Chapter: 1   Usability and Accessibility Requirements

1.1   Overview

The importance of usability and accessibility 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 election officials must be able to use them effectively and efficiently.

There are some properties of voting systems that make good design especially difficult:

- The voting task itself can be fairly complex; the voter may have to navigate an electronic ballot, choose multiple candidates in a single contest, understand the effect of party-line voting, or decide on ballot questions written in legal language.

- Voting is performed infrequently (compared with tasks such as using an ATM), so there is relatively limited opportunity for voters and poll workers to gain familiarity with the process.

- Changes in the election process, including new voting equipment, may require voters and poll workers to use new and unfamiliar procedures.

- The set of "users" for voting equipment is exceptionally diverse. The voting public encompasses a broad range of factors, including physical and cognitive abilities, language skills, and technology experience.

1.1.1   Purpose

The challenge, then, is to provide a voting system that 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. Three broad principles motivate this section:

1. All eligible voters are to have access to the voting process without discrimination. The voting process must be accessible to individuals with disabilities. The voting process includes access to the polling place, instructions on how to vote, initiating the voting session, making ballot selections, review of the ballot, final submission of the ballot, and getting help when needed.

2. Each cast ballot must accurately capture the selections made by the voter. The ballot is to be presented to the voter in a manner that is clear and usable. Voters should encounter no difficulty or confusion regarding the process for recording their selections.

3. The voting process must preserve the secrecy of the ballot. The voting process should 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.

Note that these principles refer to the entire voting *process*. The VVSG applies only to voting systems; other aspects of the process (such as administrative rules and procedures) are outside the scope of the VVSG, but are nonetheless crucial for the full achievement of the principles.

Also, please see section XREF/Intro which describes the relationship between HAVA and the VVSG.

1.1.2   Special Terminology

Several uncommon terms are used in this section. For the convenience of the reader, they are defined below. Many other technical terms frequently used throughout the VVSG are defined in the Glossary. Note in particular the distinctions among these terms: voting process, voting system, voting device, voting session, and voting station.

- **Accessible Voting Station (Acc-VS)** - the voting station specially equipped for individuals with disabilities referred to in HAVA 301 (a)(3)(B).

- **Audio-Tactile Interface (ATI)** - a voter interface designed 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.

- **Common Industry Format (CIF)** - the format to be used for usability test reporting, described in ISO/IEC 25062:2006 "Common Industry Format (CIF) for Usability Test Reports".

- **Voter-Editable Ballot Device (VEBD)** - voting systems such as DREs and EBMs that present voters with an editable ballot (as opposed to manually-marked paper ballots), allowing them easily to change their choices prior to final casting of the ballot. "VEBD-V" denotes the visual interface of such systems and "VEBD-A" denotes the audio interface.

- **Voting Performance Protocol (VPP)** - a carefully defined method for measuring how well subjects perform various voting tasks within a controlled experiment.

1.1.3 Interaction of Usability and Accessibility Requirements

All the requirements in Section 3 have the purpose of improving the quality of interaction between voters and voting systems. Please note how sub-sections 3.2 and 3.3 XREF work together:

-- The requirements for general usability in subsection 3.2 XREF apply to all voting systems, *including the Acc-VS.* Requirements for any alternative languages required by state or federal law are included under this heading.

-- The requirements of subsection 3.3 XREF to assist voters with physical, sensory, or cognitive disabilities apply to the *accessible voting station* (Acc-VS) required by HAVA Section 301 (a)(3)(B). The features of the Acc-VS may also assist those not usually described as having a disability, e.g., voters with poor eyesight or limited dexterity.

1.2 General Usability Requirements

The voting system should support a process that provides a high level of usability for all voters. The goal is for voters to be able to negotiate the process effectively, efficiently, and comfortably.

Many of the mandatory voting system standards in HAVA Section 301 relate to the interaction between the voter and the voting system:

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

1. In general.--

> 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--

>> 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;

>> 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

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

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

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

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

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 -

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

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).

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.

The requirements of section 3.2 XREF are intended to support these basic usability standards of HAVA.

1.2.1 Performance Requirements

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 user is the voter (although the equipment is used by poll workers as well), the product is the voting system, and the task is the correct recording of the voter's ballot selections. Additional requirements for task performance are independence and privacy: the voter should normally be able to complete the voting task without assistance from others, and the voter selections should be private. 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 basic metrics for voting usability are:

- low error rate for marking the ballot (the voter selection is correctly conveyed to and represented within the voting system)

- efficient operation (time required to vote is not excessive)

- satisfaction (voter experience is safe, comfortable, free of stress, and instills confidence)

General usability is covered by both high-level performance-based requirements (in this subsection) and design requirements (in following subsections). Whereas the latter require the presence of specific features generally thought to promote usability, the former *directly* address metrics for effectiveness (e.g., correct capture of voter selections), efficiency (e.g., time taken to vote), and satisfaction. The voting system is tested by having groups of people (representing voters) attempt to perform various typical voting tasks. The requirement is met only if those tasks are accomplished with a specified degree of success.

1.2.1.1   Overall Performance Metrics

The requirements of this section set benchmarks for the usability of the voting session as a whole.

➡   **1.2.1.1-A** Overall Effectiveness

The system shall achieve an overall accuracy rating of at least XXX, [[Actual benchmarks to be filled in later.]] as measured by the NIST Voting Performance Protocol (NIST VPP).

Applies to: *Voting device*

Test Reference: *Performance*

D I S C U S S I O N

This requirement ensures that the system enables voters to accurately cast votes for the candidates and referendum positions as intended.

➡   **1.2.1.1-B** Overall Efficiency

When the conventional visual/tactile interface is used, the system shall achieve an overall mean voting session time of at most XXX minutes as measured by the NIST VPP.

Applies to: *Voting device*

Test Reference: *Performance*

D I S C U S S I O N

This requirement ensures that the system enables voters to vote with reasonable speed. Note that this requirement does not apply to the audio

interface of a system, nor to the use of special input devices for voters with dexterity disabilities.

➜ **1.2.1.1-C** Overall Satisfaction

The system shall achieve an overall satisfaction rating of at least XXX, as measured by the NIST VPP.

Applies to: *Voting device*

Test Reference: *Performance*

D I S C U S S I O N

This requirement ensures that the system is reasonably comfortable and pleasant to use.

[[Are we keeping this or dropping it? – Question is whether it's worth the trouble of separate testing.]]

➜ **1.2.1.1-D** Support for Independent Voting

No more than XXX% of subjects shall request external assistance in the process of executing and casting their ballots, as measured by the NIST VPP.

Applies to: *Voting device*

Test Reference: *Performance*

D I S C U S S I O N

The voting system should provide clear instructions and assistance so as to allow voters to successfully execute and cast their ballots independently. Voters should not routinely need to ask for human assistance.

1.2.1.2   Vendor Testing

➜ **1.2.1.2-A** Usability Testing by Vendor

The vendor shall conduct summative usability tests on the voting system using individuals representative of the general population. The vendor shall document the testing performed and report the test results using the Common Industry Format. [[There are plans for a more specific version of the CIF targeted towards voting. If this comes about, it will be referred to here.]] This documentation shall be included in the Technical Data Package submitted to the EAC for national certification.

Applies to: Voting device

Test Reference: Inspection

D I S C U S S I O N

Voting system developers are required to conduct realistic usability tests on the final product before submitting the system to conformance testing. This is to encourage early detection and resolution of usability problems.

1.2.2   Functional Capabilities

The usability of the voting process is enhanced by the presence of certain functional capabilities. These capabilities differ somewhat depending on whether or not the system presents an editable interface within which voters can easily change their selections (typically an electronic screen) or an interface in which voters must obtain a new ballot to make changes (typically a manually marked paper ballot).

