

# VVSG 2.0

## Human Factors Requirements

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August 5, 2019

## Overview

# VVSG 2.0 Human Factors Requirements

- NIST HF Public Working Group consensus
- Voter and election worker interaction with the voting system
- Usability, accessibility, privacy while voting
- Paper only as part of the voting system (e.g., accessibility of verifying, not paper ballot design per se)
- Updated and less-prescriptive than VVSG 1.1
  - >10 years of voting & human factors research
  - Current practice in voting systems
  - Reports of problems in real elections

## Overview (continued)

# VVSG 2.0 Human Factors Requirements

- All voter interfaces must meet ALL applicable human factors requirements
  - VVSG 1.0, 1.1 made a distinction between accessible and non-accessible electronic voting systems based on the products and state of the art in 2005
- Harmonized with current federal accessibility standards
  - Section 508, Web Content Accessibility Guidelines, etc.
- Organized according to the widely-accepted accessibility POUR principles
  - Perceivable, Operable, Understandable, and Robust
- Addresses all **modes** of interaction
  - Visual, enhanced visual, audio, tactile, non-manual, limited dexterity control

# Organization and Structure of Requirements

- Number and title
- Normative text, may include scope
- Optional informative discussion field
- Optional informative fields for source and applicability

## 8.1-B – Flashing

If the voting system emits lights in flashes, there must be no more than three flashes in any one-second period.

### Discussion

This requirement has been updated to meet WCAG 2.0 and Section 508 software design issue standards.

External references: WCAG 2.0/Section 508

Prior VVSG sources: VVSG 1.1 - 3.2.5.a.i

Applies to: Electronic interfaces

## Principle 5

### Equivalent and Consistent Voter Access

**All voters can access and use the voting system regardless of their abilities, without discrimination.**

- 12 requirements
- Ensure that all voters have the ability to cast their votes easily and accurately, regardless of any disabilities they may have. HAVA Section 301(a)(3)
- Consistent: same mode of presentation throughout the voting process
- Equivalent across modes, without bias

## Principle 5 (Continued)

### Equivalent and Consistent Voter Access

- All modes of interaction and presentation applied throughout the voting session, fully supporting accessibility for voters with a wide range of disabilities
  - Session: Mark, Review, Verify, Cast
  - Modes:
    - Visual
    - Enhanced visual
    - Audio
    - Tactile
    - Non-manual
    - Limited dexterity control

## Guideline 5.1 – Examples\*

**Voters have a consistent experience throughout the voting process in all modes of voting.**

**5.1-A – Interaction modes** All interaction modes including audio, tactile, enhanced visual, and non-manual must have the same capabilities as the visual interaction mode including ballot activation, voting, verification, and casting.

**5.1-E – Reading paper ballots** If the voting system generates a paper record (or some other durable, human-readable record) that can be the official ballot or determinative vote record, then the voting system must allow the voter to verify that the paper record uses the same access features they used to mark the ballot, including audio, tactile, enhanced visual, and non-manual.

\* See VVSG 2.0 requirements documents for complete set. Only examples will be shown in this briefing

## Guideline 5.2

### **Voters receive equivalent information and options in all modes of voting.**

**5.2.A – No bias** The voting system must not introduce bias for or against any of the contest options presented to the voter. In audio, tactile, enhanced visual, and non-manual modes, all ballot options are to be presented in an equivalent manner.

**5.2-C – All information in all modes** All instructions, warnings, messages, notifications of undervotes or overvotes, and contest options must be presented to voters in all interaction modes for all functions. This includes ballot activation, voting, verification, and casting.

**5.2-E – Sound cues** Sound and visual cues must be coordinated so that:

- Sound cues are accompanied by visual cues unless the system is in audio-only mode.
- Visual cues are accompanied by sound cues, unless the system is in visual-only mode.

## Principle 6

### Voter Privacy

**Voters can mark, verify, and cast their ballot privately and independently.**

- 5 requirements
- Distinguishes voter privacy from ballot secrecy
- Privacy for voters refers to the property of a voting system that is designed and deployed to enable voters to obtain a ballot, and mark, verify, and cast it without revealing their ballot selections or selections of language, display, and interaction modes to anyone else.

