance requirements.
- The actual benefit of numerous detailed design guidelines is difficult to prove or measure.
- The technical complexity and costs of a large set of detailed requirements may not be justified.
- Guidelines that are difficult to test because of insufficient specificity have been omitted.

Electronic Privacy Information Center Voting Project – www.epic.org/privacy/voting/

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This is not to say that an extensive set of design guidelines is without value. But we wish to distinguish between good advice to be considered by developers and strict requirements that will be enforced by a regime of formal testing. For more detail on the issue of design vs. performance standards, see Sections 2.3 and 6.1 et al. of NIST Special Publication 500-256: Improving the Usability and Accessibility of Voting Systems and Products (<http://vote.nist.gov/Final%20Human%20Factors%20Report%20%205-04.pdf>).

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GENERAL ISSUES FOR THE USABILITY REQUIREMENTS

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As mentioned in Section 2.2.7.1, many of the guidelines in this section enhance accessibility as well as general usability. The scope of usability includes the entire voting process, although the emphasis herein is on the interface between the voter and the voting station. The requirements in this sub-section generally assume a visual-tactile interface, but also see requirements in Sections 2.2.7.1 and Section 2.2.7.2 for alternative formats, including audio.

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The outline for Section 2.2.7.3 is:

2.2.7.3. Usability

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2.2.7.3.1 Usability Testing by Vendor

2.2.7.3.2 Functional Capabilities

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2.2.7.3.3 Cognitive Issues

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2.2.7.3.4 Perceptual Issues

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2.2.7.3.5 Interaction Issues

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1. The vendor should conduct summative usability tests on the voting system using subjects representative of the general population and report the test results to the [voting system test lab](#) according to the Common Industry Format (CIF).

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BEGIN EAC PAGE 2-34

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VOLUNTARY VOTING SYSTEM GUIDELINES DOCUMENT COMPARE

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Discussion: This requirement is meant to encourage Acc-VS designers to conduct some realistic usability tests on the final product. For now, it is purely a documentation recommendation. Future revisions of the Guidelines will include requirements for usability testing to be conducted by the voting system test lab, with specific performance benchmarks.

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2. The voting process shall provide certain functional capabilities to support voter usability.

2.1 As mandated by HAVA 301 (a)(1)(A), the voting system shall support a process that allows the voter to review his or her completed ballot before final submission in order to verify that it correctly represents the intended vote and to correct the ballot if mistakes are detected.

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Discussion: Note that this review and correction may be achieved by procedural means (e.g. in the case of paper ballots), as well as technical (see HAVA 301 (a)(1)(B)). This requirement is a brief paraphrase of the HAVA language but the statutory language is determinative.

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2.2 As mandated by HAVA 301 (a)(1)(A), the voting system shall support a process that notifies the voter if he or she has attempted to vote for more candidates than the maximum permitted in a given race and that provides the voter with the opportunity to correct the ballot before final submission.

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Discussion: Note that this notification and correction may be achieved by procedural means (e.g. in the case of paper ballots), as well as technical (see HAVA 301 (a)(1)(B)). This requirement is a brief paraphrase of the HAVA language but the statutory language is determinative.

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2.3 DRE voting stations shall allow the voter to change a vote within a race before advancing to the next race.

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VOLUNTARY VOTING SYSTEM GUIDELINES DOCUMENT COMPARE

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Discussion: The point here is that voters using a DRE should not have to wait for the final ballot review in order to change a vote.

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2.4 The voting system should support a process that notifies the voter if he or she has attempted to vote for fewer candidates than the maximum permitted in a given race and that provides the voter with the opportunity to change the ballot before final submission. The process shall also notify the voter that such an "undervote" is permitted and shall accept a ballot if the voter so chooses.

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Discussion: Note that this notification and correction may be achieved by procedural means (e.g. in the case of paper ballots), as well as technical (see HAVA 301 (a)(1)(B)).

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2.5 DRE voting stations should provide navigation controls that allow the voter to advance to the next race or go back to the previous race before completing a vote on the race or races currently being presented (whether visually or aurally).

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Discussion: For example, the voter should not be forced to proceed sequentially through all the races and/or candidates before going back to check the status of a previous race.

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3. The voting process shall be designed to minimize cognitive difficulties for the voter.

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3.1 Consistent with election law, the voting system should support a process that does not introduce any bias for or against any of the choices to be made by the voter. In both visual and aural formats, candidates and choices shall be presented in an equivalent manner.

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BEGIN EAC PAGE 2-36

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Discussion: Certain differences in presentation are unavoidable, such as the order in which candidates are listed, and write-in candidates are inherently more difficult to vote for. But comparable characteristics such as font size or voice volume and speed must be the same for all choices.

