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Federal Standards and Guidelines for Voting Systems: Overview and Potential Considerations for Congress

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SUMMARY

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Federal Standards and Guidelines for Voting Systems: Overview and Potential Considerations for Congress

States and localities choose the voting systems used in elections in the United States. They decide which systems to use and contract with vendors as necessary to acquire and maintain them.

The federal government plays a role, though, in shaping the systems available for states and localities to choose from. First, federal law sets some mandatory standards for voting systems, including standards for their functionality and their accessibility to individuals with disabilities, older individuals, and members of language minority groups.

Second, federal law provides for a program, overseen by the U.S. Election Assistance Commission (EAC), to develop and update voluntary federal guidelines for voting systems and test and certify systems to the guidelines. The federal voting system testing and certification program was designed as a service to states and localities, and use of systems that conform to the EAC's Voluntary Voting System Guidelines (VVSG) is voluntary under federal law. However, widespread adoption of the program by states under their own state laws means that the VVSG have significant influence in practice, shaping the kinds of voting systems vendors develop and market.

The EAC's Technical Guidelines Development Committee is charged by the Help America Vote Act of 2002 (HAVA) with helping the agency's executive director develop draft VVSG, with technical support from the National Institute of Standards and Technology (NIST). The draft VVSG are shared with the public and the EAC's Board of Advisors and Standards Board for review and comment before they are submitted to the agency's commissioners for a vote on adoption. The commissioners have adopted three versions of the guidelines to date: VVSG 1.0 in 2005, VVSG 1.1 in 2015, and VVSG 2.0 in 2021.

Testing and certification of voting systems to the VVSG is also overseen by the EAC. The agency's commissioners, with assistance from NIST, accredit laboratories to test voting systems to the guidelines. Confirmation by an EAC-accredited lab that a vendor's voting system conforms to the VVSG is the main requirement for federal certification. However, vendors also have to meet other requirements before their systems are certified, such as depositing voting system software in an EAC-approved repository, and after certification, such as notifying the EAC of any malfunctions of their fielded voting systems and participating in the agency's Quality Monitoring Program.

HAVA established general procedures for developing the VVSG and for testing and certifying voting systems to the guidelines, but, as is often the case with statutory language, it did not specify all the details of how the procedures should work or what they should cover. Those specifics have been filled in by the EAC, its advisory bodies, and NIST, with input from the public. Some Members of Congress have introduced legislation to codify, change, or supplement those choices, offering bills on the VVSG development, testing, and certification processes or the scope of the guidelines.

Some Members have also proposed expanding the scope of mandatory federal standards for voting systems. As noted above, the VVSG have significant influence in practice because many states have adopted some or all of the federal voting system testing and certification program. However, there are relatively few actual federal mandates for voting systems. While some Members favor limited involvement by the federal government in this area, others have seen a role for new federal requirements. They have introduced bills that would limit foreign ownership or control of voting system vendors, for example, or require voting systems to produce individual paper records that can be verified by voters and manually audited by election officials.

Setting standards and guidelines is perhaps the most direct way Congress can influence choices about voting systems. Voting system policymaking comes with some complexities, however, due to (1) the multiple objectives voting systems are expected to meet, and (2) practical constraints on voting system production and implementation. Members who are interested in engaging with voting system policy might choose to consider whether or how to account for those complexities when designing new standards and guidelines. Alternatively, they might consider exploring other avenues for advancing voting system priorities. For example, Members might choose to consider other legislative tools—such as funding, research, or technical assistance—or other congressional authorities, such as oversight or appointment authorities.

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Introduction

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The federal government plays a role, though, in shaping the systems available for states and localities to choose from. First, federal law sets some mandatory standards voting systems must meet, including standards for their functionality and their accessibility to individuals with disabilities, older individuals, and members of language minority groups.[1]

Second, federal law provides for a program, overseen by the U.S. Election Assistance Commission (EAC), to develop and update voluntary federal guidelines for voting systems and test and certify systems to the guidelines. The federal voting system testing and certification program was designed as a service to states and localities, and use of systems that conform to the EAC's Voluntary Voting System Guidelines (VVSG) is voluntary under federal law.[2] However, widespread adoption of the program by states under their own state laws means that the VVSG have significant influence in practice,[3] shaping the kinds of voting systems vendors develop and market.[4]

This report provides an overview of the federal standards and guidelines that shape the voting systems used in U.S. elections. It starts by describing how those federal standards and guidelines fit into a broader system of checks on voting systems, then summarizes the current standards and guidelines and related legislative activity. The report closes by introducing some considerations that may be of interest to Members who are considering whether or how to engage with federal voting system policy.

Scope of the Report

This report focuses on federal standards and guidelines for systems that are used for in-person voting on Election Day and covered by the definition of "voting system" in the Help America Vote Act of 2002 (HAVA; P.L. 107-252; 52 U.S.C. §§20901-21145) or VVSG 2.0, the current

[1] Prior to enactment of the Help America Vote Act of 2002 (HAVA), "standards" was used to refer to voluntary federal guidelines for voting systems. HAVA set requirements for voting systems that it referred to as "voting systems standards" and, perhaps to distinguish the voluntary guidelines from those mandatory standards, renamed the voluntary guidelines "voluntary voting system guidelines." This report follows the usage in HAVA, using "standards" for requirements voting systems must meet and "guidelines" for voluntary guidance. 52 U.S.C. §21081; and 52 U.S.C. §§20961-20962.

[2] The federal voting system testing and certification program is intended to help set a baseline for voting systems, offer an alternative to state-by-state testing to that baseline, and officially recognize voting systems that meet it. See, for example, U.S. Election Assistance Commission (EAC), *Reforming the Testing and Certification Process*, June 12, 2014, pp. 38-40, at https://www.eac.gov/sites/default/files/event_document/files/EAC%20Roundtable%206-12-14.pdf; EAC, *Requirements for the Voluntary Voting System Guidelines 2.0*, February 10, 2021, p. 9, at https://www.eac.gov/sites/default/files/TestingCertification/Voluntary_Voting_System_Guidelines_Version_2_0.pdf; and EAC, *Voting System Testing and Certification Program Manual Version 3.0*, November 15, 2022, p. 15, at https://www.eac.gov/sites/default/files/TestingCertification/Testing%20and%20Certification%20Program%20Manual%20Version%203.0%20(2).pdf.

[3] According to a 2020 EAC report, 37 states and the District of Columbia (DC) have adopted some or all of the program. EAC, *State Requirements and the U.S. Election Assistance Commission Voting System Testing and Certification Program*, September 4, 2020, at https://www.eac.gov/sites/default/files/TestingCertification/State_Requirements_for_Certification09042020.pdf.

[4] See, for example, National Institute of Standards and Technology (NIST), "VVSG Introduction," at https://www.nist.gov/itl/voting/vvsg-introduction; and U.S. Congress, Senate Committee on Rules and Administration, *Oversight of the U.S. Election Assistance Commission*, 116th Cong., 1st sess., May 15, 2019, p. 15.

version of the VVSG (for details of those definitions, see **Table 1**). Specifically, it focuses on (1) mandatory federal standards for features of the equipment and materials used in those systems, including features and practices of the private-sector vendors and laboratories that produce and test them, and (2) the VVSG and the federal voting system testing and certification program.

Table 1. Federal Definitions of "Voting System"

Help America Vote Act of 2002 (HAVA)	Voluntary Voting System Guidelines (VVSG) 2.0
(1) the total combination of mechanical, electromechanical, or electronic equipment (including the software, firmware, and documentation required to program, control, and support the equipment) that is used— (A) to define ballots; (B) to cast and count votes; (C) to report or display election results; and (D) to maintain and produce any audit trail information; and (2) the practices and associated documentation used— (A) to identify system components and versions of such components; (B) to test the system during its development and maintenance; (C) to maintain records of system errors and defects; (D) to determine specific system changes to be made to a system after the initial qualification of the system; and (E) to make available any materials to the voter (such as notices, instructions, forms, or paper ballots).	Equipment (including hardware, firmware, and software), materials, and documentation used to enact the following functions of an election: 1. define elections and ballot styles, 2. configure voting equipment, 3. identify and validate voting equipment configurations, 4. perform logic and accuracy tests, 5. activate ballots for voters, 6. record votes cast by voters, 7. count votes, 8. label ballots needing special treatment, 9. generate reports, 10. export election data including election results, 11. archive election data, and 12. produce records in support of audits.

Sources: 52 U.S.C. §21081(b); and U.S. Election Assistance Commission (EAC), *Requirements for the Voluntary Voting System Guidelines 2.0*, February 10, 2021, p. 10, at https://www.eac.gov/sites/default/files/TestingCertification/Voluntary_Voting_System_Guidelines_Version_2_0.pdf.

Notes: HAVA does not extend its definition of "voting system" to the provisions of the act related to the VVSG, and there was some discussion during development of VVSG 2.0 about expanding the scope of the guidelines to include election systems not covered by the act's definition of the term. According to the adopted version of the guidelines, however, the definition of "voting system" ultimately chosen to set the scope of VVSG 2.0 was not intended to expand on HAVA's definition. EAC, *Requirements for the Voluntary Voting System Guidelines 2.0*, p. 11.

With the exception of some of the discussion of proposals to expand the scope of current federal standards and guidelines in the "Legislative Activity" and "Potential Considerations for Congress" sections, this report does not generally aim to address (1) election administration processes, such as chain of custody procedures and poll worker training;[5] (2) voluntary federal

[5] Election administration processes play an important role in the overall functioning of voting systems. For example, different choices about how voting systems are deployed, such as how poll workers are trained and how many systems are available at each polling place, can introduce or prevent voting system problems. As a result, election experts have often encouraged attention to the policies and procedures associated with voting systems in addition to voting system equipment and materials. See, for example, U.S. Congress, House Committee on Government Reform, Subcommittee on Technology, Information Policy, Intergovernmental Relations and the Census, *The Science of Voting Machine Technology: Accuracy, Reliability and Security*, 108th Cong., 2nd sess., July 20, 2004, p. 17; and U.S. Congress, (continued...)

guidance other than the VVSG, such as the best practices for securing voting systems issued by the U.S. Department of Homeland Security's (DHS's) Cybersecurity and Infrastructure Agency (CISA);[6] (3) election systems other than voting systems, such as voter registration databases and election management software; or (4) voting methods other than in-person Election Day voting, such as early and mail voting. For more on some of those topics, see CRS In Focus IF11285, *Election Security: Voter Registration System Policy Issues*, by Sarah J. Eckman; and CRS In Focus IF11477, *Early Voting and Mail Voting: Overview & Issues for Congress*, by Sarah J. Eckman and Karen L. Shanton.

Background

Policymaking about voting systems includes choices about

- how voting systems are intended to function, and
- how to check that they function as intended.

Federal voting system standards and guidelines fall into the first of those categories, and testing and certification of systems to the guidelines falls into the second. Both types of federal involvement primarily play a role early in the lifecycle of voting systems, helping shape the types of systems vendors develop and market.

Other public- and private-sector stakeholders play roles throughout the voting system lifecycle and each election cycle. First, states and localities may set their own standards for how the voting systems they use are intended to function, in addition to the mandatory federal standards and any voluntary federal guidelines they choose to follow.