## Guideline 6.1

**The voting process preserves the privacy of the voter's interaction with the ballot, modes of voting, and vote selections.**

**6.1-A – Preserving privacy for voters** Privacy for voters must be preserved during the entire voting session including ballot activation, voting, verifying, and casting the ballot.

**6.1-B – Warnings** The voting system must issue all warnings in a way that preserves privacy for voters and the confidentiality of the ballot.

**6.1-C – Enabling or disabling output** The voting system must make it possible for the voter to independently enable or disable either the audio or the video output and be notified of the change, resulting in a video-only or audio-only presentation.

## Guideline 6.2

**Voters can mark, verify, and cast their ballot or other associated cast vote record without assistance from others.**

**6.2-A - Voter Independence** Voters must be able to mark, verify, and cast their ballot or other associated cast vote record independently and without assistance from others.

## Principle 7

### Marked, Verified, and Cast as Intended

**Ballots and vote selections are presented in a perceivable, operable, and understandable way and can be marked, verified, and cast by all voters.**

- 50 requirements
- Derived from Federal laws:
  - Help America Vote Act (HAVA)
  - Section 508
  - Web Content Accessibility Guidelines (WCAG)
  - Voting Rights Act

## Principle 7 (Continued)

### Marked, Verified, and Cast as Intended

- Core actions of operating the voting system
- How ballot information is presented using audio and visual settings
  - The voter's ability to adjust the voting system to meet their needs or preferences
  - Includes using color and contrast, adjusting font size, and ensuring audio settings result in understandable speech
- The interaction with and control of the ballot during voting, including how the information is displayed and the voter's ability to navigate the system
  - Scrolling through the electronic ballot
  - Use of audio and touch controls, and simple gestures
  - Need for adequate space for those who use wheelchairs
  - Both voters and election workers can use controls accurately

## Principle 7 (Continued)

### Marked, Verified, and Cast as Intended

- Ability of the voter to understand all information on the ballot as it is presented, including instructions and messages from the system
- Preventing contest layouts that can cause confusion
- Making clear the maximum number of choices a voter has, notifying the voter of any errors on the ballot (such as overvotes) before it is cast
- Letting the voter know when they have successfully voted
- Ensuring that instructions for election workers are understandable

## Guideline 7.1

**The default voting system settings for displaying the ballot work for the widest range of voters, and voters can adjust settings and preferences to meet their needs.**

**7.1-C – Default contrast** The default contrast ratio must be at least 10:1 for all elements that visually convey information such as text, controls, and infographics or icons.

1. For electronic displays for voters and election workers, this is measured as a luminosity contrast ratio between the foreground and background colors of at least 10:1.
2. For paper ballots and other paper records, the contrast ratio will be at least 10:1 as measured based on ambient lighting of at least 300 lx.

## Guideline 7.1 (Continued)

**7.1-G – Text size (electronic display)** A voting system's electronic display must be capable of showing all information in a range of text sizes that voters can select from, with a default text size at least 4.8 mm (based on the height of the uppercase I), allowing voters to both increase and decrease the text size.

The voting system may meet this requirement in one of the following ways:

1. Provide continuous scaling with a minimum increment of .5 mm that covers the full range of text sizes from 3.5 mm to 9.0 mm.
2. Provide at least four discrete text sizes, in which the main ballot options fall within one of these ranges.
  - a. 3.5-4.2 mm (10-12 points)
  - b. 4.8-5.6 mm (14-16 points)
  - c. 6.4-7.1 mm (18-20 points)
  - d. 8.5-9.0 mm (24-25 points)

## Guideline 7.1 (Continued)

**7.1-H – Scaling and zooming (electronic display)** When the text size is changed, all other information in the interface, including informational icons, screen titles, buttons, and ballot marking target areas, must change size to maintain a consistent relationship to the size of the text. Informational elements in the interface do not have to be scaled beyond the size of the text.

1. When the text is enlarged up to 200% (or 7.1 mm text size), the ballot layout must adjust so that there is no horizontal scrolling or panning of the screen.
2. When the text is enlarged more than 200%, there may be horizontal scrolling or panning if needed to maintain the layout of the ballot and a consistent relationship between the text for ballot options and associated marking targets.