➜   **1.2.2-A** Notification of Effect of Overvoting

If the voter makes more than the allowable number of selections for a contest, the voting system shall notify the voter of the effect of this action before the ballot is cast and counted.

Applies to: Voting system

Test Reference: Functional

D I S C U S S I O N

In the case of manual systems, this may be achieved through appropriately placed instructions. This requirement has no force for VEBD systems, since they prevent overvoting in the first place.

➜   **1.2.2-B** Undervoting to be Permitted

The voting system shall allow the voter, at his or her choice, to submit an undervoted ballot without correction.

Applies to: Voting device

Test Reference: Functional

D I S C U S S I O N

Click here and type the discussion about this requirement

➔ **1.2.2-C** Correction of Ballot

The voting system shall provide the voter the opportunity to correct the ballot for either an undervote or overvote before the ballot is cast and counted.

Applies to: *Voting device*

Test Reference: *Functional*

D I S C U S S I O N

In the case of manual systems, this may be achieved through appropriately placed written instructions. Some corrections may require the voter to obtain a new paper ballot from a poll worker. Also, note the requirements on precinct-count optical scanners in section 3.2.2.2 XREF below.

1.2.2.1   Editable Interfaces

Voting systems such as DREs and EBMs present voters with an editable interface, allowing them easily to change their choices prior to final casting of the ballot.

➔ **1.2.2.1-A** Prevention of Overvotes

The voting system shall prevent voters from making more than the allowable number of choices for each contest.

Applies to: *VEBD*

Test Reference: *Functional*

D I S C U S S I O N

This requirement does not specify exactly how the system must respond when a voter attempts to select an "extra" candidate. For instance, the system may prevent the selection and issue a warning, or, in the case of a single-choice contest, simply change the selection.

➔ **1.2.2.1-B** Warning of Undervotes

The voting system shall provide feedback to the voter, before final casting of the ballot, that identifies specific contests or ballot issues for which he or she has made fewer than the allowable number of selections (e.g., undervotes).

Applies to: *VEBD*

Test Reference: *Functional*

For VEBD systems, no allowance is made for disabling this feature. Also, see requirement below on "Clarity of Warnings".

➡ **1.2.2.1-C** Independent Correction of Ballot

The voting system shall provide the voter the opportunity to correct the ballot before it is cast and counted. This correction process shall not require external assistance. The corrections to be supported include modifying an undervote or overvote, and changing a vote from one candidate to another.

Applies to: *VEBD*

Test Reference: *Functional*

D I S C U S S I O N

Click here and type the discussion about this requirement

➡ **1.2.2.1-D** Ballot Editing per Contest

The voting system shall allow the voter to change a vote within a contest before advancing to the next contest.

Applies to: *VEBD*

Test Reference: *Functional*

D I S C U S S I O N

The point here is that voters using an editable interface should not have to wait for a final ballot review screen in order to change a vote.

➡ **1.2.2.1-E** Contest Navigation

The voting system shall provide navigation controls that allow the voter to advance to the next contest or go back to the previous contest before completing a vote on the contest(s) currently being presented (whether visually or aurally).

Applies to: *VEBD*

Test Reference: *Functional*

D I S C U S S I O N

For example, the voter should not be forced to proceed sequentially through all the contests before going back to check his or her selection for a previous contest.

1.2.2.2   Non-Editable Interfaces

Non-Editable interfaces, such as manually marked paper ballots (MMPB) do not have the same flexibility as do editable interfaces. Nonetheless, certain features are required, especially in the case of precinct-based optical scanners. Note that the technical definition of "marginal mark" may be found in the glossary. Basically, a marginal mark is one that, according the vendor specifications, is neither clearly countable as a vote nor clearly countable as a non-vote.

➡   **1.2.2.2-A** Notification of Overvoting

The voting system shall be capable of providing feedback to the voter that identifies specific contests or ballot issues for which he or she has made more than the allowable number of selections (i.e. overvotes).

Applies to: *PCOS*

Test Reference: *Functional*

D I S C U S S I O N

Click here and type the discussion about this requirement

➡   **1.2.2.2-B** Notification of Undervoting

The voting system shall be capable of providing feedback to the voter that identifies specific contests or ballot issues for which he or she has made fewer than the allowable number of selections (i.e. undervotes). The system shall provide a means for an authorized election official to deactivate this capability entirely and by contest.

Applies to: *PCOS*

Test Reference: *Functional*

D I S C U S S I O N

Click here and type the discussion about this requirement

➡   **1.2.2.2-C** Notification of Blank Ballots

The voting system shall be capable of notifying the voter that he or she has submitted a paper ballot that is blank on one or both sides. The system shall provide a means for an authorized election official to deactivate this capability.

Applies to: *PCOS*

Test Reference: *Functional*

One purpose of this feature is to detect situations in which the voter might be unaware that the ballot is two-sided. This feature is distinct from the ability to detect and warn about undervoting.

[[Here is the new clarifying requirement - I believe this is what was intended all along, but needed to be more explicit.]]

➡ **1.2.2.2-D** Ballot Correction or Submission Following Notification

After the voting system has notified the voter that an anomalous condition (such as an overvote, undervote, or blank ballot) exists, the system shall allow the voter to correct the ballot or to submit it as is.

Applies to:　　　　*PCOS*

Test Reference:　　*Functional*

D I S C U S S I O N

This requirement mandates that the equipment be capable of allowing either correction or immediate submission. For instance, a questionable paper ballot might be physically ejected for possible correction. This requirement does not constrain the *procedures* that jurisdictions might adopt for handling such situations (e.g. whether poll worker intervention is required).

➡ **1.2.2.2-E** Handling of Marginal Marks

Paper-based precinct tabulators should be able to identify a ballot containing marginal marks. When such a ballot is detected, the tabulator shall:

■ Return the ballot to the voter;

■ Provide feedback to the voter that identifies the specific contests or ballot issues for which a marginal mark was detected;

■ Allow the voter either to correct the ballot or to submit the ballot "as is" without correction.

Applies to:　　　　*Precinct tabulator*

Test Reference:　　*Functional*

D I S C U S S I O N

The purpose of this requirement is to provide more certainty about the handling of poorly-marked ballots. If a given candidate or option is clearly

marked as chosen, or left completely unmarked, then there is no ambiguity to resolve. But each vendor should define a "gray zone" (with respect to location, darkness, etc.) in which marks will be actively flagged as ambiguous.

1.2.3   Cognitive Issues

The features specified in this section are intended to minimize cognitive difficulties for the voter. The voter should always be able to operate the voting system and understand the effect of his/her actions.

➡   **1.2.3-A** Completeness of Instructions

The voting system shall provide instructions for all its valid operations.

Applies to: *Voting device*

Test Reference: *Inspection*

D I S C U S S I O N

If an operation is available to the voter, it must be documented. Examples include how to change a vote, how to navigate among contests, how to cast a straight party vote, how to cast a write-in vote, and how to adjust display and audio characteristics.

➡   **1.2.3-B** Availability of Assistance from the System

The voting system shall provide a means for the voter to get help directly from the system at any time during the voting session.

Applies to: *Voting device*

Test Reference: *Functional*

D I S C U S S I O N

The voter should always be able to get help from the system if needed. The purpose is to minimize the need for poll worker assistance. VEBD voting systems may provide this with a distinctive "help" button. Any type of voting system may provide written instructions that are separate from the ballot.

➜ **1.2.3-C** Plain Language

All instructional material for the voter shall conform to certain accepted norms and best practices for plain language.

Applies to: *Voting device*

Test Reference: *Functional*

D I S C U S S I O N

Although part of general usability, the use of plain language is also expected to assist voters with cognitive disabilities. The plain language requirements apply to instructions that are inherent to the voting system or that get generated by default. To the extent that instructions are determined by election officials designing the ballot, they are beyond of the scope of this requirement.