Second, states, localities, and voting system vendors take various steps to check that their voting systems function as intended. Depending on the system and jurisdiction, those steps might include

- **Vendor testing.** Voting system vendors typically conduct internal tests of their systems during development and before submitting them for state and federal certification or use by states and localities.[7] Vendors may also take advantage of voluntary technical assistance offered by federal agencies, such as the open-

Committee on House Administration, Subcommittee on Elections, *The Importance of Poll Workers: Best Practices and Recommendations*, 110th Cong., 1st sess., October 3, 2007.

[6] See, for example, Cybersecurity and Infrastructure Security Agency (CISA), *Best Practices for Securing Election Systems*, November 11, 2022, at https://www.cisa.gov/news-events/news/best-practices-securing-election-systems. This kind of guidance plays a fundamentally different role in federal voting system policy than the VVSG. As noted in the "Introduction" to this report, although use of systems that conform to the VVSG is voluntary under federal law, widespread adoption of the federal testing and certification program by the states means that the VVSG have significant influence in practice.

[7] See, for example, EAC, *United States Election Assistance Commission Public Meeting: Voting Systems Manufacturer Roundtable Discussion*, February 29, 2008, p. 43, at https://www.eac.gov/sites/default/files/event_document/files/transcript%20public%20meeting%20february%2029%202008.pdf. Voting system vendors also often have coordinated vulnerability disclosure policies, which offer a way for good-faith researchers to help them identify and address vulnerabilities in their systems. See, for example, Information Technology-Information Sharing and Analysis Center Elections Industry-Special Interest Group, "EI-SIG Members' Vulnerability Disclosure Policies," at https://www.it-isac.org/ei-sig. The EAC's commissioners indicated in testimony for a June 2023 hearing that the agency is working with CISA and NIST to develop its own voluntary coordinated vulnerability disclosure policy for voting systems. Testimony of EAC Commissioners, in U.S. Congress, Senate Committee on Rules and Administration, *Hearing on Oversight of the U.S. Election Assistance Commission*, 118th Cong., 1st sess., June 7, 2023, pp. 9-10, at https://www.rules.senate.gov/imo/media/doc/EAC_Testimony1.pdf.

ended vulnerability assessments available under CISA's Critical Product Evaluation program.[8]

- **State testing and certification.** State-level testing and certification works similarly to federal testing and certification. It typically involves checking sample voting systems for conformance to state-specific requirements.
- **Acceptance testing.** Acceptance testing is conducted on the actual equipment that will be used in elections when it is initially delivered to a jurisdiction by the vendor or returned to the jurisdiction after leaving election officials' control, such as for servicing. It is intended to check that the equipment works correctly and meets all the conditions in the jurisdiction's contract with the vendor.[9]
- **Logic and accuracy (L&A) testing.** L&A testing is carried out before an election, after the election, or both. It is designed to ensure that the equipment used in the election works correctly and has been configured with the right information for the election, such as the correct candidate names, precinct boundaries, and ballot counting logic. It typically involves casting a known pattern of test votes and confirming that the results reported by the voting system match the expected outcomes.[10]
- **Parallel testing.** Parallel testing, which is conducted during an election, involves testing randomly selected equipment in conditions that are as similar as possible to the conditions in the polling place. It is intended to help catch problems that might not be identified by checking the equipment in test mode or before or after an election, such as malicious code that is programmed to run only when the polls are open.[11]
- **Post-election audits.** Post-election audits, which typically involve checking a sample of paper records of votes against the election outcomes reported by the voting system, are intended to check whether the equipment accurately captured and counted voters' selections. Some types of post-election audits, such as risk-limiting audits, offer a specific degree of confidence that the outcomes reported by the voting system are the outcomes officials would get if they counted all of the paper records by hand.[12]

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[8] See, for example, CISA, "Election Security Services," at https://www.cisa.gov/election-security-services; and Testimony of Matthew Masterson, in U.S. Congress, House Committee on Homeland Security, Subcommittee on Cybersecurity, Infrastructure Protection, and Innovation, *Securing Democracy: Protecting Against Threats to Election Infrastructure and Voter Confidence*, 117th Cong., 2nd sess., January 20, 2022, pp. 11-12, at https://www.congress.gov/117/meeting/house/114343/witnesses/HHRG-117-HM08-Wstate-MastersonM-20220120.pdf.

[9] EAC, *Election Management Guidelines*, 2023, pp. 60-67, at https://www.eac.gov/sites/default/files/electionofficials/EMG/EAC_Election_Management_Guidelines_508.pdf.

[10] EAC, *Election Management Guidelines*, pp. 73-75.

[11] EAC, *Election Management Guidelines Chapter 6: Pre-Election and Parallel Testing*, at https://www.eac.gov/sites/default/files/eac_assets/1/6/Chapter_6__Pre-Election_and_Parallel_Testing.pdf. For discussion of some possible limitations of parallel testing and logic and accuracy testing, see Andrew W. Appel, Richard A. DeMillo, and Philip B. Stark, "Ballot-Marking Devices Cannot Ensure the Will of the Voter," *Election Law Journal: Rules, Politics, and Policy*, vol. 19, no. 3 (September 2020).

[12] EAC, *Election Management Guidelines*, pp. 124-126; and EAC, *Election Audits Across the United States*, October 6, 2021, at https://www.eac.gov/sites/default/files/bestpractices/Election_Audits_Across_the_United_States.pdf. For more on risk-limiting audits, see CRS In Focus IF11873, *Election Administration: An Introduction to Risk-Limiting Audits*, by Karen L. Shanton.

Federal standards, guidelines, testing, and certification are, therefore, part of a broader system of checks on voting systems.

Origins and Overview of Federal Standards and Guidelines

Voting in the early 20th century was a relatively low-tech process. Voters marked their selections by hand on paper ballots that were counted by hand, for example, or by pulling levers on a machine that advanced a physical counter for each selection.[13]

The second half of the century, however, saw the introduction of computerized voting systems. Computers were first used—as part of the punch card and optical scan voting systems introduced in the 1960s—to count votes marked on paper ballots. Direct-recording electronic (DRE) voting machines, which debuted the following decade, record voter selections directly into computer memory.[14] For more on the main types of voting systems that have been used for in-person voting in federal elections since the early 20th century, see **Table 2**.

Table 2. Main Types of Voting Systems Used for In-Person Voting in Federal Elections Since the Early 20th Century

Type	Description	In Use in Federal Elections as of November 2022
Hand-counted paper ballots	Selections are marked by hand or using a ballot-marking device (BMD), and counted by hand	Yes
Lever machine	Selections are marked by pulling a lever that advances a physical counter	No
Punch card system	Selections are marked by punching out pieces of card, and counted by an electronic scanner	No
Optical scan system	Selections are marked by hand or using a BMD, and counted by an electronic scanner	Yes
Direct-recording electronic (DRE) machine	Selections are recorded directly into computer memory using a button, dial, or touchscreen	Yes

Sources: CRS, based on review of U.S. Election Assistance Commission, *Election Administration and Voting Survey 2020 Comprehensive Report*, August 16, 2021, pp. 23-26, https://www.eac.gov/sites/default/files/document_library/files/2020_EAVS_Report_Final_508c.pdf; and Verified Voting, "The Verifier—Election Day Equipment—November 2022," at https://verifiedvoting.org/verifier/#mode/navigate/map/ppEquip/mapType/normal/year/2022.

Concerns about reports of problems with computerized systems prompted a 1975 study of computerized vote tallying by the National Bureau of Standards (NBS; now known as the National Institute of Standards and Technology, or NIST). Among other recommendations, the study proposed establishing federal guidelines to help states and localities ensure the accuracy and security of their systems.[15]

[13] Douglas W. Jones, "A Brief Illustrated History of Voting," Voting and Elections web pages, University of Iowa Department of Computer Science, at https://homepage.cs.uiowa.edu/~jones/voting/pictures/.

[14] Douglas W. Jones, "A Brief Illustrated History of Voting," Voting and Elections web pages, University of Iowa Department of Computer Science.

[15] Roy G. Saltman, *Computer Science & Technology: Effective Use of Computing Technology in Vote-Tallying*, National Bureau of Standards, April 1978, at https://nvlpubs.nist.gov/nistpubs/Legacy/SP/nbsspecialpublication500-(continued...)

Congress followed up on that recommendation by first directing the Federal Election Commission (FEC) and NBS to study voluntary guidelines for voting systems and then providing the FEC funding to develop such guidelines.[16] The FEC issued the first voluntary federal guidelines for voting systems in 1990, with an update in 2002.[17] The National Association of State Election Directors (NASED), a professional association for state election officials, launched a program in 1994 to test and certify systems to the guidelines.[18]

The 1975 NBS report and 1990 FEC guidelines focused primarily on the basic functionality of voting systems—whether they were secured against errors and interference, accurately and reliably capturing and counting voters' selections—and public confidence in their functionality. The period from 1975 to 1990 also saw federal interest in access to voting systems. Federal legislation enacted during that period aimed to ensure that voting systems were accessible to members of language minority groups and to individuals with disabilities and older individuals.

Both functionality and accessibility also featured in the most recent major federal statute on this topic, HAVA. A decade after the federal government had first issued voluntary guidelines for voting systems, problems with voting systems contributed to controversy over the 2000 presidential election. Congress responded to those problems, in part, by revisiting federal involvement in voting system standards and guidelines. Its primary legislative response to the problems with the administration of the 2000 elections, HAVA, specified mandatory federal standards for voting system functionality and accessibility and established new federal processes for developing voluntary voting system guidelines and testing and certifying systems to them.[19]

Mandatory Standards

Some voters voted in the 2000 elections on punch card voting systems, punching out pieces of card known as "chads" that corresponded to their selections. Accidental marks or incomplete punches resulted in some ballots with chads that were dimpled or partially removed instead of fully detached. Difficulty discerning voter intent from those "pregnant" and "hanging" chads

30.pdf. This report was originally published in 1975 and republished in 1978. Roy G. Saltman, *Requirements for Evaluation of Voting System Security*, September 20, 2004, p. 1, at https://www.nist.gov/system/files/documents/itl/vote/NISTpaper-040920.pdf.

[16] P.L. 96-187; and Federal Election Commission (FEC), *Performance and Test Standards for Punchcard, Marksense, and Direct Recording Electronic Voting Systems*, January 1990, p. xviii, at https://www.eac.gov/sites/default/files/eac_assets/1/28/FEC_1990_Voting_System_Standards1.pdf.

[17] FEC, Performance and Test Standards for Punchcard, Marksense, and Direct Recording Electronic Voting Systems; FEC, Voting Systems Standards Volume 1 – Performance Standards, April 2002, at https://www.eac.gov/sites/default/files/eac_assets/1/28/Voting_System_Standards_Volume_I.pdf; and FEC, Voting Systems Standards Volume II – Test Standards, April 2002, at https://www.eac.gov/sites/default/files/eac_assets/1/28/Voting_System_Standards_Volume_II.pdf.

[18] U.S. Congress, Committee on House Administration and House Committee on Science, *Voting Machines: Will the New Standards and Guidelines Help Prevent Future Problems?* 109th Cong., 2nd sess., July 19, 2006, p. 110. The FEC and NASED referred to the latter process as "qualifying" systems to the guidelines. HAVA renamed the process "certification," and this report follows that usage. As noted by EAC staff in a 2005 public meeting, the two terms refer to the same basic process and can be used interchangeably in this context. EAC, *United States Election Assistance Commission Public Meeting*, August 23, 2005, p. 33, at https://www.eac.gov/sites/default/files/event_document/files/transcript%20public%20meeting%20august%2023%202005.pdf.

