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 learning and familiarity are lower than for more frequent tasks, such as use of an ATM.

- Jurisdictions may change voting equipment, thus obviating whatever familiarity the voter might have acquired.

- Once the voting session has been completed by the voter, there is never a chance for later correction.

- Voting must be accessible to all eligible citizens, whatever their age, physical abilities, language skills, or experience with technology.

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 on human factors:

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

    The voting process shall allow eligible voters of whatever age, condition, or background to be able to go through the entire voting process with the same degree of independence, privacy, and confidence, insofar as technology will allow. 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 CAPTURE THE INTENT OF THE VOTER WHO CAST THAT BALLOT.

1 Voters have the right to have the ballot presented to them in a manner that is clear and
2 usable. Voters should encounter no difficulty or confusion in recording their choices.
3
4 3. THE VOTING PROCESS SHALL PRESERVE THE SECRECY OF THE BALLOT.
5
6 The voting process shall preclude anyone else from determining the content of a voter's
7 ballot, with or without the voter's cooperation. If such a determination is made against the
8 wishes of the voter, then his or her privacy has been violated. The process must also
9 preclude the voter from disclosing the content of the ballot to anyone else.
10
11 All the requirements within Section 2.2.7 have the purpose of improving the quality of
12 interaction between voters and voting systems.
13
14 • Requirements that are likely to be relevant only to those with some disability are listed
15   under Section 2.2.7.1, although they may also assist those not usually described as having
16   a disability, e.g. voters with poor eyesight or somewhat limited dexterity.
17
18 • Requirements that are likely to be relevant only to those with limited English proficiency
19   are listed in Section 2.2.7.2.
20
21 • Finally, requirements for general usability make up Section 2.2.7.3 and those for privacy,
22   Section 2.2.7.4.
23
24 Certain abbreviations and terms are used extensively throughout Section 2.2.7:
25
26 • CIF: Common Industry Format: Refers to the format described in ANSI/INCITS 354-
27   2001 "Common Industry Format (CIF) for Usability Test Reports."
28
29 • Acc-VS: Accessible Voting Station - the voting station equipped for individuals with
30   disabilities referred to in HAVA 301 (a)(3)(B).
31
32 • ATI: Audio-Tactile Interface - a voter interface designed so as not to require visual
33   reading of a ballot. Audio is used to convey information to the voter and sensitive tactile
34   controls allow the voter to convey information to the voting system.
35
36 • ALVS: Alternative Language Voting Station - a voting station designed to be usable by
37   voters who have limited English proficiency.
38
39 This section also uses common terms as defined in the updated Glossary. Note in particular, the
40 distinctions among "voting system," "voting station," and "voting process."
41

1   **1.   The voting process shall be accessible to voters with disabilities. As a**
2   **minimum, every polling place shall have at least one voting station**
3   **equipped for individuals with disabilities, as provided in HAVA 301**
4   **(a)(3)(B). A station so equipped is referred to herein as an accessible**
5   **voting station (Acc-VS).**
6

7   HAVA Section 301 (a)(3) reads in part:
8
9   "ACCESSIBILITY FOR INDIVIDUALS WITH DISABILITIES.--The voting system
10   shall—
11   (A) be accessible for individuals with disabilities, including nonvisual accessibility
12   for the blind and visually impaired, in a manner that provides the same opportunity
13   for access and participation (including privacy and independence) as for other voters;
14   (B) satisfy the requirement of subparagraph (A) through the use of at least one direct
15   recording electronic voting system or other voting system equipped for individuals
16   with disabilities at each polling place;"
17
18   The requirements within Section 2.2.7.1 are intended to address this mandate. Ideally every
19   voter would be able to vote independently and privately. As a practical matter, there may be a
20   small number of voters whose disabilities are so severe that they will need personal assistance.
21   Nonetheless, the requirements of this section are meant to make the voting system directly
22   accessible to as many voters as possible.
23
24   Note that this section does not replace requirements of other sections, but adds to them. In
25   particular, the requirements of Section 2.2.7.3 on usability apply either to all voting stations or,
26   in some cases, to all DRE voting stations; many of these requirements support accessibility as
27   well as general usability.
28
29   Certain accessibility features that are likely to be useful to a wide range of voters are required on
30   all voting stations, not just the Acc-VS. Finally, note that the Acc-VS is not necessarily a full-
31   fledged DRE; for instance, an implementation may provide an ATI that generates an optiscan
32   ballot.
33
34   The outline for Section 2.2.7.1 is:
35
36   2.2.7.1 Accessibility
37   2.2.7.1.1   Voters with Disabilities - General
38   2.2.7.1.2   Vision
39   2.2.7.1.2.1   Partial Vision
40   2.2.7.1.2.2   Blind
41   2.2.7.1.3   Dexterity
42   2.2.7.1.4   Mobility

1   2.2.7.1.5   Hearing
2   2.2.7.1.6   Speech
3   2.2.7.1.7   Cognitive
4
5
6 **1. The voting process shall incorporate features that are applicable to several types of**
7   **disability.**

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

10

11   **1.1   When the provision of accessibility involves an alternative format for ballot**
12   **presentation, then all the other information presented to voters in the case of**
13   **non-disabled English-literate voters (including instructions, warnings,**
14   **messages, and ballot choices) shall also be presented in that alternative format.**

15 | V | Voting System Vendor

         | Pre-Voting | Voting | Post-Voting |

16
17   Discussion: This is a general principle to be followed for any alternative format
18   presentation. Two particular cases, (a) audio formats and (b) non-
19   English formats, are the subject of specific requirements in later
20   sections.

21
22   [*Best Practice for Voting Officials*] When the provision of accessibility involves an
23   alternative format for ballot presentation, then all the other information presented to
24   voters in the case of non-disabled English-literate voters (including instructions,
25   warnings, messages, and ballot choices) is also presented in that alternative format.
26
27
28   **1.2   An Acc-VS shall provide direct accessibility such that voters' personal assistive**
29   **devices are not required for voting.**

30 | V | Voting System Vendor

         | Pre-Voting | Voting | Post-Voting |

31
32   Discussion: Voters are not to be obliged to supply any special equipment in order to
33   vote. This requirement does not preclude the Acc-VS from providing
34   interfaces to assistive technology.

1
2
3
4
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.

5
| V | Voting System Vendor |

| Pre-Voting | Voting | Post-Voting |

6
7   Discussion: For example, if fingerprints were used for identification, there would
8   have to be another mechanism for voters without usable fingerprints.