## Guideline 7.1 (Continued)

**7.1-L – Speech frequencies** The voting system's audio format interface must be able to reproduce frequencies over the audible speech range of 315 Hz to 10 KHz.

### **7.1-P – Identifying controls**

Buttons and controls that perform different navigation or selection functions must be distinguishable by both shape and color for tactile and visual perception.

Well-known arrangements of groups of keys may be used only for their primary purpose. For example, a full alphabetic keyboard is acceptable for entering a write-in candidate name, but individual keys cannot be used for navigation or selection.

## Guideline 7.2

**Voters and election workers can use all controls accurately, and voters have direct control of all ballot changes.**

**7.2-B – Navigation between contests** The electronic ballot interface must provide navigation controls that allow the voter to advance to the next contest or go back to the previous contest before completing their vote.

## Guideline 7.2 (Continued)

**7.2-C – Voter control** An electronic ballot interface must give voters direct control over making or changing vote selections within a contest:

1. In a vote-for-one contest, selecting a candidate may deselect a previously selected candidate, but the system must announce the change in audio and visual display.
2. In a vote-for-N-of-M contest, the system must not deselect any candidate automatically.
3. In a vote-for-N-of-M contest, the system must inform the voter that they have attempted to make too many selections and offer an opportunity to change their selections.
4. Ballot options intended to select a group of candidates, such as straight-party voting, must provide clear feedback on the result of the action of selecting this option.
5. Ballots with preferential or ranking voting methods must not re-order candidates except in response to an explicit voter command.

## Guideline 7.2 (Continued)

**7.2-E – Touchscreen gestures** Voting systems with a touch screen may use touchscreen gestures (physical movements by the user while in contact with the screen to activate controls) in the interface if the following conditions are met:

1. Gestures are offered as another way of interacting with a touch screen and an optional alternative to the other interaction modes.
2. Gestures are limited to simple, well-known gestures.
3. Gestures do not include navigation off the current contest.
4. Gestures are used in a way that does not create accidental activation of an action through an unintended gesture.
5. Gestures work consistently across the entire voting interaction.
6. Gestures do not require sequential, timed or simultaneous actions.

## Guideline 7.2 (Continued)

**7.2-Q – Physical dimensions** The physical dimensions of the voting station must meet the U.S. Access Board requirements in Appendix A to Part 1194 – Section 508 of the Rehabilitation Act: Application and Scoping Requirements, Chapter 4: Hardware, Section 407.8 Operable Parts: Reach Height and Depth.

**7.2-R – Control labels visible** Control labels must be placed:

1. on a surface of the voting system where voters can see them from a normal seated or standing posture, and
2. within the dimensions required in 7.2-Q – Physical Dimensions.

## Guideline 7.3

**Voters can understand all information as it is presented, including instructions, messages from the system, and error messages.**

**7.3-A – System-related errors** The voting system must help voters complete their ballots effectively, ensuring that the features of the system do not lead to voters making errors during the voting session.

## Guideline 7.3 (Continued)

**7.3-G – Full ballot selections review** A voting system with an electronic voting interface must provide the voter with a function to review their selections before printing or casting their ballot that:

1. displays all of the contests on the ballot with:
  - the voter's selections for that contest, or
  - a notification that they have not made an election, or
  - a notification that they have made fewer selections than allowed, and
2. offers an opportunity to change the selections for a contest and return directly to the review screen to see the results of that change, and
3. allows the voter to continue to the function for casting the ballot without making a correction at any time in the review process.

The review function may also be provided on a scanner or other device where the voter casts a paper ballot.

## Guideline 7.3 (Continued)

**7.3-M – Identifying languages** When presenting a list of languages to the voter:

1. the electronic ballot interface must use the native name of each language, and
2. the controls to identify or change language must be visible on the screen, not hidden in a help or settings feature.

**7.3-P – Plain language** Information and instructions for voters and election workers must be written clearly, following the best practices for plain language. This includes messages generated by the voting system for election workers in support of the operation, maintenance, or safety of the system.