[19] For more on Congress's response to problems with the 2000 elections, see CRS Report R46949, *The Help America Vote Act of 2002 (HAVA): Overview and Ongoing Role in Election Administration Policy*, by Karen L. Shanton.

contributed to disputes over the Florida vote count that delayed resolution of the 2000 presidential election for weeks.[20]

The layout of the ballots in Florida's Palm Beach County added further complications in 2000. In an effort to make ballots more readable for older voters, the county's clerk increased the font size and spread the presidential candidates' names across two pages with a column of punch holes in the middle. Some county voters, confused by the "butterfly" layout of the ballot, marked their ballots for a different presidential candidate than the one they intended to support.[21]

The problems with Florida's punch card systems were the highest-profile problems with voting systems in 2000, but post-election investigations also flagged others. Lever machines and DREs without a voter verifiable paper audit trail (VVPAT) could jam or malfunction, for example, and did not produce paper records that could be used to reconstruct votes cast on a jammed or malfunctioning machine. Some types of voting systems registered higher rates of uncounted ballots, overvotes (more selections for a given contest than permitted), and undervotes (fewer selections for a given contest than permitted) than others.[22]

Post-2000 election investigations also highlighted problems with voting system accessibility. Federal statutes and regulations had established some accessibility standards for voting systems before the 2000 elections. A 1975 amendment (P.L. 94-73) to the Voting Rights Act of 1965 (VRA; P.L. 89-110) introduced requirements for certain states and localities to provide voting materials in the languages of applicable language minority groups.[23] The Voting Accessibility for the Elderly and Handicapped Act of 1984 (VAEHA; P.L. 98-435; 52 U.S.C. §§20101-20107) required states to make voting aids like large print instructions and telecommunications devices available for federal elections.[24] The Americans with Disabilities Act of 1990 (ADA; P.L. 101-336; 42 U.S.C. §§12101-12213) included a broad prohibition on excluding individuals with disabilities from public services that had various implications for voting systems.[25]

However, representatives of those groups reported encountering continued obstacles to voting in 2000. Some voting systems were inaccessible to individuals with disabilities, for example,

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[20] See, for example, Samantha Levine, "Hanging Chads: As the Florida Recount Implodes, the Supreme Court Decides Bush v. Gore," *U.S. News & World Report*, January 17, 2008, at https://www.usnews.com/news/articles/2008/01/17/the-legacy-of-hanging-chads.

[21] *ABC News*, "Butterfly Ballot Designer Speaks Out," December 21, 2000, at https://abcnews.go.com/Politics/story?id=122175&page=1.

[22] See, for example, R. Michael Alvarez et al., *Voting—What Is, What Could Be*, Caltech/MIT Voting Technology Project, July 2001, at https://vote.caltech.edu/reports/1; and U.S. General Accounting Office (GAO), *Elections: Statistical Analysis of Factors that Affected Uncounted Votes in the 2000 Presidential Elections*, October 2001, at https://www.gao.gov/assets/gao-02-122.pdf.

[23] A 1982 amendment to the act (P.L. 97-205) also provides for voters who need help voting due to a disability or inability to read or write to receive assistance from the person of their choice.

[24] VAEHA also requires states and localities to ensure that polling places for federal elections are accessible to individuals with disabilities and older individuals or, if there is an emergency or no accessible polling places are available, to offer an alternative means of casting a ballot.

[25] For more on some of those implications, see U.S. Department of Justice (DOJ), *The Americans with Disabilities Act and Other Federal Laws Protecting the Rights of Voters with Disabilities*, September 2014, at https://archive.ada.gov/ada_voting/ada_voting_ta.htm. The Rehabilitation Act of 1973 (P.L. 93-112; 29 U.S.C. §§701-796l) contains a similar prohibition on excluding individuals with disabilities from programs or activities receiving federal funding. For more on federal funding for election administration, see CRS Report R46646, *Election Administration: Federal Grant Funding for States and Localities*, by Karen L. Shanton; and CRS Report WPD00035, *Federal Role in Elections Funding*, by Karen L. Shanton.

leaving them unable to cast a secret ballot or, in some cases, any ballot at all.[26] The bilingual voting materials mandated by the VRA were not always available.[27]

Congress responded to the reports of problems with the administration of the 2000 elections, in part, with mandatory federal standards for voting systems. Title III of HAVA requires states to specify what counts as a vote for each type of voting system they use in federal elections and election officials to post certain federal election materials, such as voting instructions and sample ballots, at the polls.[28] Title III also requires voting systems used in federal elections to

- offer voters the opportunity to check and correct their ballots before they are cast and counted,
- notify voters about overvoting,
- produce a manually auditable permanent paper record,
- provide for accessibility for individuals with disabilities,
- provide for accessibility for members of language minority groups as required by Section 203 of the VRA, and
- comply with the error rate standards specified by the FEC guidelines that were in effect when the act was enacted.[29]

HAVA reserved discretion about exactly how to meet its Title III requirements to the states but directed the EAC to issue guidance for implementing them and provided for enforcement through state-based administrative complaint procedures and civil action by the U.S. Department of Justice (DOJ).[30]

Voluntary Guidelines

Congress helped fund development of the FEC's voluntary voting system guidelines, but it did not explicitly assign the agency authority for developing or maintaining them.[31] It also did not charge the FEC—or any other federal agency—with overseeing testing or certification of systems to the guidelines. That responsibility was undertaken, instead, by NASED.[32]

Investigations into the problems with voting systems in 2000 prompted proposals to revisit the federal role in voting system guidance. A 2001 report from the U.S. General Accounting Office (GAO; now known as the U.S. Government Accountability Office) found that the FEC guidelines were not sufficiently comprehensive or current, for example, and suggested assigning federal

[26] See, for example, U.S. Commission on Civil Rights, *Voting Irregularities in Florida During the 2000 Presidential Election Chapter 6: Accessibility Issues*, at https://www.usccr.gov/files/pubs/vote2000/report/ch6.htm.

[27] See, for example, U.S. Congress, Senate Committee on Rules and Administration, *Election Reform*, 107th Cong., 1st sess., March 14, 2001, pp. 44, 183.

[28] 52 U.S.C. §§21081-21082.

[29] 52 U.S.C. §21081.

[30] 52 U.S.C. §21003; 52 U.S.C. §§21101-21102; and 52 U.S.C. §§21111-21112. For more on the EAC, see CRS Report R45770, *The U.S. Election Assistance Commission (EAC): Overview and Selected Issues for Congress*, by Karen L. Shanton. For information about DOJ settlements and cases raising claims under HAVA, see DOJ, "Voting Section Litigation," at https://www.justice.gov/crt/voting-section-litigation#hava.

[31] GAO, *Elections: Status and Use of Federal Voting Equipment Standards*, October 2001, p. 6, at https://www.gao.gov/assets/gao-02-52.pdf.

[32] U.S. Congress, Committee on House Administration and House Committee on Science, *Voting Machines: Will the New Standards and Guidelines Help Prevent Future Problems?* 109th Cong., 2nd sess., July 19, 2006, p. 110.

agencies explicit responsibility for voting system guidelines, testing, and certification.[33] A commission led by former Presidents Gerald Ford and Jimmy Carter endorsed similar federal authorities in a report released the same year, with specific recommendations to consult with state and local officials and reserve a role for NIST.[34]

Congress took up those recommendations in HAVA. HAVA created a new federal agency dedicated to election administration, the EAC, and authorized it to (1) develop and maintain the VVSG, and (2) oversee testing and certification of voting systems to the guidelines. The act provided for consultation on those processes with state and local officials—as well as a range of other elections stakeholders—and technical assistance from NIST with carrying them out.

Development and Maintenance

The EAC consists of an appointed commission, a professional staff led by an executive director and general counsel, an Office of Inspector General (OIG), an agency-created Local Leadership Council (LLC), and three statutory advisory bodies: the Technical Guidelines Development Committee (TGDC), the Board of Advisors, and the Standards Board. For details of the memberships of these three statutory advisory bodies, see **Table 3**.[35]

Table 3. Memberships of the U.S. Election Assistance Commission's Statutory Advisory Bodies

Advisory Body	Number of Members	Composition of Membership
Technical Guidelines Development Committee (TGDC)	15	Chaired by the director of the National Institute of Standards and Technology, who works with the U.S. Election Assistance Commission's commissioners to appoint 14 other members that include • an equal number of members of each of the Board of Advisors, Standards Board, and Access Board; • a representative of each of the American National Standards Institute and Institute of Electrical and Electronics Engineers; • two representatives of the National Association of State Election Directors who are not members of the Board of Advisors, the Standards Board, or the same political party; and • other individuals with technical and scientific expertise related to voting systems
Standards Board[a]	110	One state election official and one local election official from different political parties for each of the 50 states, the District of Columbia, American Samoa, Guam, Puerto Rico, and the U.S. Virgin Islands[b]

[33] GAO, *Elections: Status and Use of Federal Voting Equipment Standards*, October 2001, pp. 11-12, 16.

[34] The National Commission on Federal Election Reform, *To Assure Pride and Confidence in the Electoral Process*, August 2001, p. 57, at https://www.verifiedvoting.org/wp-content/uploads/2012/10/NCFER_2001.pdf.

[35] For more on the structure of the EAC, see CRS Report R45770, *The U.S. Election Assistance Commission (EAC): Overview and Selected Issues for Congress*, by Karen L. Shanton.

Advisory Body	Number of Members	Composition of Membership
Board of Advisors	35[c]	Two members appointed by each of the • National Governors Association; • National Conference of State Legislatures; • National Association of Secretaries of State; • National Association of State Election Directors; • National Association of Counties; • International Association of Government Officials; • United States Conference of Mayors; • Election Center; • United States Commission on Civil Rights; and • Access Board Chiefs of the U.S. Department of Justice's Office of Public Integrity and its Civil Rights Division's Voting Section or their designees Director of the U.S. Department of Defense's Federal Voting Assistance Program Four members representing science and technology professionals, of whom one is appointed by each of the majority and minority leadership of the House and Senate Eight members representing voters, of whom two are appointed by each of the chairs and ranking members of the Committee on House Administration and Senate Committee on Rules and Administration

Source: CRS, based on review of the *U.S. Code*.

Notes:

a. The Standards Board has a nine-member Executive Board that is appointed by the membership of the full board. No more than five members of the Executive Board may be either state officials, local officials, or members of the same political party. 52 U.S.C. §20943.

b. The Commonwealth of the Northern Mariana Islands (CNMI) is not represented on the Standards Board because it did not hold federal elections when the act that established the board, the Help America Vote Act of 2002, was enacted. Testimony of the Honorable Gregorio Kilili Camacho Sablan, in U.S. Congress, Committee on House Administration, Subcommittee on Elections, *Voting Rights and Election Administration in the U.S. Virgin Islands and Other Territories*, hearing, 116th Congress, 2nd session, July 28, 2020, p. 2.

c. The Board of Advisors originally had 37 members, but its membership dropped to 35 with the 2016 merger of two of the organizations responsible for appointing its members. The National Association of County Recorders, Election Officials, and Clerks and the International Association of Clerks, Recorders, Election Officials, and Treasurers merged to form the International Association of Government Officials. Doug Chapin, "Fewer Letters in the Alphabet Soup: NACRC, IACREOT to Merge," *Election Academy*, July 7, 2015, at http://editions.lib.umn.edu/electionacademy/2015/07/07/fewer-letters-in-the-alphabet-soup-nacrc-iacreot-to-merge/.