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3.2 The voting system or related materials shall provide clear instructions and assistance so as to allow voters to successfully execute and cast their ballots independently.

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Discussion: Voters should not routinely need to ask for human assistance.

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3.2.1 Voting stations or related materials shall provide a means for the voter to get help at any time during the voting session.

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Discussion: The voter should always be able to get help at the station if confused. DRE voting stations may provide this with a distinctive "help" button. Any type of voting station may provide written instructions that are available and separate from the ballot. Note special requirements for the Acc-VS in requirement 2.2.7.1.2.2.2 (Acc-VS/ATI).

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3.2.2 The voting station shall provide instructions for all its valid operations.

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Discussion: If an operation is available to the voter, it must be documented. Examples include how to change a vote, how to navigate among races, how to cast a straight party vote, and how to cast a write-in vote.

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3.3 The voting system shall provide the capability to design a ballot for maximum clarity and comprehension.

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BEGIN EAC PAGE 2-37

3.3.1 The voting station should not visually present a single race spread over two pages or two columns.

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Discussion: Such a visual separation poses the risk that the voter will perceive the race as two races. Of course, if a race has a very large number of candidates, it may be infeasible to observe this guideline.

3.3.2 The ballot shall clearly indicate the maximum number of candidates for which one can vote within a single race.

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3.3.3 There shall be a consistent relationship between the name of a candidate and the mechanism used to vote for that candidate.

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Discussion: For example, if the response field where voters indicate their selections is located to the left of a candidate's name, then each response field shall be located to the left of the associated candidates' names.

3.4 Warnings and alerts issued by the voting system should clearly state the nature of the problem and the set of responses available to the voter. The warning should clearly state whether the voter has performed or attempted an invalid operation or whether the voting equipment itself has failed in some way.

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Discussion: In case of an equipment failure, the only action available to the voter might be to get assistance from a poll worker.

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[Best Practice for Voting Officials]

Deleted: voting station does not visually present a single race spread over two pages or two columns.

3.3.2 . The

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[Best Practice for Voting Officials] The ballot presents the relationship between the name of a candidate and the mechanism used to vote for that candidate in a consistent manner.

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VOLUNTARY VOTING SYSTEM GUIDELINES DOCUMENT COMPARE

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3.5 The use of color by the voting system should agree with common conventions: (a) Green, blue or white is used for general information or as a normal status indicator; (b) Amber or yellow is used to indicate warnings or a marginal status; (c) Red is used to indicate error conditions or a problem requiring immediate attention.

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4. The voting process shall be designed to minimize perceptual difficulties for the voter. 4.1 No display screen of a voting station shall flicker with a frequency between 2 Hz and 55 Hz.

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Discussion: Aside from usability concerns, this requirement protects voters with epilepsy. 4.2 Any aspect of the voting station that is adjustable by the voter or poll worker, including font size, color, contrast, and audio volume, shall automatically reset to a standard default value upon completion of that voter's session.

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Discussion: This implies that the voting station presents the same initial appearance to every voter. 4.3 If any aspect of a voting station is adjustable by the voter or poll worker, there should be a mechanism to reset all such aspects to their default values.

Deleted: (excluding, of course, substantive differences in the ballot content due to residence or party of the voter). .

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Discussion: The purpose is to allow a voter who has adjusted the station into an undesirable state to reset all the aspects to begin again.

Deleted: so as to get a fresh start.

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4.4 The minimum font size for all text intended for the voter during the voting session shall be 3.0mm (measured as the height of a capital letter).

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4.5 All text intended for the voter during the voting session should be presented in a sans serif font.

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Discussion: Experimentation has shown that users prefer such a font and the legibility of serif and sans serif fonts is equivalent.

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4.6 The minimum figure-to-ground ambient contrast ratio for all text and informational graphics (including icons) intended for the voter shall be 3:1.

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5. The voting process shall be designed to minimize interaction difficulties for the voter.

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5.1 Voting systems with electronic image displays shall not require page scrolling by the voter.

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Deleted: stations

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Discussion: This is not an intuitive operation for those unfamiliar with the use of computers. Even those experienced with computers often do not notice a scroll bar and miss information below the page. DREs may require voters to move to the next or previous "page."

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BEGIN EAC PAGE 2-40

5.2 The voting system shall provide unambiguous feedback regarding the voter's selection, such as displaying a checkmark beside the selected option or conspicuously changing its appearance.

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5.3 If the voting station requires a response by a voter within a specific period of time, it shall issue an alert at least 20 seconds before this time period has expired and provide a means by which the voter may receive additional time.