↳ **1.2.3-C.1** Clarity of Warnings

Warnings and alerts issued by the voting system should clearly state:

- the nature of the problem

- whether the voter has performed or attempted an invalid operation or whether the voting equipment itself has malfunctioned in some way.

- the set of responses available to the voter.

Applies to: *Voting device*

Test Reference: *Functional*

D I S C U S S I O N

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

↳ **1.2.3-C.2** Context before Action

Within conditional instructions, the conditions should be stated first, and then the action to be performed.

Applies to: *Voting device*

Test Reference: *Functional*

D I S C U S S I O N

For instance, use "In order to change your vote, do X", rather than "Do X, in order to change your vote".

↳ **1.2.3-C.3** Simple Vocabulary

The system should use familiar, common words and avoid technical or specialized words that voters are not likely to understand.

Applies to: *Voting device*

Test Reference: *Functional*

D I S C U S S I O N

For instance, "... there are more contests on the other side ..." rather than "...additional contests are presented on the reverse ..."

↳ **1.2.3-C.4** Start Each Instruction on a New Line

The system should start the visual presentation of each new instruction on a new line.

Applies to: *Voting device*

Test Reference: *Functional*

D I S C U S S I O N

This implies not "burying" several unrelated instructions in a single long paragraph.

↳ **1.2.3-C.5** Use of Positive

The system should issue instructions on the correct way to perform actions, rather than telling voters what not to do.

Applies to: *Voting device*

Test Reference: *Functional*

D I S C U S S I O N

Click here and type the discussion about this requirement

↳ **1.2.3-C.6** Use of Imperative Voice

The system's instructions should address the voter directly rather than use passive voice constructions.

Applies to: *Voting device*

Test Reference: *Functional*

For example, "remove and retain this ballot stub" rather than "this ballot stub must be removed and retained by the voter."

↳ **1.2.3-C.7** Gender-based Pronouns

The system should avoid the use of gender-based pronouns.

Applies to: *Voting device*

Test Reference: *Functional*

D I S C U S S I O N

For example, "...write in your choice directly on the ballot..." rather than "...write in his name directly on the ballot..."

➡ **1.2.3-D** No Bias among Choices

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

Applies to: *Voting device*

Test Reference: *Inspection*

D I S C U S S I O N

Certain differences in presentation are mandated by state law, such as the order in which candidates are listed and provisions for voting for write-in candidates. But comparable characteristics such as font size or voice volume and speed must be the same for all choices.

➡ **1.2.3-E** Ballot Design

The voting system shall provide the capability to design a ballot with a high level of clarity and comprehensibility.

Applies to: *Voting device*

Test Reference: *Functional*

D I S C U S S I O N

Click here and type the discussion about this requirement

↳ **1.2.3-E.1** Contests Split among Pages or Columns

The voting system should not visually present a single contest spread over two pages or two columns.

Applies to: Voting device

Test Reference: Functional

D I S C U S S I O N

Such a visual separation poses the risk that the voter may perceive one contest as two, or fail to see additional choices. If a contest has a large number of candidates, it may be infeasible to observe this guideline.

↳   **1.2.3-E.2** Indicate Maximum Number of Candidates

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

Applies to: Voting device

Test Reference: Functional

D I S C U S S I O N

Click here and type the discussion about this requirement

↳   **1.2.3-E.3** Consistent Representation of Candidate Selection

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

Applies to: Voting device

Test Reference: Functional

D I S C U S S I O N

For example, the response field where voters indicate their selections must not be located to the left of some candidates' names, and to the right of others'.

↳   **1.2.3-E.4** Placement of Instructions

The system should display instructions near to where they are needed.

Applies to: Voting device

Test Reference: Functional

D I S C U S S I O N

For instance, only general instructions should be grouped at the beginning of the ballot; those pertaining to specific situations should be presented where and when needed. This is especially important for VEBD type systems.

➡ **1.2.3-F** Conventional Use of Color

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.

Applies to: *Voting device*

Test Reference: *Functional*

D I S C U S S I O N

Click here and type the discussion about this requirement

➡ **1.2.3-G** Icons and Language

When an icon is used to convey information, indicate an action, or prompt a response, it shall be accompanied by a corresponding linguistic label.

Applies to: *Voting device*

Test Reference: *Functional*

D I S C U S S I O N

While icons can be used for emphasis when communicating with the voter, they must not be the sole means by which information is conveyed, since there is no widely accepted "iconic" language and therefore not all voters may understand a given icon.

1.2.4   Perceptual Issues

The requirements of this section are designed to minimize perceptual difficulties for the voter.

➡ **1.2.4-A** Screen Flicker

No voting machine display screen shall flicker with a frequency between 2 Hz and 55 Hz.

Applies to: *VEBD-V*

Test Reference: *Inspection*

D I S C U S S I O N

Aside from usability concerns, this requirement protects voters with epilepsy.

➡ **1.2.4-B** Resetting of Adjustable Aspects at End of Session

Any aspect of the voting station that is adjustable by the voter or poll worker, including font size, color, contrast, audio volume, or rate of speech shall automatically reset to a standard default value upon completion of that voter's session.

Applies to: *Voting device*

Test Reference: *Functional*

D I S C U S S I O N

This ensures that the voting station presents the same initial appearance to every voter.

➡ **1.2.4-C** Ability to Reset to Default Values

If any aspect of a voting machine is adjustable by the voter or poll worker, there shall be a mechanism to reset all such aspects to their default values.

Applies to: *Voting device*

Test Reference: *Functional*

D I S C U S S I O N

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

➡ **1.2.4-D** Minimum Font Size

All voting systems shall provide a minimum font size of 3.0mm (measured as the height of a capital letter) for all text intended for the voter.

Applies to: *Voting device*

Test Reference: *Functional*

D I S C U S S I O N

All millimeters will be calculated using Hard Metric Conversion. (See Glossary for definition.)

[[Two issues: 1) what about the wording for "continuous adjustability"? 2) now that this is mandatory for all screen-based systems, should we drop the Acc-VS req as redundant?]]

➡ **1.2.4-E** Available Font Sizes

A voting station that uses an electronic image display shall be capable of showing all information in at least two font sizes, (a) 3.0-4.0 mm and (b) 6.3-9.0 mm, under control of the voter. The system shall allow the voter to adjust font size throughout the voting session while preserving the current ballot choices.

Applies to: VEBD-V

Test Reference: Functional

D I S C U S S I O N

[[dropping: Note that the corresponding requirement for the accessible voting station is mandatory.]] All millimeters will be calculated using Hard Metric Conversion. (See Glossary for definition.)

➡ **1.2.4-F** Use of Sans Serif Font

All text intended for the voter should be presented in a sans serif font.

Applies to: Voting device

Test Reference: Functional

D I S C U S S I O N

Experimentation has shown that users prefer such fonts.

➡ **1.2.4-G** Legibility of Paper Ballots

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

Applies to: Paper-based device

Test Reference: Functional

D I S C U S S I O N

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.

[[No consensus yet on whether or how to change this.]]

➡ **1.2.4-H** Visual Access to VVPAT

When the voting system asks a voter to compare two distinct records of his/her vote (as in VVPAT systems), both records shall be positioned so as to be easily viewable and legible from the same posture.

Applies to: VVPAT

Test Reference: Functional

D I S C U S S I O N

For instance, the voter should not have to swivel from side to side as he/she compares records.

➡ **1.2.4-I** Contrast Ratio

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

Applies to: Voting device

Test Reference: Inspection

D I S C U S S I O N

Click here and type the discussion about this requirement

➡ **1.2.4-J** High Contrast for Electronic Displays

The voting station shall be capable of showing all information in high contrast either by default or under the control of the voter. The system shall allow the voter to adjust contrast throughout the voting session while preserving the current ballot choices. High contrast is a figure-to-ground ambient contrast ratio for text and informational graphics of at least 6:1.