The TGDC is charged by HAVA with helping the executive director of the EAC develop draft VVSG (for an illustration of the process for developing the VVSG and an overview of federal responsibilities for the process, see **Figure 1** and **Table 4**, respectively). The act directs NIST to provide technical support for that work on request, including through research on topics such as voting system security, fraud prevention and detection, voter privacy protections, human factors, and remote access voting.[36]

[36] 52 U.S.C. §20961. HAVA lists the security of statewide voter registration databases as a possible subject of this (continued...)

Once developed by the TGDC, the draft VVSG are shared with the Board of Advisors, the Standards Board and its Executive Board, and the general public for review and comment before they are submitted to the EAC's commissioners for a vote on adoption. HAVA specifically mandates opportunities for public comment and a public hearing on the VVSG, as well as publication in the *Federal Register* of the TGDC's recommendations, notice of proposed guidelines, and the final guidelines.[37] Adoption of the VVSG requires approval by a three-vote quorum of the EAC's four-member commission.[38]

Selected Work by NIST on Voting Systems

NIST supported development of the most recent iteration of the VVSG, in part, by helping lead public working groups. HAVA provides for opportunities for input into the VVSG by elections stakeholders and the general public through roles for the EAC's statutory advisory bodies and requirements for public notice and comment. The EAC and NIST expanded on those opportunities for VVSG 2.0 with two sets of working groups that were open to anyone: (1) three election cycle groups, focused on the preelection, election, and post-election periods; and (2) four constituency groups, addressing issues related to cybersecurity, human factors, interoperability, and testing.[39]

Other NIST work on voting systems has included

- **Leading development of common data formats for elections data.** Elections involve various types of data, from precinct boundaries to candidate names to election results. Voting systems have historically tended to store data in formats that are proprietary to the vendors who manufacture them, but elections stakeholders saw some potential advantages of standardizing formats across systems. Common data formats could increase the accuracy and efficiency of elections work, for example, by making it easier to transfer data between election systems or export it for federal, state, or local reporting purposes. They might help reduce costs by making it possible to combine components of voting systems from different vendors and to test and certify those components independently.[40]

  Starting with the TGDC's work on the 2007 recommendations for the VVSG and continuing through work with the Institute of Electrical and Electronics Engineers (IEEE) and the VVSG 2.0 public working groups, NIST has led efforts to develop common data formats for elections data.[41] VVSG 2.0 requires federally certified voting systems to support those common data formats, and the EAC's testing and certification program manual provides for a pilot program to test and certify individual voting system components.[42]
- **Collaborating on soliciting, evaluating, and approving protocols for end-to-end verifiable (E2E-V) voting systems.** Voting systems are expected not only to report accurate election outcomes but also to offer the public confidence that they do so. One approach many have proposed to achieving those objectives is verifying the reported outcomes. A key component of that approach is a feature of voting systems known as "software independence." Sometimes compared to tamper-evident packaging, software independence is when "an undetected error or fault in the voting system's software is not capable of causing an undetectable

research. However, as noted in **Table 1** and the "Scope of the Report" section of this report, voter registration databases are not included in the scope of VVSG 2.0.

[37] 52 U.S.C. §§20961-20962.

[38] 52 U.S.C. §20928.

[39] NIST, "Voting Working Groups—General Information," at https://www.nist.gov/itl/voting/voting-working-groups-general-information. The new working groups provided for input by a wide range of interested parties, but some practitioners reported that the broader scope made the working groups less effective for their purposes. See, for example, EAC, *United States Election Assistance Commission Public Meeting*, April 23, 2019, pp. 132-134, at https://www.eac.gov/sites/default/files/event_document/files/EAC042319VerbatimPublicHearing.pdf; and EAC, *VVSG Public Hearing*, May 20, 2019, at https://www.eac.gov/events/2019/05/20/vvsg-public-hearing-silver-spring.

[40] See, for example, NIST, "An Introduction to the Common Data Format Project," at https://www.nist.gov/itl/voting/introduction-common-data-format-project; and NIST, "Voting System Interoperability Working Group," at https://www.nist.gov/itl/voting/voting-system-interoperability-working-group.

[41] NIST, "Interoperability," at https://www.nist.gov/itl/voting/interoperability.

[42] EAC, *Requirements for the Voluntary Voting System Guidelines 2.0*, pp. 6, 116-117; and EAC, *Voting System Testing and Certification Program Manual Version 3.0*, November 15, 2022, p. 79.

change in election results."[43]

VVSG 2.0 requires federally certified voting systems to be software independent and provides for two ways to meet the requirement: (1) paper-based systems that produce paper records of votes that voters can verify and election officials can check against the outcomes reported by the voting system, and (2) E2E-V systems that use cryptography to enable voters to verify that their votes were cast as intended and anyone to check that votes were tallied as cast.[44] There were no E2E-V voting systems on the market as of the adoption of VVSG 2.0, so the guidelines called for development of a separate approval process for E2E-V cryptographic protocols.[45] The EAC and NIST have started collaborating on establishing that process.[46]

- **Developing a Cybersecurity Framework Profile for election infrastructure.** NIST works with public- and private-sector partners to develop and maintain a Cybersecurity Framework that organizations can use to help identify, assess, and manage their cybersecurity risks. The core of the framework is a set of five functions—Identify, Protect, Detect, Respond, and Recover—that are divided into categories and subcategories of desirable outcomes paired with references to sample standards, guidelines, and best practices that organizations can use to achieve them.[47]

  Some of the categories and subcategories of outcomes in the Framework Core may be more important for certain types of work than others, and individual organizations or sectors can choose to prioritize them in an organization- or sector-specific Framework Profile.[48] NIST released a draft Election Infrastructure Profile in March 2021 that is intended to be tailored to the specific needs of the election sector.[49]
- **Conducting research on voting system usability and accessibility.** The accessibility of voting systems to individuals with disabilities and older individuals has featured in various federal statutes, from VAEHA to HAVA. Some of the catalysts for HAVA, such as Palm Beach County's butterfly ballots, also highlighted the importance of ensuring that voting systems are usable by voters in general and by poll workers and election officials.[50]

  NIST has conducted research into voting system usability and accessibility that has informed the sections of the VVSG on those topics and has released some of its work in publicly available resources, including guidance for testing voting systems to VVSG 2.0's usability and accessibility requirements, writing instructions and messages for voters and poll workers, and using color in voting systems.[51]

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[43] EAC, *Requirements for the Voluntary Voting System Guidelines 2.0*, pp. 181-182. For more on software independence, see Ronald L. Rivest and John P. Wack, *On the Notion of "Software-Independence" in Voting Systems*, July 28, 2006, at https://people.csail.mit.edu/rivest/pubs/RW06.pdf; and Matthew Bernhard et al., "Public Evidence from Secret Ballots," in *Electronic Voting: Second International Joint Conference, E-Vote-ID 2017*, eds. Robert Krimmer et al., (Springer, 2017), pp. 84-109.

[44] EAC, *Requirements for the Voluntary Voting System Guidelines 2.0*, pp. 181-182. For more on E2E-V voting systems, see Josh Benaloh et al., *End-to-End Verifiability*, February 2, 2014, at https://arxiv.org/ftp/arxiv/papers/1504/1504.03778.pdf.

[45] EAC, *Requirements for the Voluntary Voting System Guidelines 2.0*, p. 186.

[46] EAC, "End to End (E2E) Protocol Evaluation Process," at https://www.eac.gov/voting-equipment/end-end-e2e-protocol-evaluation-process; and NIST, "The Path to End-to-End (E2E) Protocols for Voting Systems," October 6-7, 2022, at https://www.nccoe.nist.gov/get-involved/attend-events/path-end-end-e2e-protocols-voting-systems/post-workshop-materials.

[47] NIST, *Framework for Improving Critical Infrastructure Cybersecurity, Version 1.1*, April 16, 2018, p. 3, at https://nvlpubs.nist.gov/nistpubs/CSWP/NIST.CSWP.04162018.pdf.

[48] NIST, *Framework for Improving Critical Infrastructure Cybersecurity, Version 1.1*, p. 4.

[49] Mary Brady et al., *Cybersecurity Framework Election Infrastructure Profile*, NIST, March 2021, at https://nvlpubs.nist.gov/nistpubs/ir/2021/NIST.IR.8310-draft.pdf.

[50] See, for example, U.S. Congress, House Committee on House Administration, *Hearing on Oversight of the Election Assistance Commission*, 109th Cong., 2nd sess., June 8, 2006, pp. 68-69; and U.S. Congress, Committee on House Administration and House Committee on Science, *Voting Machines: Will the New Standards and Guidelines Help Prevent Future Problems?* 109th Cong., 2nd sess., July 19, 2006, pp. 78-79.

[51] NIST, "Accessibility and Human Factors," at https://www.nist.gov/itl/voting/research-and-projects/accessibility-and-human-factors.

The EAC's commission adopted the first version of the VVSG, VVSG 1.0, in December 2005.[52] The departures of commissioners in 2009 and 2010 and resulting loss of numbers for a quorum contributed to delaying—and scaling back the agency's ambitions for—an update to those initial guidelines.[53] VVSG 1.1, which was a relatively minor modification of VVSG 1.0, was adopted in March 2015.[54]

The delay in updating the VVSG introduced challenges for states, localities, and voting system vendors. Some reported that the delay made it more difficult for them to address emerging security threats and vulnerabilities, for example, or limited their capacity or incentive to take advantage of new technological innovations.[55]

Those challenges prompted exploration of a different approach to the next update. VVSG 1.0 and VVSG 1.1 were lengthy documents that were intended to provide enough technical detail to enable vendors to build voting systems to the guidelines. The project charter the TGDC released for VVSG 2.0 in 2016 proposed replacing that detailed technical guidance with a set of high-level principles and guidelines.[56] Under the proposal, the EAC would still produce detailed technical requirements to help guide manufacture of systems to the principles and guidelines, but those requirements would not officially be part of the VVSG or subject to approval by the agency's commissioners.[57] As a result, updates to the high-level principles and guidelines would require a commission vote, but the more technical requirements could be maintained by the agency's professional staff.[58]

That proposed division of responsibilities between the EAC's commission and its professional staff was ultimately not implemented, following an internal legal opinion questioning its permissibility under HAVA.[59] The EAC did, however, retain the structure proposed by the TGDC. VVSG 2.0, which the commissioners adopted in February 2021, is divided into high-level

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[52] EAC, "EAC Adopts 2005 Voluntary Voting System Guidelines," press release, December 13, 2005, at https://web.archive.org/web/20170327213819/https://www.eac.gov/assets/1/28/VVSG_1.0_Press_Release.pdf. HAVA indicated that the 2002 FEC guidelines would be deemed to have been adopted by the commission as of the act's enactment, but VVSG 1.0 was the first set of guidelines the EAC's commissioners voted to adopt. For discussion of EAC adoption of the FEC guidelines, see EAC, *United States Election Assistance Commission Public Meeting*, September 21, 2010, pp. 91-92, at https://web.archive.org/web/20210702213539/https://www.eac.gov/sites/default/files/event_document/files/transcript%20public%20meeting%20september%2021%202010.pdf/.