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5.4 Input mechanisms shall be designed so as to minimize accidental activation (also, see requirement 2.2.7.1.2.2.7 on tactile discernability). 5.4.1 On touch screens, the sensitive touch areas shall have a minimum height of 0.5 inches and minimum width of 0.7 inches. The vertical distance between the centers of adjacent areas shall be at least 0.6 inches, and the horizontal distance at least 0.8 inches.

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5.4.2 No key or control on a voting station shall have a repeat feature enabled.

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Discussion: This is to preclude accidental activation.

BEGIN EAC PAGE 2-41

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4. The voting process shall preclude anyone else from determining the content of a voter's ballot, without the voter's cooperation.

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Discussion: Voter privacy is strongly supported by HAVA - see Sections 221 (e)(2)(C) and 301 (a)(1). In this subsection, we address only privacy concerns in relation to human factors issues, but not with respect to the processing of cast ballots.

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Although elections in American history have sometimes been public (and certain "town-hall" questions are still voted openly), the use of the secret ballot for political office is now universal.

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Privacy in this context, including the property of the voter being unable to disclose his or her vote, ensures that the voter can make choices based solely on his or her own preferences without intimidation or inhibition. Among other practices, this forbids the issuance of a receipt to the voter that would provide proof to another how he or she voted.

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2.2.7.4.3 Absentee Balloting

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Deleted: ballot and any input controls are visible only to the voter during the voting session and ballot submission. Poll workers need to take into account such factors as visual barriers, windows, permitted waiting areas for other voters, and procedures for ballot submission when not performed at the voting station, e.g. submission of optiscan ballots to a central reader.

1.2 . The

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[Best Practice for Voting Officials] The audio interface is audible only to the voter.

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The outline for Section 2.2.7.4 is:

2.2.7.4 Privacy

2.2.7.4.1 Privacy at the polling place

2.2.7.4.2 No preservation of alternative formats

1. The voting station and polling place shall be configured so as to prevent others from learning the contents of a voter's ballot.

1.1 The ballot and any input controls shall be visible only to the voter during the voting session and ballot submission.

Deleted Diagram

1.2 The audio interface shall be audible only to the voter.

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Discussion: Voters who are hard of hearing but need to use an audio interface may also need to increase the volume of the audio. Such situations require headphones with low sound leakage.

BEGIN EAC PAGE 2-42

1.3 As mandated by HAVA 301 (a)(1)(C), the voting system shall notify the voter of an attempted overvote in a way that preserves the privacy of the voter and the confidentiality of the ballot.

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Discussion: This requirement is a brief paraphrase of the HAVA language but of course the statutory language is determinative.

2. Voter anonymity shall be maintained for alternative format ballot presentation.

2.1. No information shall be kept within a non-paper-based **cast vote record** that identifies any accessibility feature(s) used by a voter.

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Discussion: Large-print paper ballots unavoidably preserve such information.

2.1.1. No information shall be kept within a non-paper-based **cast vote record** that identifies any alternative language feature(s) used by a voter.

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Discussion: Non-English paper ballots unavoidably preserve such information.

BEGIN EAC PAGE 2-43

2.2.8. Vote Tabulating Program

Each voting system shall have a vote tabulation program that will meet specific functional requirements.

2.2.8.1. Functions

The vote tabulating program software resident in each voting device, vote count server, or other devices shall include all software modules required to:

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[Best Practice for Voting Officials] As mandated by HAVA 301 (a)(1)(C), the voting system notifies the voter of an attempted overvote in a way that preserves the privacy of the voter and the confidentiality of the ballot.

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Deleted: Cast Vote Record

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[Best Practice for Voting Officials] Appropriate procedures are needed to ensure that absentee balloting enable the voter to preserve privacy. There is no practical means to prevent a voter from revealing an absentee paper ballot to others. But the process...

Deleted: 6 Accessibility

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- a. Monitor system status and generate machine-level audit reports; Deleted: ... [112]
- b. Accommodate device control functions performed by polling place officials and maintenance personnel; Deleted: ... [113]
- c. Register and accumulate votes; and d. Accommodate variations in ballot counting logic; Deleted: ... [114]

2.2.8.2 Voting Variations Deleted: ... [115]

There are significant variations among state election laws with respect to permissible ballot contents, voting options, and the associated ballot counting logic. The Technical Data Package accompanying the system shall specifically identify which of the following items can and cannot be supported by the system, as well as how the system can implement the items supported; Deleted: the ... of the 50 states ... [116]

- a. Closed primaries; Deleted: ... [117]
- b. Open primaries; Deleted: ... [118]
- c. Partisan offices; Deleted: ... [119]
- d. Non-partisan offices; Deleted: ... [120]
- e. Write-in voting; Deleted: ... [121]
- f. Primary presidential delegation nominations; Deleted: ... [122]
- g. Ballot rotation; Deleted: ... [123]
- h. Straight party voting; Deleted: ... [124]
- i. Cross-party endorsement; Deleted: ... [125]
- j. Split precincts; Deleted: ... [126]
- k. Vote for N of M; Deleted: ... [127]
- l. Recall issues, with options; Deleted: ... [128]
- m. Cumulative voting; Deleted: ...