9
10   [*Best Practice for Voting Officials*] When the primary means of voter identification
11   or authentication uses biometric measures that require a voter to possess particular
12   biological characteristics, the voting process provides a secondary means that does
13   not depend on those characteristics.
14
15
16   [*Best Practice for Voting Officials*] Polling places are subject to the appropriate guidelines
17   of the Americans with Disabilities Act (ADA) of 1990 and of the Architectural Barriers Act
18   (ABA) of 1968. This requirement does not stem from HAVA, but rather is a reminder of
19   other legal obligations. For more details, see http://www.access-board.gov/ada-aba.htm and
20   http://www.usdoj.gov/crt/ada/votingck.htm.
21
22
23   **2.   The voting process shall be accessible to voters with visual disabilities.**

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

26
27   **2.1   The Acc-VS shall be accessible to voters with partial vision.**

28
29
30
31   **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 appropriate testing authority according to the Common Industry Format (CIF).**

32
| V | Voting System Vendor |

| Pre-Voting | Voting | Post-Voting |

33
34   Discussion: This requirement is meant to encourage Acc-VS designers to
35   conduct some realistic usability tests on the final product. For

1 now, it is purely a documentation recommendation. Future
2 versions of the VVSG will include requirements for usability
3 testing to be conducted by the testing authority, with specific
4 performance benchmarks.

5

6 **2.1.2**   **The Acc-VS and any voting station with an electronic image display**
7 **shall be capable of showing all information in at least two font sizes,**
8 **(a) 3.0-4.0 mm and (b) 6.3-9.0 mm, under control of the voter or poll**
9 **worker.**

10 | V | Voting System Vendor

   | Pre-Voting | Voting | Post-Voting |

11

12 Discussion: While larger font sizes may assist most voters with poor
13 vision, certain disabilities such as tunnel vision are best
14 addressed by smaller font sizes. It is anticipated that future
15 versions of the VVSG will require font size to be under the
16 independent control of the voter.

17

18 **2.1.3**   **All voting stations using paper ballots should make provisions for**
19 **voters with poor reading vision.**

20 | V | Voting System Vendor

   | Pre-Voting | Voting | Post-Voting |

21

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

25 **2.1.4**   **An Acc-VS and any voting station with a black-and- white-only**
26 **electronic image display shall be capable of showing all information in**
27 **high contrast either by default or under the control of the voter or poll**
28 **worker. High contrast is a figure-to-ground ambient contrast ratio for**
29 **text and informational graphics of at least 6:1.**

30 | V | Voting System Vendor

   | Pre-Voting | Voting | Post-Voting |

31

32 Discussion: It is anticipated that future versions of the VVSG will require
33 contrast to be under the independent control of the voter.

1

2   **2.1.5**   **An Acc-VS with a color electronic image display shall allow the voter**
3   **or poll worker to adjust the color or the figure-to-ground ambient**
4   **contrast ratio.**

5 | V | Voting System Vendor

| Pre-Voting | Voting | Post-Voting |

6
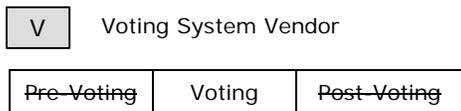
7   Discussion: See NASED Technical Guide #1 for examples of how a
8   voting station may meet this requirement by offering a limited
9   number of discrete choices. In particular, it is not required
10   that the station offer a continuous range of color or contrast
11   values.

12

13   **2.1.6**   **On all voting stations, the default color coding shall maximize correct**
14   **perception by voters and operators with color blindness.**

15 | V | Voting System Vendor

| Pre-Voting | Voting | Post-Voting |
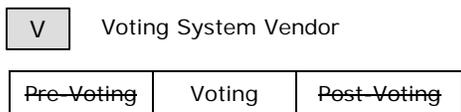
16
17
18   [***Best Practice for Voting Officials***] On all voting stations, the default color
19   coding maximizes correct perception by voters and operators with color
20   blindness.
21
22
23   **2.1.7**   **On all voting stations, color coding shall not be used as the sole means**
24   **of conveying information, indicating an action, prompting a response,**
25   **or distinguishing a visual element.**

26 | V | Voting System Vendor

| Pre-Voting | Voting | Post-Voting |
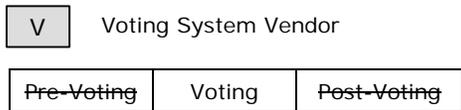
27
28   Discussion: This implies that although color can be used for emphasis,
29   some other non-color mode must also be used to convey the
30   information, such as a shape or text style. For example, red
31   can be enclosed in an octagon shape.

1
2   **2.1.8   Buttons and controls on all voting stations should be distinguishable by both shape and color.**
3

4 | V | Voting System Vendor |

         | Pre-Voting | Voting | Post-Voting |
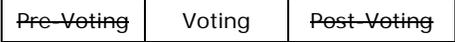
5
6   Discussion: The redundant cues have been found to be helpful to those
7   with partial vision.

8   **2.1.9   Any voting station using an electronic image display should also**
9   **provide synchronized audio output to convey the same information as**
10   **that on the screen.**

11 | V | Voting System Vendor |

         | Pre-Voting | Voting | Post-Voting |
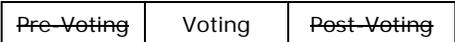
12
13   Discussion: Synchronized presentation of information in both visual and
14   aural modes is a recommendation in this version of the VVSG,
15   but it is anticipated that this will become a requirement in
16   future versions.

17   **2.2   The Acc-VS shall be accessible to voters who are blind.**

18   Discussion: Of course, many of the features under this requirement are also useful
19   for voters with partial vision (see requirement # 2.2.7.1.2.1) and for
20   voters who cannot read English for other reasons (see requirement #
21   2.2.7.2).

22   **2.2.1   The vendor should conduct summative usability tests on the Acc-VS**
23   **using subjects who are blind and report the test results to the**
24   **appropriate testing authority according to the Common Industry**
25   **Format (CIF).**

26 | V | Voting System Vendor |

         | Pre-Voting | Voting | Post-Voting |

27
28   Discussion: This requirement is meant to encourage Acc-VS designers to
29   conduct some realistic usability tests on the final product. For
30   now, it is purely a documentation recommendation. Future
31   versions of the VVSG will include requirements for usability

1   testing to be conducted by the testing authority, with specific
2   performance benchmarks.