[53] EAC, *Statement of Gracia M. Hillman on the Occasion of Her Resignation as Commissioner, U.S. Election Assistance Commission*, December 6, 2010, at https://www.eac.gov/sites/default/files/document_library/files/GH%20Statement_12_06_10.pdf; and EAC, *2012 Activities Report*, p. 2, at https://web.archive.org/web/20170328053540/https://www.eac.gov/assets/1/6/FY-2012-EAC-Activities-Report-Website-Scanned.pdf.

[54] EAC, "EAC Updates Federal Voting System Guidelines," press release, March 31, 2015, at https://web.archive.org/web/20170327213732/https://www.eac.gov/assets/1/28/EAC%20Updates%20Federal%20Voting%20System%20Guidelines-News-Release-FINAL-3-31-15-website.pdf; and EAC, *United States Election Assistance Commission Standards Board Meeting*, April 11-12, 2019, p. 86, at https://www.eac.gov/sites/default/files/event_document/files/EAC0411-1219VerbatimStandardsBoard.pdf.

[55] See, for example, EAC, *United States Election Assistance Commission Public Meeting*, April 23, 2019, pp. 119-120; and EAC, *United States Election Assistance Commission Board of Advisors Meeting*, April 24-25, 2019, pp. 272-275, at https://www.eac.gov/sites/default/files/event_document/files/EAC0419VerbatimBOA.pdf.

[56] EAC Technical Guidelines Development Committee (TGDC), *Project Charter, VVSG Version 2.0*, June 26, 2016, p. 2.

[57] "Requirements" in this context refers to requirements voting systems must meet in order to receive federal certification, not mandatory federal standards for all voting systems. As noted in the "Introduction" to this report, use of voting systems that conform to the VVSG is voluntary under federal law.

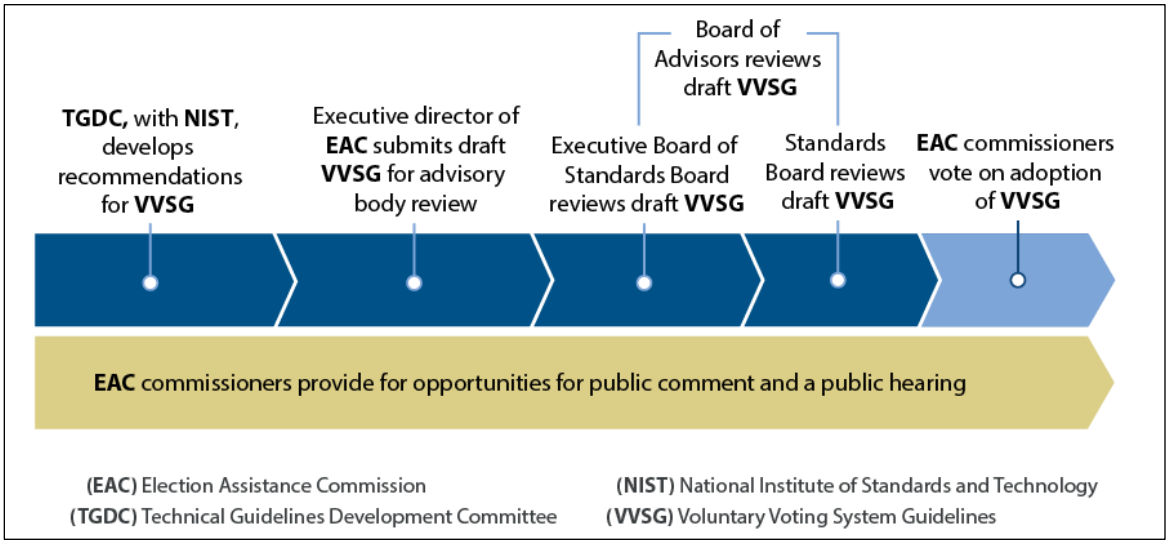
[58] National Association of State Election Directors (NASED), *NASED Executive Board Comment on the Voluntary Voting System Guidelines*, May 3, 2019, at https://www.nased.org/news/2019/5/3/comment-on-the-vvsg.

[59] EAC, *Technical Guidelines Development Committee Meeting*, September 19, 2019, pp. 42, 304-305, at https://www.eac.gov/sites/default/files/2020-01/EAC09192019VerbatimTGDC%20%282%29.pdf.

principles and guidelines and more detailed technical requirements (for the list of high-level principles and guidelines, see the **Appendix**).[60]

Figure 1. Process for Developing the Voluntary Voting System Guidelines

(as specified by the Help America Vote Act of 2002)



Sources: CRS, based on review of the *U.S. Code*.

Note: The process presented in this figure is as specified in statute.

The EAC also developed a lifecycle policy that agency leadership has described as intended to help promote more regular updating of the VVSG.[61] The policy, which was adopted by the commissioners in April 2022 and updated in October 2022, establishes a 12-month review cycle that includes opportunities for the EAC's statutory advisory bodies and the public to propose changes to the VVSG and culminates in a decision by the agency's executive director about whether to initiate an update.[62]

[60] EAC, "U.S. Election Assistance Commission Adopts New Voluntary Voting System Guidelines 2.0," press release, February 10, 2021, at https://www.eac.gov/news/2021/02/10/us-election-assistance-commission-adopts-new-voluntary-voting-system-guidelines-20; and EAC, *Requirements for the Voluntary Voting System Guidelines 2.0*, p. 5. Additional guidance from the EAC on testing and certifying voting systems to VVSG 2.0 is available in test assertions and VSTL and vendor program manuals. EAC, *Voluntary Voting System Guidelines Version 2.0: Test Assertions Version 1.2*, at https://www.eac.gov/sites/default/files/TestingCertification/VVSG%202.0%20Test%20Assertions%20v1.2.pdf; EAC, *Voting System Test Laboratory Program Manual Version 3.0*, November 15, 2022, at https://www.eac.gov/sites/default/files/TestingCertification/VSTL%20Program%20Manual%20Version%203.0%20(3).pdf; and EAC, *Voting System Testing and Certification Program Manual Version 3.0*, November 15, 2022.

[61] EAC, *VVSG Lifecycle Policy Vote Meeting*, April 5, 2022, at https://www.eac.gov/events/2022/04/05/vvsg-lifecycle-policy-10-vote-meeting. As NASED noted in a comment on a draft of the lifecycle policy, the policy does not appear to address concerns some have voiced about the effects on the VVSG of loss of a quorum at the EAC. EAC, *Public Comments for VVSG Lifecycle Policy*, at https://www.eac.gov/sites/default/files/TestingCertification/Comments_Received_for_VVSG_Lifecycle_Policy_Final.xlsx.

[62] EAC, "EAC Adopts Voluntary Voting System Guidelines Lifecycle Policy," press release, April 5, 2022, at https://www.eac.gov/news/2022/04/05/eac-adopts-voluntary-voting-system-guidelines-lifecycle-policy; EAC, "Voluntary Voting System Guidelines," at https://www.eac.gov/voting-equipment/voluntary-voting-system-guidelines; and EAC, *Voting System Testing and Certification: VVSG Lifecycle Policy*, pp. 5-7, at https://www.eac.gov/sites/default/files/TestingCertification/VVSG_Lifecycle_Policy.pdf.

Testing and Certification

The EAC's new lifecycle policy also aims to address another concern some have raised about the VVSG. Although an update to VVSG 1.0 was adopted in 2015, vendors could continue to submit voting system modifications for testing to the first version of the guidelines, and they generally opted to do so; no voting systems were ever certified to VVSG 1.1.[63] Under the new policy, by contrast, most testing to previous iterations of the VVSG is supposed to be discontinued 12 months after the first voting system test laboratory (VSTL) is accredited to test systems to a new version.[64]

The first VSTL was accredited to test systems to the current iteration of the VVSG, VVSG 2.0, in November 2022.[65] As with adoption of the VVSG, accreditation of labs to test voting systems to the guidelines—and revocation of accreditation, if necessary—requires approval by a three-vote majority of the EAC's commissioners.[66]

Also as with the VVSG, HAVA assigns NIST a technical support role in lab accreditation. The act directs NIST to make accreditation recommendations to the EAC's commission and, in cooperation with the commission and consultation with the Board of Advisors and Standards Board, to monitor and review VSTL performance (for an overview of federal responsibilities for voting system testing and certification, see **Table 4**).[67]

Table 4. Federal Responsibilities for Voluntary Voting System Guidelines, Testing, and Certification

(as specified by the Help America Vote Act of 2002)

	Responsibilities for Developing the Voluntary Voting System Guidelines (VVSG)	Responsibilities for Testing and Certifying Voting Systems to the VVSG
U.S. Election Assistance Commission (EAC) Commissioners	Provide for publication of final VVSG and notice of proposed VVSG in *Federal Register* Provide for public comment and hearing on proposed VVSG Vote on adoption of VVSG	Provide for testing, certification, decertification, and recertification of voting systems to the VVSG Vote on accreditation and revocation of accreditation of voting system test laboratories (VSTLs)

[63] EAC, "Certified Voting Systems," at https://www.eac.gov/voting-equipment/certified-voting-systems; and Matt Masterson et al., *Zero Trust: How to Secure American Elections When the Losers Won't Accept They Lost*, Stanford Internet Observatory, 2021, p. 17, at https://stacks.stanford.edu/file/druid:mf969dh7882/SIO_Zero_Trust_2021.pdf.

[64] EAC, *Voting System Testing and Certification: VVSG Lifecycle Policy*, pp. 4-5. As the EAC emphasizes in the policy, this deprecation of previous versions of the VVSG is not the same as decertification of systems certified to previous iterations of the guidelines. States and localities can continue to use such systems, and the lifecycle policy includes exceptions that are designed to enable them to maintain those systems. The policy permits testing of the following types of changes to systems certified to deprecated guidelines: (1) security updates, (2) bug fixes, (3) commercial-off-the-shelf (COTS) equipment replacements, (4) jurisdictional rule changes, and (5) updates or additions of components that comply with the current version of the VVSG.

[65] EAC, "EAC Commissioners Accredit First Voting System Testing Lab to Test Voting Systems to Voluntary Voting System Guidelines 2.0," press release, December 7, 2022, at https://www.eac.gov/news/2022/12/07/eac-commissioners-accredit-first-voting-system-testing-lab-test-voting-systems.

[66] 52 U.S.C. §20971. The loss of a quorum that delayed an update to the VVSG also delayed lab accreditation. Accreditation for at least one VSTL was pending when the EAC was without a quorum from 2010 to 2014, and the lab could not receive accreditation or start testing voting systems to the VVSG until the quorum was restored. EAC, *Reforming the Testing and Certification Process*, June 12, 2014, pp. 15-16.

[67] 52 U.S.C. §20971.