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- n. Ranked order voting; and Deleted: ... [129]
- o. Provisional or challenged ballots; Deleted: ... [130]

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2.2.9 Ballot Counter

For all voting systems, each device that tabulates ballots shall provide a counter that:

- a. Can be set to zero before any ballots are submitted for tally;
- b. Records the number of ballots cast during a particular test cycle or election;
- c. Increases the count only by the input of a ballot;
- d. Prevents or disables the resetting of the counter by any person other than authorized persons at authorized points; and
- e. Is visible to designated election officials.

2.2.10. Telecommunications. For all voting systems that use telecommunications for the transmission of data during pre-voting, voting or post-voting activities, capabilities shall be provided that ensure data are transmitted with no alteration or unauthorized disclosure during transmission. Such transmissions shall not violate the privacy, secrecy, and integrity demands of the [Guidelines](#). Section 5 describes telecommunications standards that apply to, at a minimum, the following types of data transmissions:

- ◆ **Voter Authentication:** Coded information that confirms the identity of a voter for security purposes for a system that transmit votes individually over a public network;
- ◆ **Ballot Definition:** Information that describes to a voting machine the content and appearance of the ballots to be used in an election;
- ◆ **Vote Transmission to Central Site:** For systems that transmit votes individually over a public network, the transmission of a single vote to the county (or contractor) for consolidation with other county vote data;
- ◆ **Vote Count:** Information representing the tabulation of votes at any one of several levels: polling place, precinct, or central count; and
- ◆ **List of Voters:** A listing of the individual voters who have cast ballots in a specific election.

2.2.11 Data Retention

United States Code Title 42, Sections 1974 through 1974e, states that election administrators shall preserve for 22 months “all records and paper that came into (their) possession relating to an application, registration, payment of poll tax, or other act requisite to voting.” This retention requirement applies to systems that will be used at anytime for voting of candidates for Federal offices (e.g., Member of

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Congress, United States Senator, and/or Presidential Elector). Therefore, all systems shall provide for maintaining the integrity of voting and audit data during an election and for a period of at least 22 months thereafter.

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Because the purpose of this law is to assist the Federal government in discharging its law enforcement responsibilities in connection with civil rights and elections crimes, its scope must be interpreted in keeping with that objective. The appropriate state or local authority must preserve all records that may be relevant to the detection and prosecution of federal civil rights or election crimes for the 22-month federal retention period, if the records were generated in connection with an election that was held in whole or in part to select federal candidates. It is important to note that Section 1974 does not require that election officials generate any specific type or classification of election record. However, if a record is generated, Section 1974 comes into force and the appropriate authority must retain the records for 22 months.

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For 22-month document retention, the general rule is that all printed copy records produced by the election database and ballot processing systems shall be so labeled and archived. Regardless of system type, all audit trail information spelled out in subsection 4.5 shall be retained in its original format, whether that be real-time logs generated by the system, or manual logs maintained by election personnel. The election audit trail includes not only in-process logs of election-night (and subsequent processing of absentee or provisional ballots), but also time logs of baseline ballot definition formats, and system readiness and testing results.

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In many voting systems, the source of election-specific data (and ballot formats) is a database or file. In precinct count systems, this data is used to program each machine, establish ballot layout, and generate tallying files. It is not necessary to retain this information on electronic media if there is an official, authenticatable printed copy of all final database information. However, it is recommended that the state or local jurisdiction also retain electronic records of the aggregate data for each device so that reconstruction of an election is possible without data re-entry. The same requirement and recommendation applies to vote results generated by each precinct device or system.

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2.3 Pre-voting Functions

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This section defines capabilities required to support functions performed prior to the opening of polls. All voting systems shall provide capabilities to support:

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VOLUNTARY VOTING SYSTEM GUIDELINES DOCUMENT COMPARE

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- ◆ Ballot preparation;
- ◆ Election programming;
- ◆ Ballot and program installation and control;
- ◆ Readiness testing;
- ◆ Verification at the polling place; and
- ◆ Verification at the central counting place.

The standards also include requirements to ensure compatible interfaces with the ballot definition process and the reporting of election results.

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2.3.1 Ballot Preparation

Ballot preparation is the process of using election databases to define the specific contests, questions, and related instructions to be contained in ballots and to produce all permissible ballot layouts. Ballot preparation requirements include:

- ◆ General capabilities for ballot preparation;
- ◆ Ballot formatting; and
- ◆ Ballot production.