3   **2.2.2   The Acc-VS shall provide an audio-tactile interface (ATI) that**
4   **supports the full functionality of a normal ballot interface, as specified**
5   **in Section 2.4.**

6 | V | Voting System Vendor

| Pre-Voting | Voting | Post-Voting |

7
8   Discussion: Note the necessity of both audio output and tactilely
9   discernible controls for voter input. Full functionality includes
10   at least:

11   • Instructions and feedback on initial activation of the ballot
12   (such as insertion of a smart card), if this is normally
13   performed by the voter on comparable voting stations,

14   • Instructions and feedback to the voter on how to operate the
15   Acc-VS, including settings and options (e.g. volume
16   control, repetition),

17   • Instructions and feedback for navigation of the ballot,

18   • Instructions and feedback for voter selections in races and
19   referenda, including write-in candidates,

20   • Instructions and feedback on confirming and changing
21   selections, and

22   • Instructions and feedback on final submission of ballot.
23

24   **2.2.2.1   The ATI of the Acc-VS shall provide the same capabilities to**
25   **vote and cast a ballot as are provided by the other voting**
26   **stations or by the visual interface of the Acc-VS. Therefore,**
27   **functional features that exceed the requirements of Section**
28   **2.4 must be provided on a non-discriminatory basis.**

29 | V | Voting System Vendor

| Pre-Voting | Voting | Post-Voting |

30

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.

| V | Voting System Vendor |

| Pre-Voting | Voting | Post-Voting |
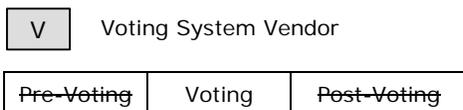
2.2.2.3   The ATI shall allow the voter to pause and resume the audio presentation.

| V | Voting System Vendor |

| Pre-Voting | Voting | Post-Voting |
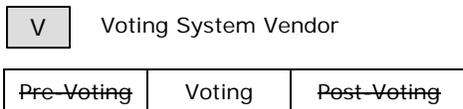
2.2.2.4   The ATI shall allow the voter to skip to the next contest or return to previous contests.

| V | Voting System Vendor |

| Pre-Voting | Voting | Post-Voting |
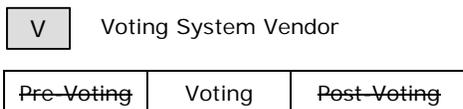
Discussion: This is analogous to the ability of sighted voters to move on to the next race once they have made a selection or to abstain from voting on a contest.

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

| V | Voting System Vendor |

| Pre-Voting | Voting | Post-Voting |
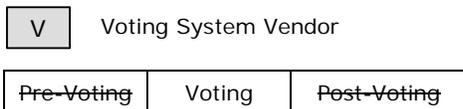
Discussion: This is analogous to the ability of sighted voters to skip over the wording of a referendum on which they have already made a decision prior to the voting session (e.g. "Vote yes on proposition

#123"). It is anticipated that this recommendation will become a requirement in future versions of the VVSG.

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.

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.**

| V | Voting System Vendor |

| ~~Pre-Voting~~ | Voting | ~~Post-Voting~~ |

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.**

| V | Voting System Vendor |

| ~~Pre-Voting~~ | Voting | ~~Post-Voting~~ |

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.**

1

V	Voting System Vendor

~~Pre-Voting~~	Voting	~~Post-Voting~~

2
3   Discussion: "Hearing devices" includes hearing aids and
4   cochlear implants.

5   **2.2.3.4   A sanitized headphone or handset should be made available**
6   **to each voter.**

7
8

V	Voting System Vendor

~~Pre-Voting~~	Voting	~~Post-Voting~~

9
10   Discussion: This requirement can be achieved in various ways,
11   including the use of "throwaway" headphones, or of
12   sanitary coverings.

13
14   [***Best Practice for Voting Officials***] A sanitized headphone or
15   handset is made available to each voter.
16
17

18   **2.2.3.5   The voting station shall set the initial volume for each voter**
19   **between 40 and 50 dB SPL.**

20

V	Voting System Vendor

~~Pre-Voting~~	Voting	~~Post-Voting~~

21
22   Discussion: A voter does not "inherit" the volume as set by the
23   previous user of the voting station.

24   **2.2.3.6   The voting station shall provide a volume control with an**
25   **adjustable amplification from a minimum of 20dB SPL up to**
26   **a maximum of 105 dB SPL, in increments no greater than**
27   **20dB.**

28

V	Voting System Vendor

~~Pre-Voting~~	Voting	~~Post-Voting~~

29
30

1
2

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

3

| V | Voting System Vendor |

| Pre-Voting | Voting | Post-Voting |

4
5

6
7

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

8

| V | Voting System Vendor |

| Pre-Voting | Voting | Post-Voting |

9
10   Discussion: Most users prefer real speech over synthesized
11   speech.

12
13
14

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

15

| V | Voting System Vendor |

| Pre-Voting | Voting | Post-Voting |

16
17   Discussion: Many blind voters are accustomed to interacting
18   with accelerated speech.

19
20
21
22

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.

23

24

| V | Voting System Vendor |

| Pre-Voting | Voting | Post-Voting |

25
26   Discussion: For example, smart cards might provide tactile cues so as to
27   allow correct insertion.

28

1   **2.2.5   If the normal procedure is for voters to submit their own ballots, then**
2   **the voting process should provide features that enable voters who are**
3   **blind to perform this submission.**

4 | V | Voting System Vendor

     | Pre-Voting | Voting | Post-Voting |
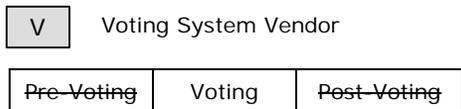
5
6   Discussion: For example, if voters normally feed their own optiscan
7   ballots into a reader, blind voters should also be able to do so.

8
9   [*Best Practice for Voting Officials*] If the normal procedure is for voters
10   to submit their own ballots, then the voting process provides features that
11   enable voters who are blind to perform this submission.
12
13

14   **2.2.6   If the normal procedure includes VVPAT, the Acc-VS should provide**
15   **features that enable voters who are blind to perform this verification.**

16 | V | Voting System Vendor

     | Pre-Voting | Voting | Post-Voting |
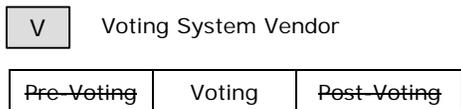
17
18   Discussion: For example, the Acc-VS might provide an automated reader
19   for the paper record that converts the contents of the paper into
20   audio output. It is anticipated that this recommendation will
21   become a requirement in future versions of the VVSG.

22   **2.2.7   All mechanically operated controls or keys on an Acc-VS shall be**
23   **tactilely discernible without activating those controls or keys.**

24 | V | Voting System Vendor

     | Pre-Voting | Voting | Post-Voting |

25
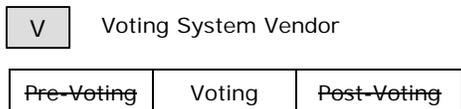
26   **2.2.8   On an Acc-VS, the status of all locking or toggle controls or keys (such**
27   **as the "shift" key) shall be visually discernible, and discernible either**
28   **through touch or sound.**

29 | V | Voting System Vendor

     | Pre-Voting | Voting | Post-Voting |

30
31
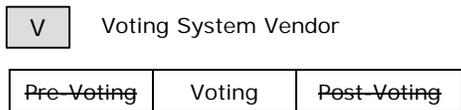
1 **3. The voting process shall be accessible to voters who lack fine motor control or the use of**
2 **their hands.**

3
4   **3.1   The vendor should conduct summative usability tests on the Acc-VS with**
5   **subjects lacking fine motor control and report the test results to the**
6   **appropriate testing authority according to the Common Industry Format**
7   **(CIF).**

8
9 | V | Voting System Vendor

     | Pre-Voting | ~~Voting~~ | ~~Post-Voting~~ |

10
11   Discussion: This requirement is meant to encourage Acc-VS designers to conduct
12   some realistic usability tests on the final product. For now, it is purely
13   a documentation recommendation. Future versions of the VVSG will
14   include requirements for usability testing to be conducted by the testing
15   authority with specific performance benchmarks.