Applies to: VEBD-V

Test Reference: Inspection

D I S C U S S I O N

[[Dropped: Note that the corresponding requirement for the accessible voting station is mandatory.]]

➡ **1.2.4-K** Accommodation for Color Blindness

The default color coding shall support correct perception by voters with color blindness.

Applies to: *Voting device*

Test Reference: *Inspection*

D I S C U S S I O N

There are many types of color blindness and no color coding can, by itself, guarantee correct perception for everyone. However, designers should take into account such factors as: red-green color blindness is the most common form; high luminosity contrast will help colorblind voters to recognize visual features; and color-coded graphics can also use shape to improve the ability to distinguish certain features.

➡ **1.2.4-L** No Reliance Solely on Color

Color coding shall not be used as the sole means of conveying information, indicating an action, prompting a response, or distinguishing a visual element.

Applies to: *Voting device*

Test Reference: *Functional*

D I S C U S S I O N

While 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.

1.2.5   Interaction Issues

The requirements of this section are designed to minimize interaction difficulties for the voter.

➡ **1.2.5-A** No Page Scrolling

Voting machines shall not require page scrolling by the voter.

Applies to: *VEBD*

Test Reference: *Functional*

D I S C U S S I O N

That is, the page of displayed information must fit completely within the physical screen presenting it. Scrolling 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 at the bottom of the "page." Voting systems may require voters to move to the next or previous "page."

➡ **1.2.5-B** Unambiguous Feedback for Voter's Selection

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

Applies to:　　　*Voting device*

Test Reference:　*Functional*

D I S C U S S I O N

Click here and type the discussion about this requirement

➡ **1.2.5-C** Accidental Activation

Input mechanisms shall be designed to minimize accidental activation.

Applies to:　　　*Voting device*

Test Reference:　*Functional*

D I S C U S S I O N

Click here and type the discussion about this requirement

↳ **1.2.5-C.1** Size and Separation of Touch Areas

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.

Applies to:　　　*VEBD*

Test Reference:　*Functional*

D I S C U S S I O N

Click here and type the discussion about this requirement

↳ **1.2.5-C.2** No Repeating Keys

No key or control on a voting machine shall have a repetitive effect as a result of being held in its active position.

Applies to:　　　*Voting device*

Test Reference: Functional

This is to preclude accidental activation. For instance, if a voter is typing in the name of a write-in candidate, depressing and holding the "e" key results in only a single "e" added to the name.

1.2.5.1   Timing Issues

These requirements address how long the system and voter wait for each other to interact. For the purposes of this section we define the following terms:

- ■   **Initial system response time:** the time taken from when the voter performs some detectible action (such as pressing a button) to when the voting system *begins* responding in some obvious way (such as an audible response or any change on the screen).

- ■   **Completed system response time:** the time taken from when the voter performs some detectible action to when the voting system completes its response and settles into a stable state (e.g. finishes "painting" the screen with a new page).

- ■   **Voter inactivity time:** the amount of time the equipment will wait for detectible voter activity before issuing an alert to the voter.

- ■   **Alert time:** the amount of time the equipment will wait for detectible voter activity after issuing an alert and then going into an inactive state requiring poll worker intervention.

➡   **1.2.5.1-A** Maximum Initial System Response Time

The initial system response time of the voting system shall be no greater than 0.5 seconds.

Applies to: VEBD

Test Reference: Functional

This is so the voter can very quickly apprehend that his/her action has been detected and is being processed. The voter never gets the sense of dealing with an unresponsive or "dead" system. Note that this requirement applies to VEBD-A (audio) as well as to VEBD-V (visual) systems.

➜ **1.2.5.1-B** Maximum Completed System Response Time for Vote

Confirmation

When the voter performs an action to record a single vote, the
completed system response time of the voting system shall be no
greater than one second in the case of a visual response, and no
greater than five seconds in the case of an audio response.

Applies to: VEBD

Test Reference: *Functional*

D I S C U S S I O N

For example, if the voter touches a button to indicate a vote for a
candidate, a visual system might paint an "X" next to the candidate's name,
and an audio system might announce "You have voted for Smith for
Governor".

➜ **1.2.5.1-C** Maximum Completed System Response Time for All Operations

The completed system response time of the voting system for visual
operations shall be no greater than 10 seconds.

Applies to: VEBD-V

Test Reference: *Functional*

D I S C U S S I O N

Even for "large" operations such as initializing the ballot or painting a new
screen, the system shall never take more than 10 seconds. In the case of
audio systems, no upper limit is specified, since certain operations, such as
reading out all the candidates running in a contest, may take a long time.

➜ **1.2.5.1-D** System Response Indicator

If the system has not completed its visual response within one
second, it shall present to the voter, within 0.5 seconds of the voter's
action, some indication that it is preparing its response.

Applies to: VEBD

Test Reference: *Functional*

D I S C U S S I O N

For instance, the system might present an hourglass icon indicating that it
is "busy" processing the voter's request. This requirement is intended to
preclude the "frozen screen" effect, in which no detectible activity is taking
place for several seconds. There need not be a specific "activity" icon, as

long as some visual change is apparent (such as progressively "painting" a new screen).

➡ **1.2.5.1-E** Voter Inactivity Time

The voting system shall detect and warn about lengthy voter inactivity during a voting session. Each system shall have a defined and documented inactivity time, and that time shall be between 2 and 5 minutes.

Applies to: *VEBD*

Test Reference: *Functional*

D I S C U S S I O N

Each type of system must have a given inactivity time that is consistent for all voting sessions.

➡ **1.2.5.1-F** Alert Time

Upon expiration of the voter inactivity time, the voting system shall issue an alert and provide a means by which the voter may receive additional time. The alert time shall be between 20 and 45 seconds.

Applies to: *VEBD*

Test Reference: *Functional*

D I S C U S S I O N

Click here and type the discussion about this requirement

1.2.6   Alternative Languages

HAVA Section 301 (a)(4) states that 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). 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 population. Thus, election officials must ensure that the voting system they deploy is capable of handling the languages meeting the legal threshold within their districts.

While the following requirements support this process, it should be noted that they are requirements only for voting systems to be *certified*. It is expected that jurisdictions will apply additional requirements appropriate for their particular circumstances for procurement and deployment.

➡ **1.2.6-A** General Support for Alternative Languages

The voting system shall be capable of presenting the ballot, ballot selections, review screens and instructions in any language declared by the vendor to be supported by the system.

Applies to: *Voting device*

Test Reference: *Functional*

D I S C U S S I O N

For example, if the vendor claims that a given system is capable of supporting Spanish and Chinese, then it must do so.

[[NEW:]]

↳ **1.2.6-A.1** Voter Control of Language

The system shall allow the voter to select among the available languages throughout the voting session while preserving the current ballot choices.

Applies to: *VEBD*

Test Reference: *Functional*

D I S C U S S I O N

For instance, a voter may initially choose an English version of the ballot, but then wish to switch to another language in order to read a referendum question.

↳ **1.2.6-A.2** Complete Information in Alternative Language

All the information presented to the voter in the typical case of English-literate voters (including instructions, warnings, messages, ballot choices, and VVPAT information) shall also be presented when an alternative language is being used, whether the language is written or spoken.

Applies to: *Voting device*

Test Reference: *Functional*

D I S C U S S I O N

Therefore, it may not be sufficient simply to present the ballot *per se* in the alternative language, especially in the case of VEBD systems. All the supporting information must also be available in the alternative language.