	Responsibilities for Developing the Voluntary Voting System Guidelines (VVSG)	Responsibilities for Testing and Certifying Voting Systems to the VVSG
EAC Technical Guidelines Development Committee (TGDC)	Assist EAC executive director with developing VVSG Provide for publication of VVSG recommendations in *Federal Register*	—
EAC Board of Advisors and EAC Standards Board	Review proposed VVSG, and submit comments and recommendations	Consult on VSTL monitoring and review
National Institute of Standards and Technology (NIST)	Chair TGDC, and provide technical support on request	Recommend VSTLs for accreditation Monitor and review VSTL performance, and make recommendations about continuing accreditation

Source: CRS, based on review of the *U.S. Code*.

Notes: A version of this table was first published in February 2021 in CRS Insight IN11592, *Voluntary Voting System Guidelines (VVSG): An Overview*, by Karen L. Shanton. The responsibilities described in the table are as specified in statute. For more on the composition and duties of the EAC's statutory advisory bodies, see **Table 3** of this report and CRS Report R45770, *The U.S. Election Assistance Commission (EAC): Overview and Selected Issues for Congress*, by Karen L. Shanton.

NIST's VSTL accreditation work, which is carried out by its National Voluntary Laboratory Accreditation Program (NVLAP), is primarily aimed at ensuring VSTLs have the technical competency to conduct the necessary testing.[68] Other requirements for EAC accreditation address other aspects of test labs' operations, such as their finances and hiring practices. For example, labs interested in accreditation must provide the EAC with recent annual reports and financial statements and certify that they do not hire staff for roles related to voting system testing who have been convicted of a felony or other criminal offense involving fraud, misrepresentation, or deception.[69]

Vendors who are interested in submitting voting systems for federal certification also must provide information about their operations, such as their organization and ownership, in order to register with the EAC.[70] Once registered, they can submit voting systems for certification. VSTLs check that the systems that vendors submit are ready for testing, including by conducting penetration testing and a preliminary source code review, and then test them for conformance to the VVSG.[71]

Confirmation by an EAC-accredited VSTL that a vendor's voting system conforms to the VVSG is the primary requirement for federal certification. The vendor must also document to the EAC that the system's software has been subjected to a "trusted build" and deposited in an EAC-approved repository and that it can be verified using the vendor's system identification tools.[72] Decisions about certification are made by the EAC's executive director or the executive director's

[68] EAC, *Voting System Test Laboratory Program Manual Version 3.0*, November 15, 2022, pp. 4, 7.

[69] EAC, *Voting System Test Laboratory Program Manual Version 3.0*, November 15, 2022, pp. 13, 24-26, 54.

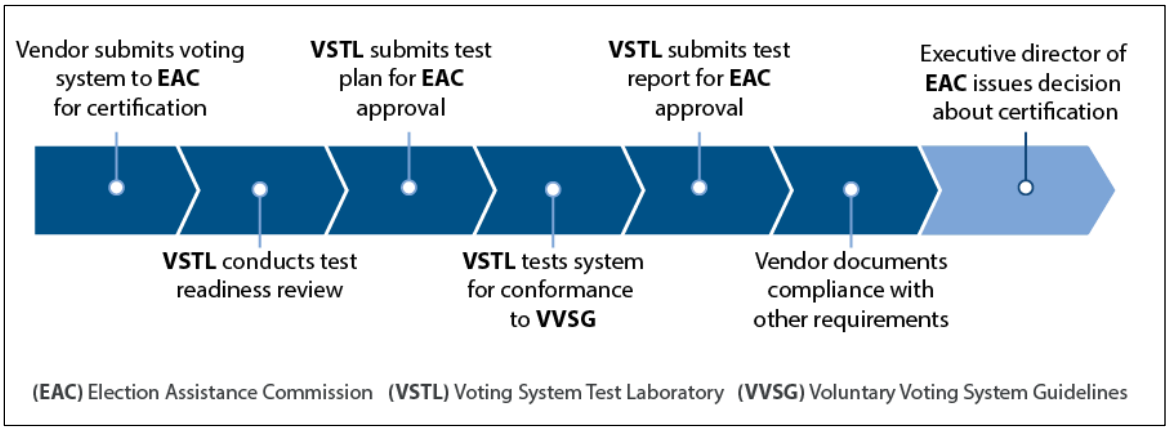
[70] EAC, *Voting System Testing and Certification Program Manual Version 3.0*, November 15, 2022, pp. 8-12.

[71] EAC, *Voting System Testing and Certification Program Manual Version 3.0*, November 15, 2022, pp. 24-30. Penetration testing was added to the process as part of the most recent update to the testing and certification program. See, for example, EAC, "U.S. Election Assistance Commission Adopts New Voluntary Voting System Guidelines 2.0."

[72] EAC, Voting System Testing and Certification Program Manual Version 3.0, November 15, 2022, pp. 36-38. For more on trusted builds, see EAC, Voting System Testing and Certification Program Manual Version 3.0, pp. 30-32; and EAC, "What Is a Trusted Build and Why Is It Used?" September 16, 2021, at https://www.eac.gov/what-trusted-build-and-why-it-used.

designee and subject to appeal to an Appeal Authority consisting of two or more EAC commissioners or commission appointees (for an illustration of the certification process, see **Figure 2**).[73]

Figure 2. Process for Certifying Voting Systems to the Voluntary Voting System Guidelines



Source: CRS, based on review of EAC, *Voting System Testing and Certification Program Manual Version 3.0*, November 15, 2022, at https://www.eac.gov/sites/default/files/TestingCertification/Testing%20and%20Certification%20Program%20Manual%20Version%203.0%20(2).pdf.

Vendors with certified systems must also meet program requirements after certification. For example, they must notify the EAC of any malfunctions of their fielded voting systems and participate in the agency's Quality Monitoring Program.[74] The Quality Monitoring Program, which is intended to supplement but not substitute for vendor quality control, involves EAC review of vendor manufacturing facilities and fielded voting systems, state and local reporting on voting system anomalies, and vendor submission of technical bulletins and product advisories.[75]

Failure to comply with such requirements could potentially lead to decertification of a certified system. The EAC's testing and certification program manual lists the following as grounds for decertification: (1) the voting system does not conform to the applicable VVSG; (2) the system has been modified or changed without following the manual's requirements; and (3) the vendor did not follow the manual's procedural requirements and the quality, configuration, or compliance of the system is in question. Decertifying a voting system can have significant consequences—

[73] EAC, *Voting System Testing and Certification Program Manual Version 3*.0, November 15, 2022, pp. 36-45.

[74] EAC, *Voting System Testing and Certification Program Manual Version 3*.0, November 15, 2022, pp. 9-10.

[75] EAC, *Voting System Testing and Certification Program Manual Version 3*.0, November 15, 2022, pp. 54-58. In addition to the long-standing Quality Monitoring Program, the EAC has initiated a Field Services Program that is aimed at helping local officials monitor election system quality. As part of that program, EAC Commissioner Donald Palmer testified in March 2023, the EAC will deploy staff to local jurisdictions to help officials ensure that the equipment they receive matches the system certified by the EAC and meets the conditions set out in the vendor contract, conduct voting system site surveys, assess best practices, collect system census information, and analyze anomaly reports. Testimony of EAC Commissioner Donald Palmer, in U.S. Congress, Committee on House Administration, *2022 Midterms Look Back Series: Government Voter Suppression in Luzerne County, Pennsylvania*, 118th Cong., 1st sess., March 28, 2023, pp. 1-2, at https://cha.house.gov/sites/evo-subsites/cha.house.gov/files/evo-media-document/eac-commissioner-donald-palmer-testimony-3.28.2023.pdf.

including for the states, localities, and voters that use it—so the EAC offers vendors opportunities to resolve issues before proceeding with decertification.[76]

Legislative Activity

HAVA established general procedures for developing the VVSG and for testing and certifying voting systems to the guidelines, but, as is often the case with statutory language, it did not specify all the details of how the procedures should work or what they should cover. Those specifics have been filled in by the EAC, its advisory bodies, and NIST, with input from the public. Some Members of Congress have introduced legislation to codify, change, or supplement those choices, offering bills on the VVSG development, testing, and certification processes or the scope of the guidelines.

Some Members have also proposed expanding the scope of mandatory federal standards for voting systems. The VVSG have significant influence in practice, as noted in the "Introduction" to this report, because many states have adopted some or all of the federal voting system testing and certification program. However, there are relatively few actual federal mandates for voting systems. While some Members favor limited involvement by the federal government in this area, others have seen a role for new federal requirements.

VVSG Development, Testing, and Certification Processes

HAVA provided for input by a range of elections stakeholders into VVSG development, testing, and certification by assigning roles in the processes to the EAC's statutory advisory bodies. The TGDC is charged with helping develop draft VVSG, and the Board of Advisors and Standards Board are responsible for reviewing the draft guidelines and consulting on VSTL monitoring and review (see **Table 4**).

The act explicitly designated seats on one or more of the advisory bodies for representatives of various types of interests and expertise (see **Table 3** for details), but not all potential stakeholders are guaranteed a seat. For example, none of the EAC's advisory bodies is required by HAVA to include representatives of voting system vendors or new stakeholders that have emerged since the act's enactment, such as DHS.[77]

Some of those stakeholders have been added to the advisory bodies in practice through appointment in other capacities. Representatives of voting system vendors and DHS have each been appointed to the TGDC in their capacities as technical experts, for example.[78] However,

[76] EAC, Voting System Testing and Certification Program Manual Version 3.0, November 15, 2022, pp. 46-53. See also, for example, U.S. Congress, Committee on House Administration, 2020 Election Security—Perspectives from Voting System Vendors and Experts, 116th Cong., 2nd sess., January 9, 2020, p. 286; and EAC, U.S. Election Assistance Commission Voting Fraud-Voter Intimidation Meeting, October 26, 2006, pp. 56-59, at https://www.eac.gov/sites/default/files/event_document/files/transcript%20public%20meeting%20october%2026%202006.pdf.

[77] The U.S. Department of Homeland Security (DHS) has taken on new responsibilities for election security following foreign efforts to interfere in the 2016 elections and the department's January 2017 designation of election systems as critical infrastructure. DHS, "Statement by Secretary Jeh Johnson on the Designation of Election Infrastructure as a Critical Infrastructure Subsector," January 6, 2017, at https://www.dhs.gov/news/2017/01/06/statement-secretary-johnson-designation-election-infrastructure-critical. For more on the critical infrastructure designation, see CRS In Focus IF10677, *The Designation of Election Systems as Critical Infrastructure*, by Brian E. Humphreys.

[78] See, for example, EAC TGDC, *Technical Guidelines Development Committee (TGDC) Member Roster*, December 8, 2022, p. 2, at https://www.eac.gov/sites/default/files/TechnicalGuidelinesDevelopmentCommittee/TGDC_Member_Roster_Dec_8_2022.pdf.

some legislation would formalize their participation. Some Members have proposed adding the Secretary of Homeland Security or the Secretary's designee to the Board of Advisors, for example, or adding representatives of CISA or the voting system manufacturing industry and voting system usability and accessibility sector to the TGDC.[79]

The bills described above focus on the participants in VVSG-related processes. Other legislative proposals would address the processes themselves. First, Members have introduced legislation related to development of the guidelines. The technical support function HAVA assigned NIST is a central part of the VVSG development process. NIST's research can inform choices about what to include in the guidelines, for example, and help develop technologies or methodologies that make them easier to implement.[80] Some bills would direct the agency to conduct research on particular topics related to voting systems, such as E2E-V systems and post-election audits, or to provide for voting system research, such as by administering a voting system research grant program or establishing a center of excellence in election systems.[81]

Second, Members have offered legislation related to voting system testing and certification. Some of those bills have focused on the technical side of testing and certification, specifying certain types or timing of testing. For example, some Members have proposed codifying inclusion of penetration testing in the testing and certification process or requiring retesting of federally certified systems for conformance to the VVSG before each regular federal general election.[82]

Other bills have addressed procedural aspects of testing and certification, such as conflicts of interest and transparency. Vendors currently choose and pay VSTLs for testing to the VVSG. Concerns about potential conflicts of interest have prompted some to propose a different funding arrangement, in which vendors would pay into a revolving fund or escrow account that would be used to fund testing, or codification of conflict-of-interest requirements for vendors or VSTLs.[83]

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[79] See, for example, the 110th Congress's Bipartisan Electronic Voting Reform Act of 2008 (S. 3212/S. 3722), the 116th Congress's Voting System Cybersecurity Act of 2019 (S. 1454), and the 117th Congress's For the People Act of 2021 (H.R. 1/S. 1/S. 2093).