2.3.1.1 General Capabilities

All systems shall provide the general capabilities for ballot preparation.

2.3.1.1.1 Common Requirements

All systems shall be capable of:

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| a. Enabling the automatic formatting of ballots in accordance with the requirements for offices, candidates, and measures qualified to be placed on the ballot for each political subdivision and election district; | Deleted: ... | ... [134] |
| b. Collecting and maintaining the following data: | Deleted: ... | ... [135] |
| 1). Offices and their associated labels and instructions; | Deleted: ... | ... [136] |
| 2). Candidate names and their associated labels; and | Deleted: ... | ... [137] |
| 3). Issues or measures and their associated text; | Deleted: ... | ... [138] |
| c. Supporting the maximum number of potentially active voting positions as indicated in the system documentation; | Deleted: ... | ... [139] |
| d. For a primary election, generating ballots that segregate the choices in partisan races by party affiliation; | Deleted: . | |
| e. Generating ballots that contain identifying codes or marks uniquely associated with each format; and | Deleted: . | |
| f. Ensuring that vote response fields, selection buttons, or switches properly align with the specific candidate names and/or issues printed on the ballot display, ballot card or sheet, or separate ballot pages. | Deleted: . | ... [140] |

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2.3.1.1.2 Paper-Based System **Requirements** In addition to the common **requirements**, paper-based systems shall meet the following **requirements** applicable to the technology used: a. Enable voters to make selections by punching a hole or by making a mark in areas designated for this purpose upon each ballot card or sheet; b. For punchcard systems, ensure that the vote response fields can be properly aligned with punching devices used to record votes; and c. For marksense systems, ensure that the timing marks align properly with the vote response fields.

2.3.1.2 Ballot Formatting Ballot formatting is the process by which election officials or their designees use election databases and vendor system software to define the specific contests and related instructions contained on the ballot and present them in a layout permitted by state law. All systems shall provide a capability for: a. Creation of newly defined elections; b. Rapid and error-free definition of elections and their associated ballot layouts; c. Uniform allocation of space and fonts used for each office, candidate, and contest such that the voter perceives no active voting position to be preferred to any other; d. Simultaneous display of the maximum number of choices for a single contest as indicated by the vendor in the system documentation; e. Retention of previously defined formats for an election; f. Prevention of unauthorized modification of any ballot formats; and g. Modification by authorized persons of a previously defined ballot format for use in a subsequent election.

2.3.1.3 Ballot Production Ballot production is the process of converting ballot formats to a media ready for use in the physical ballot production or electronic presentation.

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2.3.1.3.1 Common Requirements

The voting system shall provide a means of printing or otherwise generating a ballot display that can be installed in all system voting devices for which it is intended. All systems shall provide a capability to ensure:

- a. The electronic display or printed document on which the user views the ballot is capable of rendering an image of the ballot in any of the languages required by The Voting Rights Act of 1965, as amended;
- b. The electronic display or printed document on which the user views the ballot does not show any advertising or commercial logos of any kind, whether public service, commercial, or political, unless specifically provided for in State law. Electronic displays shall not provide connection to such material through hyperlink; and
- c. The ballot conforms to vendor specifications for type of paper stock, weight, size, shape, size and location of punch or mark field used to record votes, folding, bleed through, and ink for printing if paper ballot documents or paper displays are part of the system.

2.3.1.3.2 Paper-Based System Requirements

In addition to the common requirements, vendor documentation for marksense systems shall include specifications for ballot materials to ensure that vote selections are read from only a single ballot at a time, without detection of marks from multiple ballots concurrently (e.g., reading of bleed-through from other ballots).

2.3.2 Election Programming

Election programming is the process by which election officials or their designees use election databases and vendor system software to logically define the voter choices associated with the contents of the ballots. All systems shall provide for the:

- a. Logical definition of the ballot, including the definition of the number of allowable choices for each office and contest;
- b. Logical definition of political and administrative subdivisions, where the list of candidates or contests varies between polling places;

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c. Exclusion of any contest on the ballot in which the voter is prohibited from casting a ballot because of place of residence, or other such administrative or geographical criteria;

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d. Ability to select from a range of voting options to conform to the laws of the jurisdiction in which the system will be used; and

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e. Generation of all required master and distributed copies of the voting program, in conformance with the definition of the ballots for each voting device and polling place, and for each tabulating device.

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2.3.3. Ballot and Program Installation and Control

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All systems shall provide a means of installing ballots and programs on each piece of polling place or central count equipment in accordance with the ballot requirements of the election and the requirements of the jurisdiction in which the equipment will be used.