16
17   **3.2   All keys and controls on the Acc-VS shall be operable with one hand and shall**
18   **not require tight grasping, pinching, or twisting of the wrist. The force**
19   **required to activate controls and keys shall be no greater 5 lbs. (22.2 N).**

20 | V | Voting System Vendor

     | ~~Pre-Voting~~ | Voting | ~~Post-Voting~~ |

21
22   Discussion: Controls are to be operable without excessive force.

23
24   **3.3   The Acc-VS controls shall not require direct bodily contact or for the body to**
25   **be part of any electrical circuit.**

26 | V | Voting System Vendor

     | ~~Pre-Voting~~ | Voting | ~~Post-Voting~~ |

27
28   Discussion: This requirement ensures that controls are operable by individuals
29   using prosthetic devices.

30

1   **3.4**   **The Acc-VS should provide a mechanism to enable non-manual input that is**
2   **functionally equivalent to tactile input.**

3 | V | Voting System Vendor |

~~Pre-Voting~~	Voting	~~Post-Voting~~

4
5   Discussion: This recommendation ensures that the Acc-VS is operable by
6   individuals who do not have the use of their hands. All the
7   functionality of the Acc-VS (e.g. straight party voting, write-in
8   candidates) that is available through the other forms of input, such as
9   tactile, must also be available through the input mechanism if it is
10   provided by the Acc-VS.

11
12 **4. The voting process shall be accessible to voters who use mobility aids, including**
13   **wheelchairs.**

14
15   **4.1**   **The Acc-VS shall provide a clear floor space of 30 inches (760 mm) minimum**
16   **by 48 inches (1220 mm) minimum for a stationary mobility aid. The clear**
17   **floor space shall be level with no slope exceeding 1:48 and positioned for a**
18   **forward approach or a parallel approach.**

19 | V | Voting System Vendor |

Pre-Voting	Voting	~~Post-Voting~~

20
21   [***Best Practice for Voting Officials***] The Acc-VS provides a clear floor space of 30
22   inches (760 mm) minimum by 48 inches (1220 mm) minimum for a stationary
23   mobility aid. The clear floor space is level with no slope exceeding 1:48 and
24   positioned for a forward approach or a parallel approach.
25
26
27   **4.2**   **All controls, keys, audio jacks and any other part of the Acc-VS necessary for**
28   **the voter to operate the voting system shall be within reach as specified under**
29   **the following sub-requirements.**

30 | V | Voting System Vendor |

Pre-Voting	Voting	~~Post-Voting~~

31
32   Discussion: All dimensions are given in inches. To convert to millimeters, multiply
33   by 25.4 and then round to the nearest multiple of 5. Note that these
34   sub-requirements have meaningful application mainly to controls in a

1   fixed location. A hand-held tethered control panel is another acceptable
2   way of providing reachable controls. All the sub-requirements inherit
3   the "responsible entity" and "process" properties.

4
5   [*Best Practice for Voting Officials*] All controls, keys, audio jacks and any other
6   part of the Acc-VS necessary for the voter to operate the voting system are within
7   the reach regions as specified in the VVSG Volume I, Section 2.2.7.1.4.3.
8
9
10   **4.2.1   If the Acc-VS has a forward approach with no forward reach
11   obstruction then the high reach shall be 48 inches maximum and the
12   low reach shall be 15 inches minimum. See Figure 2.2.7.1-1.**

13 | V | Voting System Vendor |

      | Pre-Voting | Voting | ~~Post-Voting~~ |
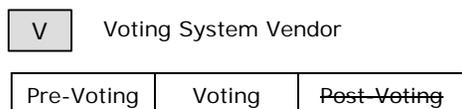
14
15
16   **4.2.2   If the Acc-VS has a forward approach with a forward reach
17   obstruction, the following sub-requirements apply. See Figure
18   2.2.7.1-2.**

19
20   **4.2.2.1   The forward obstruction shall be no greater than 25 inches in
21   depth, its top no higher than 34 inches and its bottom surface
22   no lower than 27 inches.**

23 | V | Voting System Vendor |

          | Pre-Voting | Voting | ~~Post-Voting~~ |
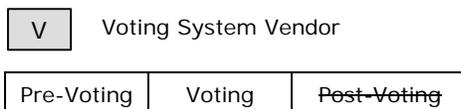
24
25   **4.2.2.2   If the obstruction is no more than 20 inches in depth, then
26   the maximum high reach shall be 48 inches, otherwise it shall
27   be 44 inches.**

28 | V | Voting System Vendor |

          | Pre-Voting | Voting | ~~Post-Voting~~ |

29
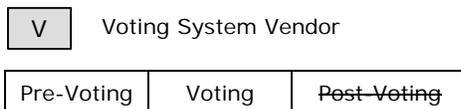
4.2.2.3 Space under the obstruction between the finish floor or ground and 9 inches (230 mm) above the finish floor or ground shall be considered toe clearance and shall comply with the following sub-requirements.

V	Voting System Vendor

Pre-Voting	Voting	~~Post-Voting~~

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

V	Voting System Vendor

Pre-Voting	Voting	~~Post-Voting~~

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.

V	Voting System Vendor

Pre-Voting	Voting	~~Post-Voting~~

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

V	Voting System Vendor

Pre-Voting	Voting	~~Post-Voting~~

4.2.2.4 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.

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

V	Voting System Vendor

Pre-Voting	Voting	~~Post-Voting~~

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.**

V	Voting System Vendor

Pre-Voting	Voting	~~Post-Voting~~

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.**

V	Voting System Vendor

Pre-Voting	Voting	~~Post-Voting~~

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.

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

V	Voting System Vendor

Pre-Voting	Voting	~~Post-Voting~~

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.**

V	Voting System Vendor

Pre-Voting	Voting	~~Post-Voting~~

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.**

1   **4.2.4.1   The side obstruction shall be no greater than 24 inches in**
2   **depth and its top no higher than 34 inches.**

3 | V | Voting System Vendor

   | Pre-Voting | Voting | ~~Post-Voting~~ |

4
5   **4.2.4.2   If the obstruction is no more than 10 inches in depth, then**
6   **the maximum high reach shall be 48 inches, otherwise it shall**
7   **be 46 inches.**

8 | V | Voting System Vendor

   | Pre-Voting | Voting | ~~Post-Voting~~ |

9
10   Discussion: Since this is a parallel approach, no clearance under
11   the obstruction is required.