↳ **1.2.6-A.3** Usability Testing for Alternative Language

The vendor shall conduct summative usability tests for each of the system's supported languages, using subjects who are fluent in those languages but not fluent in English. The vendor shall document the testing performed and report the test results using the Common Industry Format. This documentation shall be included in the Technical Data Package submitted to the EAC for national certification.

Applies to: *Voting device*

Test Reference: *Inspection*

D I S C U S S I O N

Click here and type the discussion about this requirement

1.2.7   Privacy

The voting process must preclude anyone else from determining the content of a voter's ballot, without the voter's cooperation. Privacy ensures that the voter can make selections based solely on his or her own preferences without intimidation or inhibition.

1.2.7.1   Privacy at the Polls

➡ **1.2.7.1-A** System Support of Privacy

When deployed according to the installation instructions provided by the vendor, the voting system shall prevent others from determining the contents of a voter's ballot.

Applies to: *Voting device*

Test Reference: *Functional*

D I S C U S S I O N

Click here and type the discussion about this requirement

↳ **1.2.7.1-A.1** Visual Privacy

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

Applies to: *Voting device*

Test Reference: *Functional*

↳ **1.2.7.1-A.2** Auditory Privacy

The audio interface of the voting system shall be audible only to the voter.

Applies to: VEBD-A

Test Reference: Functional

D I S C U S S I O N

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.

↳ **1.2.7.1-A.3** Privacy of Warnings

The voting system shall issue all warnings in a way that preserves the privacy of the voter and the confidentiality of the ballot.

Applies to: Voting device

Test Reference: Functional

D I S C U S S I O N

HAVA 301 (a)(1)(C) mandates that 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. This requirement generalizes that mandate.

↳ **1.2.7.1-A.4** No Receipts

The voting system shall not issue a receipt to the voter that would provide proof to another of how he or she voted.

Applies to: Voting device

Test Reference: Functional

D I S C U S S I O N

1.2.7.2   No Recording of Alternative Format Usage

When voters use non-typical ballot interfaces, such as large print or alternative languages, their anonymity may be vulnerable. To the extent

possible, only the logical contents of their ballots should be recorded, not the special formats in which they were rendered. In the case of paper ballots, where the interface *is* the record, some format information is unavoidably preserved.

➡ **1.2.7.2-A** No Recording of Alternate Languages

No information shall be kept within an electronic cast vote record that identifies any alternative language feature(s) used by a voter.

Applies to: *Voting device*

Test Reference: *Functional*

D I S C U S S I O N

Click here and type the discussion about this requirement

➡ **1.2.7.2-B** No Recording of Accessibility Features

No information shall be kept within an electronic cast vote record that identifies any accessibility feature(s) used by a voter.

Applies to: *Voting device*

Test Reference: *Functional*

D I S C U S S I O N

Click here and type the discussion about this requirement

1.2.8   Usability for Poll Workers

Voting systems are used not only by voters to record their choices, but also by poll workers who are responsible for set-up, operation while polls are open, light maintenance, and poll closing. Because of the wide variety of implementations, it is impossible to specify detailed design requirements for these functions. The requirements below describe general capabilities that all systems must support.

1.2.8.1   Operation

Poll workers are responsible for opening polls, keeping the polls open and running smoothly during voting hours, and closing the polls afterwards. Operations may be categorized in three phases:

Setup includes all the steps necessary to take the system from its state as normally delivered to the polling place, to the state in which it is ready to record votes. It does not include ballot definition.

Polling includes such functions as:

- voter identification and authorization

- preparing the system for the next voter,

- assistance to voters who wish to change their ballots or need other help,

- system recovery in the case of voters who abandon the voting session without having cast a ballot.

- routine hardware operations, such as installing a new roll of paper.

Shutdown includes all the steps necessary to take the system from the state in which it is ready to record votes to its normal completed state in which it has captured all the votes cast and the voting information cannot be further altered.

➡ **1.2.8.1-A** Ease of Normal Operation

Procedures for system setup, polling, and shutdown shall be reasonably easy for the typical poll worker to learn, understand, and perform.

Applies to: *Voting device*

Test Reference: *Functional*

D I S C U S S I O N

This requirement covers procedures and operations for those aspects of system operation normally performed by poll workers and other "non-expert" operators. It does not address inherently complex operations such as ballot definition or system repair. While a certain amount of complexity is unavoidable, these "normal" procedures should not require any special expertise. The procedures may require a reasonable amount of training. Also, see requirements for usability of system documentation in Volume IV, Chapter 3 XREF.

➡ **1.2.8.1-B** Usability Testing by Vendor

The vendor shall conduct summative usability tests on the voting system using individuals representative of the general population. The tasks to be covered in the test shall include setup, operation, and shutdown. The vendor shall document the testing performed and report the test results using the Common Industry Format. This documentation shall be included in the Technical Data Package submitted to the EAC for national certification.

Applies to: *Voting system*

Test Reference: Inspection

Click here and type the discussion about this requirement

1.2.8.2   Maintenance

Maintainability represents the ease with which maintenance actions can be performed based on the design characteristics of equipment and software and the processes the vendor and election officials have in place for preventing failures and for reacting to failures. Maintainability includes the ability of equipment and software to self-diagnose problems and make non-technical election workers aware of a problem. Maintainability addresses all scheduled and unscheduled events, which are performed to:

- Determine the operational status of the system or a component

- Adjust, align, tune or service components

- Repair or replace a component having a specified operating life or replacement interval
   -- Repair or replace a component that exhibits an undesirable predetermined physical condition or performance degradation

- Repair or replace a component that has failed

- Verify the restoration of a component or the system to operational status

Maintainability shall be determined based on the presence of specific physical attributes that aid system maintenance activities, and the ease with which system maintenance tasks can be performed by the test lab. Although a more quantitative basis for assessing maintainability, such as the Mean Time to Repair the system is desirable, the certification of a system is conducted before it is approved for sale and thus before a broader base of maintenance experience can be obtained.

➡   **1.2.8.2-A** Physical Attributes for Maintenance

The following physical attributes shall be sufficiently available so as to support good maintainability:

- Presence of labels and the identification of test points

- Provision of built-in test and diagnostic circuitry or physical indicators of condition

- Presence of labels and alarms related to failures

- Presence of features that allow non-technicians to perform routine maintenance tasks (such as update of the system database)

Applies to: *Voting device*

Test Reference: *Inspection*

D I S C U S S I O N

Click here and type the discussion about this requirement

➡ **1.2.8.2-B** Additional Attributes for Maintenance

The following additional attributes shall be sufficiently available so as to support good maintainability:

- Ease of detection by a non-technician that equipment has failed

- Low false alarm rates (i.e. indications of problems that do not exist)

- Ease of access to components for replacement

- Ease with which adjustment and alignment can be performed

- Ease with which database updates can be performed by a non-technician

- Ease with which a poll worker can adjust, align, tune or service components

Applies to: *Voting device*

Test Reference: *Inspection*

D I S C U S S I O N

Click here and type the discussion about this requirement

1.2.8.3   Safety

[[This section has been somewhat updated. The listing of specific hazards has been moved from a supplementary requirement to the following introductory section and the basic safety requirement now refers to the underlying technical UL standard, instead of to the broader OSHA standard, which governs workplace inspections.]]

All voting systems and their components must be designed so as to eliminate hazards to personnel or to the equipment itself. Hazards include, but are not limited to:

- fire hazards

- electrical hazards

- potential for equipment tip-over (stability)

- potential for cuts and scrapes (e.g. sharp edges)

- potential for pinching (e.g. tight, spring-loaded closures)

- potential for hair or clothing entanglement

➜ **1.2.8.3-A** Compliance with Federal Regulations

All equipment associated with the voting system shall be certified in accordance with the requirements of UL 60950, Safety of Information Technology Equipment by a certification organization accredited by the Department of Labor, Occupational Safety and Health Administration's Nationally Recognized Testing Laboratory program. The certification organization's scope of accreditation shall include UL 60950.