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All systems shall include the following at the time of ballot and program installation:

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a. A detailed work plan or other documentation providing a schedule and steps for the software and ballot installation, which includes a table outlining the key dates, events and deliverables;

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b. A capability for automatically verifying that the software has been properly selected and installed in the equipment or in a programmable memory devices and for indicating errors; and

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c. A capability for automatically validating that software correctly matches the ballot formats that it is intended to process, for detecting errors, and for immediately notifying an election official of detected errors.

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2.3.4. Readiness Testing

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Election personnel conduct equipment and system readiness tests prior to the start of an election to ensure that the voting system functions properly, to confirm that system equipment has been properly integrated, and to obtain equipment status reports.

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2.3.4.1 Common Requirements

All systems shall provide the capabilities to:

- a. Verify that voting machines or vote recording and data processing equipment, precinct count equipment, and central count equipment are properly prepared for an election, and collect data that verifies equipment readiness;
- b. Obtain status and data reports from each set of equipment;
- c. Verify the correct installation and interface of all system equipment;
- d. Verify that hardware and software function correctly;
- e. Generate consolidated data reports at the polling place and higher jurisdictional levels; and

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- f. Segregate test data from actual voting data, either procedurally or by hardware/software features.

Resident test software, external devices, and special purpose test software connected to or installed in voting devices to simulate operator and voter functions may be used for these tests provided that the following standards are met:

- a. These elements shall be capable of being tested separately, and shall be proven to be reliable verification tools prior to their use; and
- b. These elements shall be incapable of altering or introducing any residual effect on the intended operation of the voting device during any succeeding test and operational phase.

2.3.4.2 Paper-Based System Requirements

Paper-based systems shall:

- a. Support conversion testing that uses all potential ballot positions as active positions; and
- b. Support conversion testing of ballots with active position density for systems without pre-designated ballot positions.

2.3.5 Verification at the Polling Place

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Election officials perform verification at the polling place to ensure that all voting systems and equipment function properly before and during an election. All systems shall provide a formal record of the following, in any media, upon verification of the authenticity of the command source:

- a. The election's identification data;
- b. The identification of all equipment units;
- c. The identification of the polling place;
- d. The identification of all ballot formats;
- e. The contents of each active candidate register by office and of each active measure register at all storage locations (showing that they contain only zeros);
- f. A list of all ballot fields that can be used to invoke special voting options; and
- g. Other information needed to confirm the readiness of the equipment, and to accommodate administrative reporting requirements.

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To prepare voting devices to accept voted ballots, all voting systems shall provide the capability to test each device prior to opening to verify that each is operating correctly. At a minimum, the tests shall include:

- a. Confirmation that there are no hardware or software failures; and
b. Confirmation that the device is ready to be activated for accepting votes.

If a precinct count system includes equipment for the consolidation of polling place data at one or more central counting places, it shall have means to verify the correct extraction of voting data from transportable memory devices, or to verify the transmission of secure data over secure communication links.

2.3.6 Verification at the Central Location

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Election officials perform verification at the central location to ensure that vote counting and vote consolidation equipment and software function properly before and after an election. Upon verification of the authenticity of the command source, any system used in a central count environment shall provide a printed record of the following :

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a. The election's identification data;

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b. The contents of each active candidate register by office and of each active measure register at all storage locations (showing that they contain all zeros); and

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c. Other information needed to ensure the readiness of the equipment and to accommodate administrative reporting requirements.

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2.4 Voting Functions

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All systems shall support:

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♦ Opening the polls; and

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♦ Casting a ballot.

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Additionally, all DRE systems shall support:

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♦ Activating the ballot.

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♦ Augmenting the election counter; and

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♦ Augmenting the life-cycle counter.

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2.4.1 Opening the Polls

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The capabilities required for opening the polls are specific to individual voting system technologies. At a minimum, the systems shall provide the functional capabilities indicated below.

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2.4.1.1 Opening the Polling Place (Precinct Count Systems)

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To allow voting devices to be activated for voting, the system shall provide:

- a. An internal test or diagnostic capability to verify that all of the polling place tests specified in Section 2.3.5 have been successfully completed; and
- b. Automatic disabling of any device that has not been tested until it has been tested.

2.4.1.2 Paper-Based System Requirements

The requirements for opening the polling place for paper-based systems consist of common requirements and additional requirements that apply to precinct count paper-based systems.

2.4.1.2.1 All Paper-Based Systems

To facilitate opening the polls, all paper-based systems shall include:

- ~~a. A means of verifying that ballot punching or marking devices are properly prepared and ready to use;~~
~~b. A voting booth or similar facility, in which the voter may punch or mark the ballot in privacy; and~~
~~c. Secure receptacles for holding voted ballots.~~

2.4.1.2.2 Precinct Count Paper-Based Systems

In addition to the above requirements, all paper-based precinct count equipment shall include a means of:

- a. Activating the ballot counting device;

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- b. Verifying that the device has been correctly activated and is functioning properly; and
c. Identifying device failure and corrective action needed.