12
13   **4.2.5   All labels, displays, controls, keys, audio jacks, and any other part of**
14   **the Acc-VS necessary for the voter to operate the voting system shall**
15   **be easily legible and visible to a voter in a wheelchair with normal**
16   **eyesight (no worse than 20/40, corrected) who is in an appropriate**
17   **position and orientation with respect to the Acc-VS.**

18 | V | Voting System Vendor

   | ~~Pre-Voting~~ | Voting | ~~Post-Voting~~ |

19
20   Discussion: There are a number of factors that could make relevant parts
21   of the Acc-VS difficult to see: small lettering, controls and
22   labels tilted at an awkward angle from the voter's viewpoint,
23   glare from overhead lighting, etc.

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

25   **5.1   The Acc-VS shall incorporate the features listed under requirement #**
26   **2.2.7.1.2.2.3 (audio presentation) to provide accessibility to voters with hearing**
27   **disabilities.**

28 | V | Voting System Vendor

   | ~~Pre-Voting~~ | Voting | ~~Post-Voting~~ |

29
30   Discussion: Note especially the requirements for volume initialization and control.

[*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.

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.**

V	Voting System Vendor

~~Pre-Voting~~	Voting	~~Post-Voting~~

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.

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

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

V	Voting System Vendor

~~Pre-Voting~~	Voting	~~Post-Voting~~

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.

V	Voting System Vendor

~~Pre-Voting~~	Voting	~~Post-Voting~~

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.

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

1
2
3
4
5   Figures for Accessibility
6
7
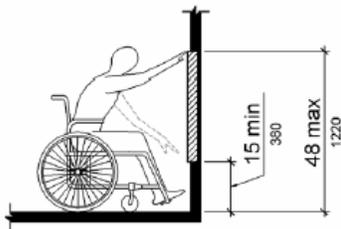
Figure 2.2.7.1-1
Unobstructed forward reach

Figure 2.2.7.1-2
Obstructed forward reach
(a) for an obstruction depth of up to 20 inches (508 mm)
(b) for an obstruction depth of up to 25 inches (635 mm)

Figure 2.2.7.1-3
Unobstructed side reach with an
allowable obstruction less than 10
inches (254 mm) deep.
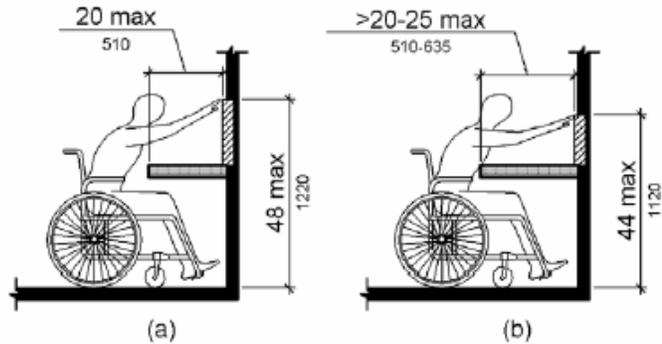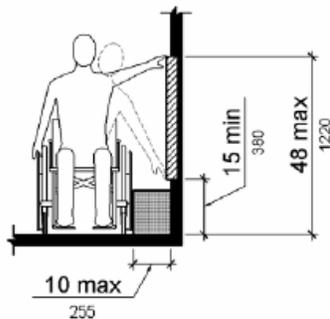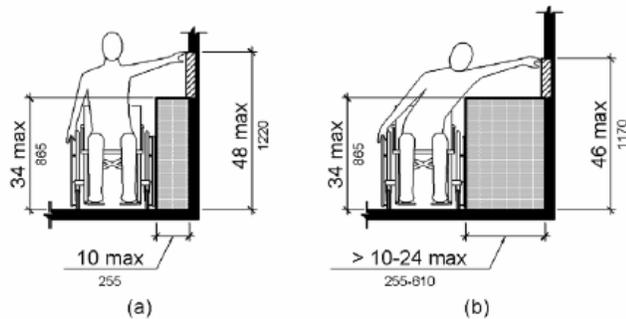

Figure 2.2.7.1-4
Obstructed side reach
(a) for an obstruction depth of up to 10 inches (254 mm)
(b) for an obstruction depth of up to 24 inches (610 mm)

8
9

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

7
8 HAVA Section 301 (a)(4) reads:

9
10   "ALTERNATIVE LANGUAGE ACCESSIBILITY.--The voting system shall provide
11   alternative language accessibility pursuant to the requirements of section 203 of the Voting
12   Rights Act of 1965 (42 U.S.C. 1973aa-1a)."

13
14 The requirements within Section 2.2.7.2 are intended to address this mandate. Ideally every
15 voter would be able to vote independently and privately, regardless of language. As a practical
16 matter, alternative language access is mandated under the Voting Rights Act of 1975, subject to
17 certain thresholds, e.g. if the language group exceeds 5% of the voting age citizens.

18
19 Note that the provision of an audio interface for people with visual disabilities as described in
20 Section 2.2.7.1 may also assist voters who speak English, but are unable to read it.

21
22 The outline for section 2.2.7.2 is:

23
24   2.2.7.2. Alternative Languages
25   2.2.7.2.1 Complete Information
26   2.2.7.2.2 Spelling of Names
27   2.2.7.2.3 Literate Voters
28   2.2.7.2.4 Illiterate Voters

29
30 **1. All the information presented in the normal case of English-literate voters (including**
31 **instructions, warnings, messages, and ballot choices) shall also be presented by the**
32 **ALVS, whether the language is written or spoken.**

33

V	Voting System Vendor

~~Pre-Voting~~	Voting	~~Post-Voting~~
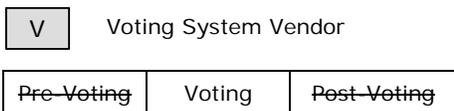
34
35   Discussion: This is in keeping with general requirement # 2.2.7.1.1.1.