Applies to: Voting device

Test Reference: Inspection

D I S C U S S I O N

UL 60950 is a comprehensive standard for IT equipment and addresses all the hazards discussed above under Safety.

1.3   Accessibility Requirements

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 voting process is to be accessible to voters with disabilities through the use of a specially equipped voting station. A machine so equipped is referred to herein as an accessible voting station (Acc-VS).

The requirements in this subsection are intended to address this HAVA mandate. Ideally, every voter would be able to vote independently and privately. As a practical matter, there may be some number of voters whose disabilities are so severe that they will need personal assistance. Nonetheless, these requirements are meant to make the voting system independently accessible to as many voters as possible. These requirements are *in addition* to those described in Subsection 3.2 XREF which generally apply to the Acc-VS.

This subsection is organized according to the type of disability being addressed. For each type, certain appropriate design features are specified. Note, however, that a feature intended primarily to address one kind of disability may very well assist voters with other kinds.

1.3.1   General

The requirements of this sub-section are relevant to a wide variety of disabilities.

➡   **1.3.1-A** Complete Information in Alternative Formats

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

Applies to: *Acc-VS*

Test Reference: *Functional*

D I S C U S S I O N

Click here and type the discussion about this requirement

➡   **1.3.1-B** No Dependence on Assistive Technology

The support provided to voters with disabilities shall be intrinsic to the accessible voting station. It shall not be necessary for the accessible voting station to be connected to any personal assistive device of the voter in order for the voter to operate it correctly.

Applies to: Acc-VS

Test Reference: Functional

D I S C U S S I O N

This requirement does not preclude the accessible voting station from providing interfaces to assistive technology. (See definition of "personal assistive devices" in the Glossary.) Its purpose is to assure that disabled voters are not required to bring special devices with them in order to vote successfully. The requirement does not assert that the accessible voting station will obviate the need for a voter's ordinary non-interfacing devices, such as eyeglasses or canes.

➡ **1.3.1-C** Secondary Means of Voter Identification

If a voting system provides for voter identification or authentication by using biometric measures that require a voter to possess particular biological characteristics, then the system shall provide a secondary means that does not depend on those characteristics.

Applies to: Acc-VS

Test Reference: Functional

D I S C U S S I O N

For example, if fingerprints are used for voter identification, another mechanism shall be provided for voters without usable fingerprints.

[[JC: The following is the draft of a new proposed requirement to address accessibility and verification.]]

➡ **1.3.1-D** Accessibility of Paper-based Vote Verification

If the Acc-VS generates a paper record (or some other durable, human-readable record) for the purpose of allowing voters to verify their ballot choices, then the system should provide a mechanism that can read that record and generate an audio representation of its contents. The use of this mechanism should be accessible to voters with dexterity disabilities.

Applies to: Acc-VS

Test Reference: Functional

D I S C U S S I O N

Sighted voters can directly verify the contents of a paper record. The purpose of this requirement is to allow voters with visual disabilities to verify, even if indirectly, the contents of the record. It is recognized that the

verification depends on the integrity of the mechanism that reads the record to the voter. The audio must be generated via the paper record and therefore not depend on any electronic or other "internal" record of the ballot. Note that the paper record and its audio representation may be rendered in an alternative language.

1.3.2   Partial Vision

These requirements specify the features of the accessible voting station designed to assist voters with partial vision.

Partial (or low) vision includes dimness of vision, haziness, film over the eye, foggy vision, extreme near-sightedness or far-sightedness, distortion of vision, color distortion or blindness, visual field defects, spots before the eyes, tunnel vision, lack of peripheral vision, abnormal sensitivity to light or glare and night blindness. For the purposes of this discussion low vision is defined as having a visual acuity worse than 20/70.

People with tunnel vision can see only a small part of the ballot at one time. For these users it is helpful to have letters at the lower end of the font size range in order to allow them to see more letters at the same time. Thus, there is a need to provide font sizes at both ends of the range.

People with low vision or color blindness benefit from high contrast and selection of color combinations that are appropriate for their needs. Between 7% and 10% of all men have color vision deficiencies. Certain color combinations in particular cause problems. Therefore, use of color combinations with good contrast is required. Note also the general requirement "Accommodation for Color Blindness" in section 3.2.4 XREF.

However, some users are very sensitive to very bright displays and cannot use them for long. An overly bright background causes a visual white-out which makes these users unable to distinguish individual letters. Thus, use of non-saturated color options is an advantage for some people.

➔   **1.3.2-A** Usability Testing by Vendor

The vendor shall conduct summative usability tests on the voting system using partially sighted individuals. The vendor shall document the testing performed and report the test results using the Common Industry Format. This documentation shall be included in the Technical Data Package submitted to the EAC for national certification.

Applies to: *Acc-VS*

Test Reference: *Inspection*

[[Redundant, given the new general req?]]

➡ **1.3.2-B** Available Font Sizes for Accessible Display

Accessible voting stations that use an electronic image display shall be capable of showing all information in at least two font sizes, (a) 3.0-4.0 mm and (b) 6.3-9.0 mm, under control of the voter. The system shall allow the voter to adjust font size throughout the voting session while preserving the current ballot choices.

Applies to: *Acc-VS*

Test Reference: Functional

DISCUSSION

All millimeters will be calculated using Hard Metric Conversion. (See Glossary for definition.) While larger font sizes may assist most voters with poor vision, certain disabilities such as tunnel vision are best addressed by smaller font sizes. Larger font sizes may also assist voters with cognitive disabilities.

[[Redundant, given the new general req?]]

➡ **1.3.2-C** High Contrast for Accessible Display

An accessible voting station shall be capable of showing all information in high contrast either by default or under the control of the voter. High contrast is a figure-to-ground ambient contrast ratio for text and informational graphics of at least 6:1. The system shall allow the voter to adjust contrast throughout the voting session while preserving the current ballot choices.

Applies to: *Acc-VS*

Test Reference: Inspection

DISCUSSION

Click here and type the discussion about this requirement

➡ **1.3.2-D** Adjustable Saturation for Color Displays

An accessible voting station with a color electronic image display shall allow the voter to adjust the color saturation throughout the voting session while preserving the current ballot choices. At least

two options shall be available: a high and a low saturation presentation.

Applies to: *Acc-VS*

Test Reference: *Functional*

D I S C U S S I O N

It is not required that the station offer a continuous range of color saturation. "High saturation" refers to bright, vibrant colors. "Low saturation" refers to muted (or grayish) colors.

➡   **1.3.2-E** Distinctive Buttons and Controls

Buttons and controls on accessible voting stations shall be distinguishable by both shape and color. This applies to buttons and controls implemented either "on-screen" or in hardware. This requirement does not apply to sizeable groups of keys, such as a conventional 4x3 telephone keypad or a full alphabetic keyboard.

Applies to: *Acc-VS*

Test Reference: *Inspection*

D I S C U S S I O N

The redundant cues are helpful to those with low vision. They are also helpful to individuals who may have difficulty reading the text on the screen.

➡   **1.3.2-F** Synchronized Audio and Video

The voting station shall provide synchronized audio output to convey the same information as that which is displayed on the screen. There shall be a means by which the voter can disable either the audio or video output, resulting in a video-only or audio-only presentation, respectively. [[Here is the "continuous adjustability" option:]] The system shall allow the voter to switch among the three modes (synchronized audio/video, video-only, or audio-only) throughout the voting session while preserving the current ballot choices.

Applies to: *Acc-VS*

Test Reference: *Functional*

D I S C U S S I O N

This feature may also assist voters with cognitive disabilities.

1.3.3 Blindness

These requirements specify the features of the accessible voting station designed to assist voters who are blind.