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2.4.1.3 DRE System Requirements

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To facilitate opening the polls, all DRE systems shall include:

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a. A security seal, a password, or a data code recognition capability to prevent the inadvertent or unauthorized actuation of the poll-opening function;

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b. A means of enforcing the execution of steps in the proper sequence if more than one step is required;

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c. A means of verifying the system has been activated correctly; and

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d. A means of identifying system failure and any corrective action needed.

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2.4.2 Activating the Ballot (DRE Systems)

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To activate the ballot, all DRE systems shall:

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a. Enable election officials to control the content of the ballot presented to the voter, whether presented in printed form or electronic display, such that each voter is permitted to record votes only in contests in which that voter is authorized to vote;

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b. Allow each eligible voter to cast a ballot;

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c. Prevent a voter from voting on a ballot to which he or she is not entitled; and

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d. Prevent a voter from casting more than one ballot in the same election.

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e. Activate the casting of a ballot in a general election;

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f. Enable the selection of the ballot that is appropriate to the party affiliation declared by the voter in a primary election;

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g. Activate all portions of the ballot upon which the voter is entitled to vote; and

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h. Disable all portions of the ballot upon which the voter is not entitled to vote.

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2.4.3 Casting a Ballot

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Some required capabilities for casting a ballot are common to all systems. Others are specific to individual voting technologies or intended use. Systems must provide additional functional capabilities that enable accessibility to disabled voters as defined in Section 2.2.7 of the Standards.

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2.4.3.1 Common Requirements

To facilitate casting a ballot, all systems shall:

- a. Provide text that is at least 3 millimeters high and provide the capability to adjust or magnify the text to an apparent size of 6.3 millimeters;
- b. Protect the secrecy of the vote such that the system cannot reveal any information about how a particular voter voted, except as otherwise required by individual State law;
- c. Record the selection and non-selection of individual vote choices for each contest and ballot measure;
- d. Record the voter's selection of candidates whose names do not appear on the ballot, if permitted under State law, and record as many write-in votes as the number of candidates the voter is allowed to select;
- e. In the event of a failure of the main power supply external to the voting system, provide the capability for any voter who is voting at the time to complete casting a ballot, allow for the graceful shutdown of the voting system without loss or degradation of the voting and audit data, and allow voters to resume voting once the voting system has reverted to back-up power; and
- f. Provide the capability for voters to continue casting ballots in the event of a failure of a telecommunications connection within the polling place or between the polling place and any other location.

2.4.3.2 Paper-Based Systems Requirements

The requirements for casting a ballot for paper-based systems consist of common requirements and additional requirements that apply to precinct count paper-based systems.

2.4.3.2.1 All Paper-Based Systems

All paper-based systems shall:

- a. Allow the voter to easily identify the voting field that is associated with each candidate or ballot measure response;
- b. Allow the voter to punch or mark the ballot to register a vote;

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- c. Allow either the voter or the appropriate election official to place the voted ballot into the ballot counting device (for precinct count systems) or into a secure receptacle (for central count systems); and
- d. Protect the secrecy of the vote throughout the process.

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2.4.3.2.2 Precinct Count Paper-Based Systems

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In addition to the above requirements, all paper-based precinct count systems shall:

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- a. Provide feedback to the voter that identifies specific contests or ballot issues for which an overvote or undervote is detected;
- b. Allow the voter, at the voter's choice, to vote a new ballot or submit the ballot 'as is' without correction; and
- c. Allow an authorized election official to turn off the capabilities defined in 'a' and 'b' above.

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2.4.3.3 DRE Systems Requirements

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In addition to the above common requirements, DRE systems shall:

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- a. Prohibit the voter from accessing or viewing any information on the display screen that has not been authorized by election officials and preprogrammed into the voting system (i.e., no potential for display of external information or linking to other information sources);
- b. Enable the voter to easily identify the selection button or switch, or the active area of the ballot display that is associated with each candidate or ballot measure response;
- c. Allow the voter to select his or her preferences on the ballot in any legal number and combination;
- d. Indicate that a selection has been made or canceled;
- e. Indicate to the voter when no selection, or an insufficient number of selections, has been made in a contest;
- f. Prevent the voter from overvoting;
- g. Notify the voter when the selection of candidates and measures is completed;
- h. Allow the voter, before the ballot is cast, to review his or her choices and, if the voter desires, to delete or change his or her choices before the ballot is cast;

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i. For electronic image displays, prompt the voter to confirm the voter's choices before casting his or her ballot, signifying to the voter that casting the ballot is