## Principle 8

### Robust, Safe, Usable, and Accessible

**The voting system and voting processes provide a robust, safe, usable, and accessible experience.**

- 14 requirements
- Covers how the voting system performs in use, including physical safety and the usability and accessibility of the complete voting system.
- Refers to Federal standards for accessibility
- Includes testing for usability

## Guideline 8.1

**The voting system's hardware and accessories protect users from harmful conditions.**

**8.1-B – Flashing** If the voting system emits lights in flashes, there must be no more than three flashes in any one-second period.

**8.1-C – Personal Assistive Technology (PAT)** The support provided to voters with disabilities must be intrinsic to the voting system. This means a voter's personal assistive devices will not be necessary to operate the voting system correctly. This does not apply to personal assistive technology required to comply with 5.1-A.

**8.1-F – Discernable audio jacks** The audio jack must be in a location that voters can easily discover, discernable by touch while sitting or standing in front of the unit, and not located near a sharp edge.

## Guideline 8.1 (continued)

**8.1-J – Hearing aids** Voters who use assistive hearing devices must be able to use voting devices as intended:

1. The voting device must not cause electromagnetic interference with assistive hearing devices that would substantially degrade the performance of those devices.
2. The voting device, measured as if it were a wireless device, must achieve at least a category T4 rating as defined by American National Standard [ANSI01] for Methods of Measurement of Compatibility between Wireless Communications Devices and Hearing Aids, ANSI C63.19.

**8.1-K – Eliminating hazards** Devices associated with the voting system must be certified in accordance with the requirements of UL 60950-1, Information Technology Equipment – Safety – Part 1 by a certification organization accredited by the Department of Labor, Occupational Safety and Health Administration’s Nationally Recognized Testing Laboratory program.

## Guideline 8.2

**8.2 – The voting system meets currently accepted federal standards for accessibility.**

**8.2-A – Federal standards for accessibility** Voting systems must meet federal standards for accessibility, including the current version of Section 508 of the Rehabilitation Act, in effect as of January 18, 2018, and the WCAG 2.0 Level AA checkpoints included in that standard.

## Guideline 8.3

**8.3 – The voting system is measured with a wide range of representative voters, including those with and without disabilities, for effectiveness, efficiency, and satisfaction.**

### **8.3-A – Usability tests with voters**

1. The manufacturer must conduct usability tests on the voting system, including all voter activities in a voter session from ballot activation to verification and casting.
  - The test participants must include voters who represent the following:
    - General population, using the visual interface
    - Voters who speak all supported languages as their primary language
    - Blind voters, using the audio format plus tactile controls
    - Voters with low vision, using the enhanced visual features with or without audio
    - Voters with limited dexterity, using the visual-tactile interface
2. The manufacturer must submit a report of the results of their usability tests as part of the Technical Data Package (TDP) using the version of the Common Industry Format modified for voting systems (CIF-for-Voting Systems).

## Guideline 8.4

### **8.4 – The voting system is evaluated for usability by election workers.**

**8.4-A – Usability tests with election workers** Voting system setup, polling, and shutdown, as documented by the manufacturer, must be reasonably easy for the typical election worker to learn, understand, and perform.

1. The manufacturer must conduct usability tests on the voting system using individuals who are representative of election workers and report the test results as part of the Technical Data Package, using the Common Industry Format.
2. The tasks to be covered in the test must include:
  - Setup and opening for voting
  - Operation during voting
  - Use of assistive technology or language options that are part of the voting system
  - Shutdown at the end of a voting day during a multi-day early voting period, if supported by the voting system
  - Shutdown at the end of voting including running any reports

## Principle 2/Guideline 2

### High Quality Implementation

**The voting system is implemented using best practice user-centered design methods for a wide range of representative voters, including those with and without disabilities, and election workers.**

**2.2-A – User-centered design process** The manufacturer must submit a report providing documentation that the system was developed following best practices for a user-centered design process.

- The report must include, at a minimum:
- A listing of user-centered design methods used
- The types of voters and election workers included in those methods
- How those methods were integrated into the overall implementation process
- How the results of those methods contributed to developing the final features and design of the voting system

# Questions?

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