36

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

5 | V | Voting System Vendor |

| ~~Pre-Voting~~ | Voting | ~~Post-Voting~~ |

6
7
8   [***Best Practice for Voting Officials***] Regardless of the language, candidate names are
9   displayed or pronounced in English on all ballots. For written languages that do not use
10 Roman characters (e.g., Chinese, Japanese, Korean, Arabic), the ballot includes
11 transliteration of candidate names into the relevant language.
12
13 **3. For literate voters, the ALVS shall provide printed or displayed instructions, messages,**
14 **and ballots in their preferred language, consistent with state and Federal law.**

15 | V | Voting System Vendor |

| ~~Pre-Voting~~ | Voting | ~~Post-Voting~~ |
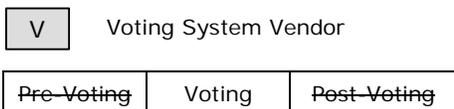
16
17
18 **3.1   The vendor should conduct summative usability tests on the ALVS with**
19 **literate subjects who neither speak nor read English and report the test results**
20 **according to the Common Industry Format (CIF).**
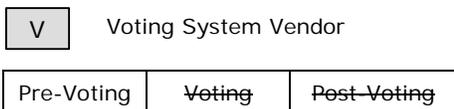
21 | V | Voting System Vendor |

| Pre-Voting | ~~Voting~~ | ~~Post-Voting~~ |

22
23 Discussion: This requirement is meant to encourage Acc-VS designers to conduct
24   some realistic usability tests on the final product. For now, it is purely
25   a documentation recommendation. Future versions of the VVSG will
26   include requirements for usability testing to be conducted by the testing
27   authority, with specific performance benchmarks.

28

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

5 | V | Voting System Vendor |

         | ~~Pre-Voting~~ | Voting | ~~Post-Voting~~ |
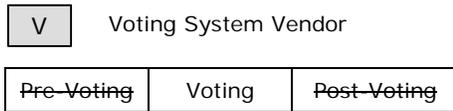
6
7   Discussion: Note that some languages have no widely accepted written form.

8
9 **3.   The voting process shall provide a high level of usability to the voters.**
10   **Accordingly, voters shall be able to negotiate the process effectively,**
11   **efficiently, and comfortably.**

12
13 Discussion: The first Voting System Standards codified in HAVA relate to the interaction
14 between the voter and the voting system. HAVA Section 301 begins:

15
16   "SEC. 301. VOTING SYSTEMS STANDARDS.

17
18   a. Requirements.--Each voting system used in an election for Federal office shall meet the
19   following requirements:
20   1. In general.--

21
22   A. Except as provided in subparagraph (B), the voting system (including any lever
23   voting system, optical scanning voting system, or direct recording electronic system)
24   shall--

25
26   i. Permit the voter to verify (in a private and independent manner) the votes
27   selected by the voter on the ballot before the ballot is cast and counted;

28
29   ii. Provide the voter with the opportunity (in a private and independent
30   manner) to change the ballot or correct any error before the ballot is cast and
31   counted (including the opportunity to correct the error through the issuance of
32   a replacement ballot if the voter was otherwise unable to change the ballot or
33   correct any error); and

34
35   iii. If the voter selects votes for more than one candidate for a single office—

36
37   I. Notify the voter that the voter has selected more than one candidate for
38   a single office on the ballot;
39

1   II. Notify the voter before the ballot is cast and counted of the effect of
2   casting multiple votes for the office; and
3
4   III. Provide the voter with the opportunity to correct the ballot before the
5   ballot is cast and counted.
6
7   B. A State or jurisdiction that uses a paper ballot voting system, a punch card voting
8   system, or a central count voting system (including mail-in absentee ballots and
9   mail-in ballots), may meet the requirements of subparagraph (A)(iii) by—
10
11   i. Establishing a voter education program specific to that voting system that
12   notifies each voter of the effect of casting multiple votes for an office; and
13
14   ii. Providing the voter with instructions on how to correct the ballot before it is
15   cast and counted (including instructions on how to correct the error through the
16   issuance of a replacement ballot if the voter was otherwise unable to change
17   the ballot or correct any error).
18
19   C. The voting system shall ensure that any notification required under this paragraph
20   preserves the privacy of the voter and the confidentiality of the ballot."
21
22   The requirements of this section supplement these basic HAVA mandates and also HAVA's
23   support for improved usability (see Section 243 and Section 221 (e)(2)(D)).
24
25   VOTING AND USABILITY
26
27   Usability is defined generally as a measure of the effectiveness, efficiency, and satisfaction
28   achieved by a specified set of users with a given product in the performance of specified tasks.
29   In the context of voting, the primary users are the voters (but also poll workers), the product is
30   the voting system, and the task is the correct representation of one's choices in the election.
31   Additional requirements for task performance are independence and privacy: the voter should
32   normally be able to complete the voting task without assistance from others (although the voting
33   system itself may offer help), and the voter's choices should be private (see Section 2.2.7.4).
34   Aside from its intrinsic undesirability, lack of independence or privacy may adversely affect
35   effectiveness (e.g. by possibly inhibiting the voter's free choice) and efficiency (e.g. by slowing
36   down the process).
37
38   Among the "bottom-line" metrics for usability are:
39
40   •   low error rate for marking the ballot (the voter's intention is correctly conveyed to and
41   represented within the voting system),
42
43   •   efficient operation (time required to vote is not excessive), and
44

1   • satisfaction (voter experience is safe, comfortable, free of stress, and instills confidence).
2
3   These criteria define the core of good voting system usability. The purpose of the detailed
4   requirements listed below is to help voting systems meet the core criteria.
5
6
7   METHODOLOGY FOR REQUIREMENTS
8
9   It is the intention of the TGDC that in forthcoming versions of the VVSG, usability will be
10   addressed by high-level performance-based requirements. That is, the requirements will directly
11   address metrics for effectiveness (e.g. correct capture of voters' intentions), efficiency (e.g. time
12   taken to vote), and satisfaction. Until the supporting research is completed, however, the
13   contents of this subsection are limited to a somewhat basic set of widely accepted design
14   requirements and lower-level performance requirements. The reasons for this approach are:
15
16   • These are to serve as interim requirements, pending the issuance of high-level
17   performance requirements.
18
19   • The actual benefit of numerous detailed design guidelines is difficult to prove or measure.
20
21   • The technical complexity and costs of a large set of detailed requirements may not be
22   justified.
23
24   • Guidelines that are difficult to test because of insufficient specificity have been omitted.
25
26   This is not to say that an extensive set of design guidelines is without value. But we wish to
27   distinguish between good advice to be considered by developers and strict requirements that will
28   be enforced by a regime of formal testing. For more detail on the issue of design vs.
29   performance standards, see Sections 2.3 and 6.1 et al. of NIST Special Publication 500-256:
30   Improving the Usability and Accessibility of Voting Systems and Products
31   (http://vote.nist.gov/Final%20Human%20Factors%20Report%20%205-04.pdf).
32
33   GENERAL ISSUES FOR THE USABILITY REQUIREMENTS
34
35   As mentioned in Section 2.2.7.1, many of the guidelines in this section enhance accessibility as
36   well as general usability.
37
38   The scope of usability includes the entire voting process, although the emphasis herein is on the
39   interface between the voter and the voting station.
40
41   The requirements in this sub-section generally assume a visual-tactile interface, but also see
42   requirements in Sections 2.2.7.1 and Section 2.2.7.2 for alternative formats, including audio.
43