➡ **1.3.3-A** Usability Testing by Vendor

The vendor shall conduct summative usability tests on the voting system using individuals who are blind. The vendor shall document the testing performed and report the test results using the Common Industry Format. This documentation shall be included in the Technical Data Package submitted to the EAC for national certification.

Applies to:　　*Acc-VS*

Test Reference:　*Inspection*

D I S C U S S I O N

Click here and type the discussion about this requirement

➡ **1.3.3-B** Audio-Tactile Interface

The accessible voting station shall provide an audio-tactile interface (ATI) that supports the full functionality of the visual ballot interface, as specified in Subsection 6.6 XREF.

Applies to:　　*Acc-VS*

Test Reference:　*Functional*

D I S C U S S I O N

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 applicable

- Instructions and feedback to the voter on how to operate the accessible voting station, including settings and options (e.g., volume control, repetition)

- Instructions and feedback for navigation of the ballot

- Instructions and feedback for contest choices, including write-in candidates

- Instructions and feedback on confirming and changing selections

- Instructions and feedback on final submission of ballot

↳   **1.3.3-B.1** Equivalent Functionality of ATI

The ATI of the accessible voting station shall provide the same capabilities to vote and cast a ballot as are provided by its visual interface.

Applies to: *Acc-VS*

Test Reference: *Functional*

D I S C U S S I O N

For example, if a visual ballot supports voting a straight party ticket and then changing the choice in a single contest, so must the ATI.

↳   **1.3.3-B.2** ATI Supports Repetition

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

Applies to: *Acc-VS*

Test Reference: *Functional*

D I S C U S S I O N

This feature may also be useful to voters with cognitive disabilities.

↳   **1.3.3-B.3** ATI Supports Pause and Resume

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

Applies to: *Acc-VS*

Test Reference: *Functional*

D I S C U S S I O N

This feature may also be useful to voters with cognitive disabilities.

↳   **1.3.3-B.4** ATI Supports Transition to Next or Previous Contest

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

Applies to: *Acc-VS*

Test Reference: *Functional*

This is analogous to the ability of sighted voters to move on to the next contest once they have made a selection or to abstain from voting on a contest altogether.

↳ **1.3.3-B.5** ATI Can Skip Referendum Wording

The ATI shall allow the voter to skip over the reading of a referendum so as to be able to vote on it immediately.

Applies to: Acc-VS

Test Reference: Functional

D I S C U S S I O N

This is analogous to the ability of sighted voters to skip over the wording of a referendum on which they have already made a decision prior to the voting session (e.g., "Vote yes on proposition #123").

➡ **1.3.3-C** Audio Features and Characteristics

All voting stations that provide audio presentation of the ballot shall do so in a usable way, as detailed in the following sub-requirements.

Applies to: VEBD-A

Test Reference: Functional

D I S C U S S I O N

These requirements apply to all voting machine audio output, not just to the ATI of an accessible voting station.

↳ **1.3.3-C.1** Standard Connector

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.

Applies to: VEBD-A

Test Reference: Functional

D I S C U S S I O N

Click here and type the discussion about this requirement

↳ **1.3.3-C.2** T-coil Coupling

When a voting machine utilizes a telephone style handset or headphone 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.

Applies to: *VEBD-A*

Test Reference: *Functional*

D I S C U S S I O N

Click here and type the discussion about this requirement

⌐ **1.3.3-C.3** Sanitized Headphone or Handset

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

Applies to: *VEBD-A*

Test Reference: *Inspection*

D I S C U S S I O N

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

⌐ **1.3.3-C.4** Initial Volume

The voting machine shall set the initial volume for each voting session between 40 and 50 dB SPL.

Applies to: *VEBD-A*

Test Reference: *Functional*

D I S C U S S I O N

A voter does not "inherit" the volume as set by the previous user of the voting station. See 3.2.4-B XREF "Resetting of Adjustable Aspects at End of Session".

⌐ **1.3.3-C.5** Range of Volume

The audio system shall allow the voter to control the volume throughout the voting session while preserving the current ballot choices. The volume shall be adjustable from a minimum of 20dB SPL up to a maximum of 100 dB SPL, in increments no greater than 10 dB.

Applies to: VEBD-A

Test Reference: *Functional*

D I S C U S S I O N

Click here and type the discussion about this requirement

↳ **1.3.3-C.6** Range of Frequency

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

Applies to: VEBD-A

Test Reference: *Functional*

D I S C U S S I O N

Click here and type the discussion about this requirement

↳ **1.3.3-C.7** Intelligible Audio

The audio presentation of verbal information should be readily comprehensible by voters who have normal hearing and are proficient in the language. This includes such characteristics as proper enunciation, normal intonation, appropriate rate of speech, and low background noise. Candidate names should be pronounced as the candidate intends.

Applies to: VEBD-A

Test Reference: *Functional*

D I S C U S S I O N

This requirement covers both recorded and synthetic speech. It applies to those aspects of the audio content that are inherent to the voting system or that get generated by default. To the extent that the audio presentation is determined by election officials designing the ballot, it is beyond of the scope of this requirement.

↳ **1.3.3-C.8** Control of Speed

The audio system shall allow the voter to control the rate of speech throughout the voting session while preserving the current ballot choices. The range of speeds supported shall include 75% to 200% of the nominal rate.

Applies to: VEBD-A

Test Reference: Functional

<small>D I S C U S S I O N</small>

Many blind voters are accustomed to interacting with accelerated speech. This feature may also be useful to voters with cognitive disabilities.

➡   **1.3.3-D** Ballot Activation

If the voting station supports ballot activation for non-blind voters, then it shall also provide features that enable voters who are blind to perform this activation.

Applies to: Acc-VS

Test Reference: Functional

<small>D I S C U S S I O N</small>

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

➡   **1.3.3-E** Ballot Submission

If the voting station supports ballot submission for non-blind voters, then it shall also provide features that enable voters who are blind to perform this submission.

Applies to: Acc-VS

Test Reference: Functional

<small>D I S C U S S I O N</small>

For example, if voters using this station normally feed their own optical scan ballots into a reader, blind voters should also be able to do so.

➡   **1.3.3-F** Tactile Discernability of Controls

All mechanically operated controls or keys on an accessible voting station shall be tactilely discernible without activating those controls or keys.

Applies to: Acc-VS

Test Reference: Functional

<small>D I S C U S S I O N</small>

Click here and type the discussion about this requirement

➡ **1.3.3-G** Discernability of Key Status

On an accessible voting station, 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.

Applies to: *Acc-VS*

Test Reference: *Functional*

D I S C U S S I O N

Click here and type the discussion about this requirement

1.3.4   Dexterity

These requirements specify the features of the accessible voting station designed to assist voters who lack fine motor control or use of their hands.

➡ **1.3.4-A** Usability Testing by Vendor

The vendor shall conduct summative usability tests on the voting system using individuals lacking fine motor control. The vendor shall document the testing performed and report the test results using the Common Industry Format. This documentation shall be included in the Technical Data Package submitted to the EAC for national certification.

Applies to: *Acc-VS*

Test Reference: *Inspection*

D I S C U S S I O N

Click here and type the discussion about this requirement

➡ **1.3.4-B** Support for Non-Manual Input

The accessible voting station shall provide a mechanism to enable non-manual input that is functionally equivalent to tactile input. All the functionality of the accessible voting station (e.g., straight party voting, write-in candidates) that is available through the conventional forms of input, such as tactile, shall also be available through the non-manual input mechanism.

Applies to: *Acc-VS*

Test Reference: *Functional*

DISCUSSION

This requirement ensures that the accessible voting station is operable by individuals who do not have the use of their hands. An example of non-manual control would be a "sip and puff" switch. While it is desirable that the voter be able to independently initiate use of the non-manual input mechanism, this requirement guarantees only that the voter can vote independently once the mechanism is enabled.