[80] For example, NIST's research on usability and accessibility has shaped the content of guidelines on those topics and its common data formats work helps facilitate the interoperability required by VVSG 2.0.

[81] See, for example, the 116th Congress's Election Technology Research Act of 2020 (H.R. 4990) and Securing and Verifying Elections in America (SAVE America) Act (H.R. 8962) and the 117th Congress's Election Security Act of 2022 (S. 5332). Some of those and other bills have also focused on general oversight of or funding for NIST's voting systems work. The Election Technology Research Act of 2020 would have directed GAO to report to Congress on NIST's work on voting systems, for example, and the For the People Act of 2021 (H.R. 1/S. 1/S. 2093) would have prohibited the agency from using funding transferred from the EAC for that work unless it committed to reporting on its use of the funds. HAVA did not explicitly authorize funding for NIST for its role in voting system guidelines development, testing, and certification, but congressional appropriators have generally directed the EAC to transfer funding or make funding available to the agency for that purpose. See, for example, the Consolidated Appropriations Act, 2005 (P.L. 108-447) and the Consolidated Appropriations Act, 2023 (P.L. 117-328).

[82] See, for example, the 116th Congress's Nonpartisan Bill for the People Act of 2019 (H.R. 1612), the 117th Congress's Enhanced Election Security and Protection Act (S. 4574), and the 118th Congress's Strengthening Election Cybersecurity to Uphold Respect for Elections through Independent Testing (SECURE IT) Act (S. 1500). As noted in the "Testing and Certification" section of this report, under the current version of the EAC's testing and certification manual, voting systems submitted for federal testing and certification are subject to penetration testing as part of a pretesting test readiness review. EAC, *Voting System Testing and Certification Program Manual Version 3.0*, November 15, 2022, pp. 24-26. For a brief discussion of considerations related to penetration testing in voting system testing and certification, see EAC, *United States Election Assistance Commission Board of Advisors Meeting*, April 24-25, 2019, pp. 223-225.

[83] See, for example, the 109th Congress's Improving Electronic Voting Standards and Disclosure Act of 2005 (H.R. 470), the 110th Congress's Bipartisan Electronic Voting Reform Act of 2008 (S. 3722), the 113th Congress's EAC Improvements Act of 2013 (H.R. 2017), and the 114th Congress's Election Integrity Act of 2016 (H.R. 6072). The EAC is prohibited from collecting fees for this purpose by the Miscellaneous Receipts Act (31 U.S.C. §3302(b)). For (continued...)

Some Members have also proposed codifying access to information about voting system testing and certification. For example, they have introduced measures that would require VSTLs to allow the EAC to observe testing or require the EAC to disclose certain information about testing and certification to election officials or the general public.[84]

Scope of the VVSG

The VVSG cover voting systems as defined by the EAC, its advisory bodies, and NIST (for details of the definition of "voting system" used to set the scope of VVSG 2.0, see **Table 1**).[85] That means many of the systems used to administer elections—from the databases that store voter registration information to electronic poll books (e-poll books) used for voter check-in—are not addressed by the guidelines or subject to federal testing and certification.[86]

Problems with those systems can have significant consequences. For example, inaccurate or incomplete voter registration information could discourage or prevent eligible voters from casting ballots.[87] Reports of crashing or freezing e-poll books could be used to spread misinformation, undermining voter confidence.[88]

Much as problems with voting systems spurred support for federal voting system guidelines, concerns about such potential consequences have prompted some to propose federal guidance for other election systems.[89] Federal agencies have taken some action on such proposals under their

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discussion of testing payment practices in other sectors, see EAC, *U.S. Election Assistance Commission Voting Fraud-Voter Intimidation Meeting*, October 26, 2006, pp. 54-55, at https://www.eac.gov/sites/default/files/event_document/files/transcript%20public%20meeting%20october%2026%202006.pdf.

[84] See, for example, the 109th Congress's Secure America's Vote Act of 2005 (H.R. 3094), the 110th Congress's Bipartisan Electronic Voting Reform Act of 2008 (S. 3722), and the 113th Congress's EAC Improvements Act of 2013 (H.R. 2017). The EAC's current policy is "to make all documents, or severable portions thereof, [related to the voting system testing and certification program] available to the public consistent with federal law (e.g., Freedom of Information Act and the Trade Secrets Act)." EAC, *Voting System Testing and Certification Program Manual Version 3.0*, November 15, 2022, p. 62. The agency publishes information about its testing and certification program, including the VSTLs it has accredited and voting systems it has certified, on its website. See, for example, EAC, "System Certification Process," at https://www.eac.gov/voting-equipment/system-certification-process; EAC, "Voting System Test Laboratories (VSTL)," at https://www.eac.gov/voting-equipment/voting-system-test-laboratories-vstl; EAC, "Withdrawn or Decertified Systems," at https://www.eac.gov/voting-equipment/withdrawn-or-decertified-systems; and EAC, "Certified Voting Systems."

[85] See, for example, EAC, *United States Election Assistance Commission Board of Advisors Meeting*, May 5, 2016, pp. 62-69, at https://www.eac.gov/sites/default/files/event_document/files/EAC.5.5.16.Board_of_Advisors.Verbatim.pdf; and NIST, *VVSG 2.0 Voting System Definition Update*, p. 9, at https://www.eac.gov/sites/default/files/2019-12/VVSGVotingSystemDefinition_TGDC_JohnWack_121819.pdf.

[86] The primary function of e-poll books—enabling voters to check in electronically at the polls—is not covered by the scope of VVSG 2.0. However, e-poll books can also be used to perform other tasks that are covered, such as ballot activation. Therefore, although e-poll books are not generally subject to the federal voting system testing and certification program, there are some circumstances in which they may be included in testing. EAC, *Requirements for the Voluntary Voting System Guidelines 2.0*, p. 27.

[87] See, for example, U.S. Congress, House Committee on the Judiciary, *Securing America's Elections*, 116th Cong., 1st sess., September 27, 2019, p. 40; and EAC, *Roundtable Discussion: E-Poll Book Testing Pilot Program Considerations*, November 17, 2021, at https://www.eac.gov/events/2021/11/17/roundtable-discussion-e-poll-book-testing-pilot-program-considerations. For more on the security of voter registration systems, see CRS In Focus IF11285, *Election Security: Voter Registration System Policy Issues*, by Sarah J. Eckman.

[88] See, for example, David Levine and Edward Perez, *Enhancing the Security of Electronic Pollbooks Is Essential for Election Integrity*, Paper for Election Integrity Project Virtual Workshop on Delivering Trusted Elections: New Challenges in Electoral Integrity, July 5-9, 2021, pp. 10-12, at https://trustthevote.org/wp-content/uploads/2021/06/26Jun21_EPollbooks-Levine_Perez.pdf.

[89] See, for example, National Academies of Sciences, Engineering, and Medicine, *Securing the Vote: Protecting American Democracy*, 2018, pp. 72-73 and 83, at https://nap.nationalacademies.org/download/25120#.

existing authorities. For example, various agencies have issued best practices for nonvoting election systems,[90] and the EAC has launched pilot programs to test and develop guidelines for them.[91]

Some Members have also introduced bills to expand the scope of federal testing and certification to include new systems. For example, they have offered legislation that would extend the VVSG and federal testing and certification to e-poll books and remote ballot-marking systems.[92]

In addition to expanding the scope of the systems covered by the VVSG, some Members have proposed codifying or expanding the scope of the guidelines' subject matter. HAVA does not explicitly say what the VVSG should cover. Floor proceedings on the act and the issues it lists as possible subjects of research by NIST might offer a sense of the kinds of topics Congress had in mind,[93] but the text of HAVA leaves open choices about exactly what to address.[94]

Some legislative proposals would codify or add some specifics. Some Members have introduced legislation to require the VVSG to include guidelines for securing data transmitted electronically to or from voting systems, for example, or to direct the TGDC to issue election cybersecurity guidelines and the EAC to provide for testing and certification to them.[95]

Scope of Mandatory Standards

Congress has used mandatory standards for voting systems to try to advance general objectives for the administration of elections, such as in VAEHA and the VRA. It has also set requirements for voting systems in response to developments in particular election cycles. HAVA's voting system standards, for example, were largely a response to problems highlighted by the 2000 elections.

Similar considerations have prompted proposals to add new standards. Some Members have proposed setting new requirements for voting systems as part of attempts to advance long-

[90] See, for example, CISA, "Election Security," at https://www.cisa.gov/topics/election-security; and NIST, "Election Security," at https://www.nist.gov/itl/voting/research-and-projects/election-security.

[91] See, for example, EAC, *2023 Election Supporting Technology Evaluation Program (ESTEP)*, January 2023, at https://www.eac.gov/sites/default/files/2023-01/TGDC%20ESTEP%20Presentation_508.pdf; Testimony of EAC Commissioners, in U.S. Congress, Senate Committee on Rules and Administration, *Hearing on Oversight of the U.S. Election Assistance Commission*, 118th Cong., 1st sess., June 7, 2023, p. 8; and EAC, "U.S. Election Assistance Commission and the Center for Internet Security Partner on Non-Voting Election Technology Verification Pilot Program," press release, June 17, 2020, at https://www.eac.gov/news/2020/06/17/us-election-assistance-commission-and-center-internet-security-partner-non-voting. For discussion of differences between voting and nonvoting systems and how they might inform choices about testing nonvoting systems, see EAC, *U.S. Election Assistance Commission Technical Guidelines Development Committee*, August 12, 2020, pp. 51-57, at https://www.eac.gov/sites/default/files/2020-08/tgdc_meeting_on_081220_transcript.pdf.

[92] See, for example, the 117th Congress's Election Security Act of 2022 (S. 5332) and Freedom to Vote: John R. Lewis Act (H.R. 5746).

[93] As it has been defined to date, the scope of the VVSG has not covered all of the potential NIST research topics listed by HAVA. For example, HAVA lists remote access voting and the security of statewide voter registration databases as possible subjects of NIST research, but neither is included in the scope of VVSG 2.0. EAC, *Requirements for the Voluntary Voting System Guidelines 2.0*, pp. 10-11, 13.