1   The outline for Section 2.2.7.3 is:
2
3   2.2.7.3. Usability
4   2.2.7.3.1 Usability Testing by Vendor
5   2.2.7.3.2 Functional Capabilities
6   2.2.7.3.3 Cognitive Issues
7   2.2.7.3.4 Perceptual Issues
8   2.2.7.3.5 Interaction Issues
9
10
11   **1. The vendor should conduct summative usability tests on the voting system using**
12   **subjects representative of the general population and report the test results to the**
13   **appropriate testing authority according to the Common Industry Format (CIF).**

14 | V | Voting System Vendor

         | Pre-Voting | ~~Voting~~ | ~~Post-Voting~~ |

15
16   Discussion: This requirement is meant to encourage Acc-VS designers to conduct
17   some realistic usability tests on the final product. For now, it is purely
18   a documentation recommendation. Future versions of the VVSG will
19   include requirements for usability testing to be conducted by the testing
20   authority, with specific performance benchmarks.

21
22   **2. The voting process shall provide certain functional capabilities to support voter**
23   **usability.**

24
25   **2.1   As mandated by HAVA 301 (a)(1)(A), the voting system shall support a**
26   **process that allows the voter to review his or her completed ballot before final**
27   **submission in order to verify that it correctly represents the intended vote and**
28   **to correct the ballot if mistakes are detected.**

29 | V | Voting System Vendor

         | ~~Pre-Voting~~ | Voting | ~~Post-Voting~~ |

30
31   Discussion: Note that this review and correction may be achieved by procedural
32   means (e.g. in the case of paper ballots), as well as technical (see
33   HAVA 301 (a)(1)(B)). This requirement is a brief paraphrase of the
34   HAVA language but of course the statutory language is determinative.

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

5 | V | Voting System Vendor

| ~~Pre-Voting~~ | Voting | ~~Post-Voting~~ |

6
7   Discussion: Note that this notification and correction may be achieved by
8   procedural means (e.g. in the case of paper ballots), as well as technical
9   (see HAVA 301 (a)(1)(B)). This requirement is a brief paraphrase of
10   the HAVA language but of course the statutory language is
11   determinative.

12   **2.3**   **DRE voting stations shall allow the voter to change a vote within a race before**
13   **advancing to the next race.**

14 | V | Voting System Vendor

| ~~Pre-Voting~~ | Voting | ~~Post-Voting~~ |

15
16   Discussion: The point here is that voters using a DRE should not have to wait for
17   the final ballot review in order to change a vote.

18   **2.4**   **The voting system shall support a process that notifies the voter if he or she**
19   **has attempted to vote for fewer candidates than the maximum permitted in a**
20   **given race and that provides the voter with the opportunity to change the**
21   **ballot before final submission. The process shall also notify the voter that such**
22   **an "undervote" is permitted and shall accept a ballot if the voter so chooses.**

23 | V | Voting System Vendor

| ~~Pre-Voting~~ | Voting | ~~Post-Voting~~ |

24
25   Discussion: Note that this notification and correction may be achieved by
26   procedural means (e.g. in the case of paper ballots), as well as technical
27   (see HAVA 301 (a)(1)(B)).

1
2
3
4
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 the completing a vote on the race or races currently being presented (whether visually or aurally).

5
| V | Voting System Vendor |

| Pre-Voting | Voting | Post-Voting |

6
7
8
9
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.

10
11
3. The voting process shall be designed to minimize cognitive difficulties for the voter.

12
13
14
15
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.

16
| V | Voting System Vendor |

| Pre-Voting | Voting | Post-Voting |

17
18
19
20
21
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.

22
23
24
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.

25
Discussion: Voters should not routinely need to ask for human assistance.

26
27
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.

28
| V | Voting System Vendor |

| Pre-Voting | Voting | Post-Voting |

29
30
31
Discussion: The voter should always be able to get help at the station if confused. DRE voting stations may provide this with a

1   distinctive "help" button. Any type of voting station may
2   provide written instructions that are available and separate
3   from the ballot. Note special requirements for the Acc-VS in
4   requirement # 2.2.7.1.2.2.2 (Acc-VS/ATI).

6   **3.2.2   The voting station shall provide instructions for all its valid**
7   **operations.**

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

15   **3.3   The voting system shall provide the capability to design a ballot for maximum**
16   **clarity and comprehension.**

18   **3.3.1   The voting station should not visually present a single race spread**
19   **over two pages or two columns.**

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

27   [*Best Practice for Voting Officials*] The voting station does not visually
28   present a single race spread over two pages or two columns.

1
2

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

3

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4
5
6   [*Best Practice for Voting Officials*] The ballot clearly indicates the
7   maximum number of candidates for which one can vote within a single
8   race.
9
10

11
12

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

13

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14
15   Discussion: For example, if the response field where voters indicate their
16   selections is located to the left of a candidate's name, then
17   each response field shall be located to the left of the associated
18   candidate's names.

19
20   [*Best Practice for Voting Officials*] The ballot presents the relationship
21   between the name of a candidate and the mechanism used to vote for that
22   candidate in a consistent manner.
23
24

25
26
27
28

3.4   Warnings and alerts issued by the voting station 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.

29

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30
31   Discussion: In case of an equipment failure, the only action available to the voter
32   might be to get assistance from a poll worker.

3.5   The use of color by the voting station 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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| ~~Pre-Voting~~ | Voting | ~~Post-Voting~~ |

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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| ~~Pre-Voting~~ | Voting | ~~Post-Voting~~ |

Discussion: This implies that the voting station presents the same initial appearance to every voter (excluding, of course, substantive differences in the ballot content due to residence or party of the voter).

4.3   If any aspect of a voting station is adjustable by the voter, there should be a mechanism to reset all such aspects to their default values.

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| ~~Pre-Voting~~ | Voting | ~~Post-Voting~~ |

Discussion: The purpose is to allow a voter who has adjusted the station into an undesirable state to reset all the aspects so as to get a fresh start.

1   **4.4   The minimum font size for all text intended for the voter during the voting**
2   **session shall be 3.0mm (measured as the height of a capital letter).**

3 | V | Voting System Vendor |

     | Pre-Voting | Voting | Post-Voting |

4
5   **4.5   All text intended for the voter during the voting session should be presented in**
6   **a sans serif font.**

7 | V | Voting System Vendor |

     | Pre-Voting | Voting | Post-Voting |

8
9   Discussion: Experimentation has shown that users prefer such a font and the
10   legibility of serif and sans serif fonts is equivalent.