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irrevocable and directing the voter to confirm the voter's intention to cast the ballot; j. Notify the voter after the vote has been stored successfully that the ballot has been cast;

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k. Notify the voter that the ballot has not been cast successfully if it is not stored successfully, including storage of the ballot image, and provide clear instruction as to the steps the voter should take to cast his or her ballot should this event occur;

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l. Provide sufficient computational performance to provide responses back to each voter entry in no more than three seconds;

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m. Ensure that the votes stored accurately represent the actual votes cast;

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n. Prevent modification of the voter's vote after the ballot is cast;

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o. Provide a capability to retrieve ballot images in a form readable by humans (in accordance with the requirements of Section 2.2.2.2 and 2.2.4.2);

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p. Increment the proper ballot position registers or counters;

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q. Protect the secrecy of the vote throughout the voting process;

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r. Prohibit access to voted ballots until after the close of polls;

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s. Provide the ability for election officials to submit test ballots for use in verifying the end-to-end integrity of the system; and

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t. Isolate test ballots such that they are accounted for accurately in vote counts and are not reflected in official vote counts for specific candidates or measures.

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2.5 Post-Voting Functions

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All systems shall provide capabilities to accumulate and report results for the jurisdiction and to generate audit trails. In addition, precinct count systems must provide a means to close the polling place including generating appropriate reports. If the system provides the capability to broadcast results, additional standards apply.

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2.5.1 Closing the Polling Place (Precinct Count)

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These requirements for closing the polling place are specific to precinct count systems. The system shall provide the means for;

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- a. Preventing the further casting of ballots once the polling place has closed;
- b. Providing an internal test that verifies that the prescribed closing procedure has been followed, and that the device status is normal;
- c. Incorporating a visible indication of system status;

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- d. Producing a diagnostic test record that verifies the sequence of events, and indicates that the extraction of voting data has been activated; and
- e. Precluding the unauthorized reopening of the polls once the poll closing has been completed for that election.

2.5.2 Consolidating Vote Data

All systems shall provide a means to consolidate vote data from all polling places, and optionally from other sources such as absentee ballots, provisional ballots, and voted ballots requiring human review (e.g., write-in votes).

2.5.3 Producing Reports

All systems shall be able to create reports summarizing the data on multiple levels. 2.5.3.1 Common Requirements All systems shall provide capabilities to:

- a. Support geographic reporting, which requires the reporting of all results for each contest at the precinct level and additional jurisdictional levels;
- b. Produce a printed report of the number of ballots counted by each tabulator;
- c. Produce a printed report for each tabulator of the results of each contest that includes the votes cast for each selection, the count of undervotes, and the count of overvotes;
- d. Produce a consolidated printed report of the results for each contest of all votes cast (including the count of ballots from other sources supported by the system as specified by the vendor) that includes the votes cast for each selection, the count of undervotes, and the count of overvotes;

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- e. Be capable of producing a consolidated printed report of the combination of overvotes for any contest that is selected by an authorized official (e.g., the number of overvotes in a given contest combining candidate A and candidate B, combining candidate A and candidate C, etc.);
- f. Produce all system audit information required in Section 4.5 in the form of printed reports, or in electronic memory for printing centrally; and
- g. Prevent data from being altered or destroyed by report generation, or by the transmission of results over telecommunications lines.

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2.5.3.2 Precinct Count Systems

In addition to the common reporting requirements, all precinct count voting systems shall:

- a. Prevent the printing of reports and the unauthorized extraction of data prior to the official close of the polling place;
- b. Provide a means to extract information from a transportable programmable memory device or data storage medium for vote consolidation;
- c. Consolidate the data contained in each unit into a single report for the polling place when more than one voting machine or precinct tabulator is used; and
- d. Prevent data in transportable memory from being altered or destroyed by report generation, or by the transmission of results over telecommunications lines.

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2.5.4 Broadcasting Results

Some voting systems offer the capability to make unofficial results available to external organizations such as the news media, political party officials, and others. Although this capability is not required, systems that make unofficial results available shall:

- a. Provide only aggregated results, and not data from individual ballots;
- b. Provide no access path from unofficial electronic reports or files to the storage devices for official data; and
- c. Clearly indicate on each report or file that the results it contains are unofficial.

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2.6 Maintenance, Transportation, and Storage

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All systems shall be designed and manufactured to facilitate preventive and corrective maintenance, conforming to the hardware standards described in Section 3.

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All vote casting and tally equipment designated for storage between elections shall:

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a. Function without degradation in capabilities after transit to and from the place of use, as demonstrated by meeting the performance standards described in Section 3; and

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b. Function without degradation in capabilities after storage between elections, as demonstrated by meeting the performance standards described in Section 3.

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