➡ **1.3.4-C** Ballot Submission

If the voting station supports ballot submission for non-disabled voters, then it shall also provide features that enable voters who lack fine motor control or the use of their hands to perform this submission.

Applies to: *Acc-VS*

Test Reference: *Functional*

DISCUSSION

Click here and type the discussion about this requirement

➡ **1.3.4-D** Manipulability of Controls

All keys and controls on the accessible voting station 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).

Applies to: *Acc-VS*

Test Reference: *Functional*

DISCUSSION

Controls are to be operable without excessive force.

➡ **1.3.4-E** No Dependence on Direct Bodily Contact

The accessible voting station controls shall not require direct bodily contact or for the body to be part of any electrical circuit.

Applies to: *Acc-VS*

Test Reference: *Functional*

DISCUSSION

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

1.3.5 Mobility

These requirements specify the features of the accessible voting station designed to assist voters who use mobility aids, including wheelchairs.

➜ **1.3.5-A** Clear Floor Space

The accessible voting station 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.

Applies to: *Acc-VS*

Test Reference: *Inspection*

D I S C U S S I O N

The accessible voting station 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.

➜ **1.3.5-B** Allowance for Assistant

When deployed according to the installation instructions provided by the vendor, the voting station shall allow adequate room for an assistant to the voter. This includes clearance for entry to and exit from the area of the voting station.

Applies to: *Acc-VS*

Test Reference: *Functional*

D I S C U S S I O N

Disabled voters sometimes prefer to have an assistant help them vote. The setup of the voting station should not preclude this.

➜ **1.3.5-C** Visibility of Displays and Controls

All labels, displays, controls, keys, audio jacks, and any other part of the accessible voting station necessary for the voter to operate the voting machine 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 accessible voting station.

Applies to: *Acc-VS*

Test Reference: Inspection

D I S C U S S I O N

There are a number of factors that could make relevant parts of the accessible voting station difficult to see such as; small lettering, controls and labels tilted at an awkward angle from the voter's viewpoint, and glare from overhead lighting.

1.3.5.1   Controls within Reach

The requirements of this sub-section ensure that the controls, keys, audio jacks and any other part of the accessible voting station necessary for its operation are within easy reach. Note that these 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.

➡   **1.3.5.1-A** Forward Approach, No Obstruction

If the accessible voting station 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 1.

Applies to: *Acc-VS*

Test Reference: Inspection

D I S C U S S I O N

Click here and type the discussion about this requirement

➡   **1.3.5.1-B** Forward Approach, with Obstruction

If the accessible voting station has a forward approach with a forward reach obstruction, the following sub-requirements apply (See Figure 2).

Applies to: *Acc-VS*

Test Reference: Inspection

D I S C U S S I O N

Click here and type the discussion about this requirement

1.3.5.1-B.1 Maximum Size of Obstruction

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.

Applies to: Acc-VS

Test Reference: Inspection

D I S C U S S I O N

Click here and type the discussion about this requirement

1.3.5.1-B.2 Maximum High Reach over Obstruction

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.

Applies to: Acc-VS

Test Reference: Inspection

D I S C U S S I O N

Click here and type the discussion about this requirement

1.3.5.1-B.3 Toe Clearance under Obstruction

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 provisions:

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

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

- Toe clearance width shall be 30 inches (760 mm) minimum.

Applies to: Acc-VS

Test Reference: Inspection

D I S C U S S I O N

Click here and type the discussion about this requirement

1.3.5.1-B.4 Knee Clearance under Obstruction

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 provisions:

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

- The minimum knee clearance depth 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.

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

- Knee clearance width shall be 30 inches (760 mm) minimum.

Applies to: *Acc-VS*

Test Reference: *Inspection*

D I S C U S S I O N

Click here and type the discussion about this requirement

1.3.5.1-C Parallel Approach, No Obstruction

If the accessible voting station 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 3.

Applies to: *Acc-VS*

Test Reference: *Inspection*

D I S C U S S I O N

Click here and type the discussion about this requirement

➡ **1.3.5.1-D** Parallel Approach, with Obstruction

If the accessible voting station has a parallel approach with a side reach obstruction, the following sub-requirements apply. See Figure 4.

Applies to: *Acc-VS*

Test Reference: *Inspection*

D I S C U S S I O N

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

↳ **1.3.5.1-D.1** Maximum Size of Obstruction

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

Applies to: *Acc-VS*

Test Reference: *Inspection*

D I S C U S S I O N

Click here and type the discussion about this requirement

↳ **1.3.5.1-D.2** Maximum High Reach over Obstruction

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.

Applies to: *Acc-VS*

Test Reference: *Inspection*

D I S C U S S I O N

Click here and type the discussion about this requirement

[[Mobility figures go here.]]

1.3.6 Hearing

These requirements specify the features of the accessible voting station designed to assist voters with hearing disabilities.

➡ **1.3.6-A** Reference to Audio Requirements

The accessible voting station shall incorporate the features listed under requirement 3.3.3-C XREF "Audio Features and Characteristics" for voting equipment that provides audio presentation of the ballot.

Applies to: *Acc-VS*

Test Reference: *Functional*

D I S C U S S I O N

Note especially the requirements for volume initialization and control.

➡ **1.3.6-B** Visual Redundancy for Sound Cues

If the voting system provides sound cues as a method to alert the voter, the tone shall be accompanied by a visual cue, unless the station is in audio-only mode.

Applies to: *Acc-VS*

Test Reference: *Functional*

D I S C U S S I O N

For instance, the voting equipment 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. If the voting system has been set to audio-only mode, there would be no visual cue.

➡ **1.3.6-C** No Electromagnetic Interference with Hearing Devices

No voting equipment shall cause electromagnetic interference with assistive hearing devices that would substantially degrade the performance of those devices. The voting equipment, considered as a wireless device, 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.

Applies to: *Voting device*

Test Reference: *Functional*

D I S C U S S I O N

"Hearing devices" include hearing aids and cochlear implants.

1.3.7　Cognition

These requirements specify the features of the accessible voting station designed to assist voters with cognitive disabilities.

➜　**1.3.7-A** General Support for Cognitive Disabilities

The accessible voting station should provide support to voters with cognitive disabilities.

Applies to:　　　*Acc-VS*

Test Reference:　*Functional*

D I S C U S S I O N

Because of the highly varied nature of disabilities falling within the "cognitive" category, there are no design features uniquely aimed at helping those with such disabilities. However, many of the features designed primarily for other disabilities and for general usability are also highly relevant to these voters:

- the synchronization of audio with the displayed screen information (3.3.2-F XREF)

- the general cognitive usability requirements (3.2.3 XREF) and, in particular, the use of plain language (3.2.3-C XREF)

- large font sizes (3.3.2-B XREF)

- the ability to control various aspects of the audio presentation (3.3.3-B and 3.3.3-C XREF) such as pausing, repetition, and speed.

1.3.8　English Proficiency

These requirements specify the features of the accessible voting station designed to assist voters who lack proficiency in reading English.

➜　**1.3.8-A** Use of ATI

For voters who lack proficiency in reading English, the voting equipment shall provide an audio interface for instructions and ballots as described in section 3.3.3-B XREF "Audio-Tactile Interface".

Applies to:　　　*Acc-VS*

Test Reference:　*Functional*

D I S C U S S I O N

Click here and type the discussion about this requirement

1.3.9   Speech

➜   **1.3.9-A** Speech not to be Required by Equipment

No voting equipment shall require voter speech for its operation.

Applies to: *Voting device*

Test Reference: *Functional*

D I S C U S S I O N

This does not preclude voting equipment from offering speech input as an option, but speech must not be the only means of input.

Summary of Requirements