11   **4.6   The minimum figure-to-ground ambient contrast ratio for all text and**
12   **informational graphics (including icons) intended for the voter shall be 3:1.**

13 | V | Voting System Vendor |

     | Pre-Voting | Voting | Post-Voting |

14
15
16   **5. The voting process shall be designed to minimize interaction difficulties for the voter.**

17
18   **5.1   Voting stations with electronic image displays shall not require page scrolling**
19   **by the voter.**

20 | V | Voting System Vendor |

     | Pre-Voting | Voting | Post-Voting |

21
22   Discussion: This is not an intuitive operation for those unfamiliar with the use of
23   computers. Even those experienced with computers often do not notice
24   a scroll bar and miss information below the page. DREs may require
25   voters to move to the next or previous "page."

1 **5.2**   **The voting station shall provide unambiguous feedback regarding the voter's**
2   **selection, such as displaying a checkmark beside the selected option or**
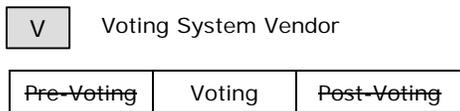3   **conspicuously changing its appearance.**

4 | V | Voting System Vendor

              | Pre-Voting | Voting | Post-Voting |
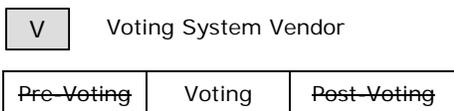
5
6
7 **5.3**   **If the voting station requires a response by a voter within a specific period of**
8   **time, it shall issue an alert at least 20 seconds before this time period has**
9   **expired and provide a means by which the voter may receive additional time.**
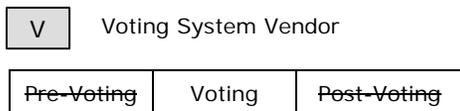10

11 | V | Voting System Vendor

              | Pre-Voting | Voting | Post-Voting |
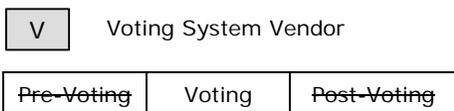
12
13
14 **5.4**   **Input mechanisms shall be designed so as to minimize accidental activation**
15   **(also, see requirement # 2.2.7.1.2.2.7 on tactile discernability).**

16   **5.4.1**   **On touch screens, the sensitive touch areas shall have a minimum**
17   **height of 0.5 inches and minimum width of 0.7 inches. The vertical**
18   **distance between the centers of adjacent areas shall be at least 0.6**
19   **inches, and the horizontal distance at least 0.8 inches.**

20 | V | Voting System Vendor

                 | Pre-Voting | Voting | Post-Voting |

21
22   **5.4.2**   **No key or control on a voting station shall have a repeat feature**
23   **enabled.**

24 | V | Voting System Vendor

                 | Pre-Voting | Voting | Post-Voting |

25
26   Discussion: This is to preclude accidental activation.

27

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

3
4 Discussion: Voter privacy is strongly supported by HAVA - see Sections 221 (e)(2)(C) and 301
5 (a)(1). In this subsection, we address only privacy concerns in relation to human factors issues,
6 but not with respect to the processing of cast ballots.
7
8 Although elections in American history have sometimes been public (and certain "town-hall"
9 questions are still voted openly), the use of the secret ballot for political office is now universal.
10
11 Privacy in this context, including the property of the voter being unable to disclose his or her
12 vote, ensures that the voter can make choices based solely on his or her own preferences without
13 intimidation or inhibition.   Among other practices, this forbids the issuance of a receipt to the
14 voter that would provide proof to another how he or she voted.
15
16 The outline for Section 2.2.7.4 is:
17
18   2.2.7.4 Privacy
19   2.2.7.4.1 Privacy at the polling place
20   2.2.7.4.2 No preservation of alternative formats
21   2.2.7.4.3 Absentee Balloting
22
23 **1. The voting station and polling place shall be configured so as to prevent others from**
24 **learning the contents of a voter's ballot.**
25

26   **1.1   The ballot and any input controls shall be visible only to the voter during the**
27   **voting session and ballot submission.**

28 | V | Voting System Vendor

            | ~~Pre-Voting~~ | Voting | ~~Post-Voting~~ |
29
30   [***Best Practice for Voting Officials***] The ballot and any input controls are visible
31   only to the voter during the voting session and ballot submission. Poll workers need
32   to take into account such factors as visual barriers, windows, permitted waiting areas
33   for other voters, and procedures for ballot submission when not performed at the
34   voting station, e.g. submission of optiscan ballots to a central reader.
35

1   **1.2   The audio interface shall be audible only to the voter.**

2 | V | Voting System Vendor

          | Pre-Voting | Voting | Post-Voting |

3
4   Discussion: Voters who are hard of hearing but need to use an audio interface may
5   also need to increase the volume of the audio. Such situations require
6   headphones with low sound leakage.

7
8   [***Best Practice for Voting Officials***] The audio interface is audible only to the voter.
9
10
11   **1.3   As mandated by HAVA 301 (a)(1)(C), the voting system shall notify the voter**
12   **of an attempted overvote in a way that preserves the privacy of the voter and**
13   **the confidentiality of the ballot.**

14 | V | Voting System Vendor

          | Pre-Voting | Voting | Post-Voting |

15
16   Discussion: This requirement is a brief paraphrase of the HAVA language but of
17   course the statutory language is determinative.

18
19   [***Best Practice for Voting Officials***] As mandated by HAVA 301 (a)(1)(C), the
20   voting system notifies the voter of an attempted overvote in a way that preserves the
21   privacy of the voter and the confidentiality of the ballot.
22
23
24   **2. Voter anonymity shall be maintained for alternative format ballot presentation.**
25

26   **2.1   No information shall be kept within a non-paper-based Cast Vote Record that**
27   **identifies any accessibility feature(s) used by a voter.**
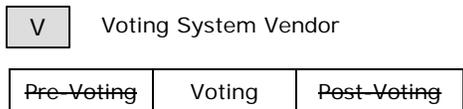
28 | V | Voting System Vendor

          | Pre-Voting | Voting | Post-Voting |

29
30   Discussion: Large-print paper ballots unavoidably preserve such information.

31

1   **2.1.1   No information shall be kept within a non-paper-based Cast Vote**
2   **Record that identifies any alternative language feature(s) used by a**
3   **voter.**

4

| V | Voting System Vendor |

| Pre-Voting | Voting | Post-Voting |

5

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

8

9   [*Best Practice for Voting Officials*] Appropriate procedures are needed to ensure
10   that absentee balloting enable the voter to preserve privacy. There is no practical
11   means to prevent a voter from revealing an absentee paper ballot to others. But the
12   procedures should ensure that if a voter chooses to maintain privacy, it is not violated
13   at a later stage, in particular when the ballot is received by voting officials.