[94] A lead sponsor of HAVA confirmed during floor proceedings on the bill that the VVSG were intended to address "the usability, accuracy, security, accessibility, and integrity of voting systems, including those areas described [as possible subjects of research by NIST]," but those specifics were not included in the text of the act. Rep. Vernon Ehlers and Rep. Robert Ney, "Conference Report on H.R. 3295, Help America Vote Act of 2002," *Congressional Record*, vol. 148, part 133 (October 10, 2002), p. H7842.

[95] See, for example, the 110th Congress's Know Your Vote Counts Act of 2007 (H.R. 3500) and the 116th Congress's Election Security Act of 2019 (H.R. 2660/S. 1540).

standing elections objectives, such as accurately capturing and counting voters' selections, and in response to developments in specific cycles, such as foreign efforts to interfere in the 2016 elections.

Some of those proposals would establish or codify standards for the vendors who manufacture and maintain voting systems used in federal elections. For example, some Members have proposed limiting foreign ownership or control of voting system vendors and requiring vendors to build their systems in the United States, use only domestically sourced parts, or disclose any foreign sourcing.[96] They have proposed requiring vendors to report certain security incidents; ensure that their information technology infrastructure meets certain cybersecurity standards; and share information about their voting system software, such as by depositing a copy of the software in an approved repository, disclosing its source code, or reporting certain information about the staff involved in developing it.[97]

Other bills would set standards for the voting systems themselves. One such proposal, which has been introduced in similar form in each Congress since HAVA's enactment in the 107th Congress, would require voting systems used in federal elections to produce individual paper records that can be verified by voters and manually audited by election officials.[98] Other examples include proposals to set mandatory standards for voting system cybersecurity and accessibility, require voting systems to support instant runoff voting, prohibit wireless components or internet connectivity, and mandate compliance with interoperability and auditability provisions of the VVSG.[99]

Potential Considerations for Congress

Policymaking about voting systems comes with some complexities. First, voting systems are expected to achieve many different objectives. They are expected to capture and count votes accurately and reliably, for example, and to offer the public confidence that they do so. They have to be accessible to individuals with disabilities and usable by voters and election workers, protect voter privacy and ballot secrecy, and facilitate timely reporting of election results.

[96] See, for example, the 115th Congress's Protect Election Systems from Foreign Control Act (H.R. 6449); the 116th Congress's Secure American-Made Voting Machines Act (H.R. 2652) and Securing America's Federal Elections (SAFE) Act (H.R. 2722/S. 2053/S. 2238); and the 117th Congress's American Election Security Act (H.R. 589), For the People Act of 2021 (H.R. 1/S. 1/S. 2093), and Protect Our Elections Act (H.R. 6574).

[97] See, for example, the 109th Congress's Improving Electronic Voting Standards and Disclosure Act of 2005 (H.R. 470) and Secure America's Vote Act of 2005 (H.R. 3094), the 110th Congress's Election Software Disclosure Act of 2008 (H.R. 7245) and Vote Integrity and Verification Act of 2007 (S. 559), the 112th Congress's Verifying Official Totals for Elections (VOTE) Act (H.R. 6246), the 115th Congress's Protect Election Systems from Foreign Control Act (H.R. 6449), the 116th Congress's Securing America's Federal Elections (SAFE) Act (H.R. 2722/S. 2053/S. 2238), and the 117th Congress's Protect Our Elections Act (H.R. 6574). As noted in the "Testing and Certification" section of this report, the EAC currently requires vendors to meet some of these or similar requirements in order to obtain and maintain federal certification for their voting systems.

[98] See, for example, the 108th Congress's Voter Confidence and Increased Accessibility Act of 2003 (H.R. 2239/S. 1980), the 117th Congress's Freedom to Vote Act (S. 2747), and the 118th Congress's Securing America's Elections Act of 2023 (H.R. 466).

[99] See, for example, the 109th Congress's Voter Choice Act of 2005 (H.R. 2690); the 114th Congress's Election Integrity Act of 2016 (H.R. 6072); the 116th Congress's Protecting American Votes and Elections Act of 2019 (H.R. 2754) and Securing America's Federal Elections (SAFE) Act (H.R. 2722/S. 2053/S. 2238); the 117th Congress's Election Audit Transparency Act (H.R. 1070), Election Technology Integrity and Fraud Prevention Act (H.R. 1071), No Wireless Installations in Federal Instruments for Voting (No WIFI) Act (H.R. 1634), and Safe and Certain Elections Act (H.R. 5037); and the 118th Congress's Election Integrity Act of 2023 (H.R. 3257).

Standards or guidelines that are intended to advance one of those objectives could introduce challenges for achieving others. For example, requirements aimed at increasing the security of voting systems could affect their usability or accessibility.[100] Efforts to expedite results reporting could make it more difficult to ensure—or assure the public—that voting systems are secure.[101]

Second, implementation of voting systems is subject to some practical constraints. With a few exceptions, voting systems are financed by states and localities and compete for limited state and local funds with other priorities like potholes and policing.[102] Implementing voting systems involves various, often cost- and time-intensive processes—from the checks described in the "Background" section of this report to state and local procurement processes to voter education and poll worker training—and is bound by state limits on preelection changes and the firm deadline of Election Day.[103]

Those practical constraints help shape the dynamics of the voting system market. States and localities tend not to replace their voting systems often and to be price sensitive when they do.[104] The limited demand for new systems, combined with barriers to entry like the high upfront costs of testing and certification and potential reputational risks of misinformation or missteps, means that the market is relatively small with limited capacity to influence its suppliers.[105] The irregularity of the demand means that much of vendors' revenue comes from license and support fees rather than new equipment sales or leases, limiting the incentive to invest in innovation.[106]

New voting system standards or guidelines have the potential to interact with those practical constraints and market dynamics in ways Members might not intend. Some requirements might

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[100] See, for example, EAC, *United States Election Assistance Commission Technical Guidelines Development Committee*, September 11, 2017, pp. 71-72, at https://www.eac.gov/sites/default/files/event_document/files/EAC_TGDC_091117verbatim1.pdf; and EAC, *United States Election Assistance Commission Public Meeting*, August 23, 2005, pp. 116-122.

[101] See, for example, Kim Zetter, "The Myth of the Hacker-Proof Voting Machine," *The New York Times Magazine*, February 21, 2018, at https://www.nytimes.com/2018/02/21/magazine/the-myth-of-the-hacker-proof-voting-machine.html.

[102] See, for example, CISA, *Election Infrastructure Subsector-Specific Plan: An Annex to the NIPP 2013*, 2020, p. 10, at https://www.cisa.gov/sites/default/files/publications/election_infrastructure_subsector_specific_plan.pdf; and Kathleen Hale, Robert Montjoy, and Mitchell Brown, *Administering Elections: How American Elections Work* (New York, NY: Palgrave Macmillan, 2015), p. 44, at https://link.springer.com/chapter/10.1057/9781137388452_2. Congress provided funding for replacing lever and punch card voting systems after the 2000 elections and has sometimes appropriated more general elections funding that states can choose to put toward replacing or upgrading their voting systems. For more on those funds, see CRS Report R46646, *Election Administration: Federal Grant Funding for States and Localities*, by Karen L. Shanton.

[103] See, for example, Edward Perez, *Moving the Needle on Voting System Updates: Improving the Process as a Matter of National Security*, OSET Institute, August 2019, p. 9, at https://trustthevote.org/wp-content/uploads/2019/08/02Aug_Briefing-VSUpdateChallenges-v3.1_Final.pdf.

[104] See, for example, Ben Wofford, "One Man's Quest to Break Open the Secretive World of American Voting Machines," *Politico Magazine*, June 25, 2021, at https://www.politico.com/news/magazine/2021/06/25/voting-machines-costs-election-technology-democracy-matthew-caulfield-483080; and The Wharton School of the University of Pennsylvania, *The Business of Voting: Market Structure and Innovation in the Election Technology Industry*, March 15, 2017, at https://verifiedvoting.org/wp-content/uploads/2021/05/the-business-of-voting-single-page.pdf.

[105] See, for example, Matthew Caulfield et al., *The Price of Voting: Today's Voting Machine Marketplace*, Verified Voting, March 2021, at https://verifiedvoting.org/wp-content/uploads/2021/03/Price-of-Voting-FINAL2.pdf; Election Reform Information Project, *Election Reform Briefing: The Business of Elections*, August 2004, p. 9, at https://electionline.org/wp-content/uploads/2018/09/The_Business_of_Elections.pdf; and U.S. Congress, Committee on House Administration, *2020 Election Security—Perspectives from Voting System Vendors and Experts*, 116th Cong., 2nd sess., January 9, 2020, pp. 58-59.

[106] See, for example, Matthew Caulfield et al., *The Price of Voting: Today's Voting Machine Marketplace*, Verified Voting, March 2021, pp. 46-51; and Edward Perez, *Moving the Needle on Voting System Updates: Improving the Process as a Matter of National Security*, OSET Institute, August 2019, pp. 2-4.

be at odds with the practical realities of producing and implementing voting systems, making it difficult or impossible for vendors or states and localities to meet them.[107] For example, voting system vendors testified at a 2020 hearing that they would not be able to comply with a requirement to source all of their components domestically because some of the parts they need are not manufactured in the United States and they do not have the market power to change their suppliers' practices.[108] Some state and local officials reported in discussions of a bill introduced in the 110th Congress that they would not be able to implement the proposed changes to their voting systems on the timeline laid out in the bill.[109]

Increased costs or practical challenges of meeting new standards or guidelines could also prompt voting system vendors to exit or opt against entering the space, further consolidating the market and potentially limiting state and local access to technical support for existing systems.[110] Financial or practical hurdles could lead some states to opt out of federal testing and certification,[111] limiting the influence of the VVSG not only in those states but also in general.[112]

The complexities of voting system policymaking might prompt Congress to keep the federal status quo on voting systems in place. Congress might choose to leave changes to voting system policy, if any, to states and localities.

Alternatively, Members might choose to consider whether or how to account for the complexities when designing standards and guidelines, balancing their overarching priorities for voting systems against other objectives and practical constraints. For example, they might set deadlines in consultation with election officials or offer flexibility about how standards and guidelines are implemented, specifying what voting systems should do rather than exactly how they should do it.[113]

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[107] See, for example, Jessica Huseman, "State Lawmakers Need to Consider Practical Realities When It Comes to Elections," *Votebeat*, February 13, 2023, at https://www.votebeat.org/2023/2/13/23594541/voting-machines-costs-state-lawmakers-procurement.

[108] U.S. Congress, Committee on House Administration, *2020 Election Security—Perspectives from Voting System Vendors and Experts*, 116th Cong., 2nd sess., January 9, 2020, pp. 53, 58-59.

[109] See, for example, U.S. Congress, Committee on House Administration, Subcommittee on Elections, *Election Reform: H.R. 811*, 110th Cong., 1st sess., March 23, 2007, p. 114; and U.S. Congress, House Committee on House Administration, *Markup of H.R. 811; Consideration of Four Election Contests; and Consideration of a Committee Franking Allocation Resolution*, 110th Cong., 1st sess., May 8, 2007, pp. 113, 129, 251.

[110] See, for example, EAC, *United States Election Assistance Commission Public Meeting: Interdisciplinary Roundtable Discussion*, May 5, 2008, pp. 114-116, 175-176, at https://www.eac.gov/sites/default/files/event_document/files/transcript%20roundtable%20may%205%202008.pdf; and EAC, *United States Election Assistance Commission Public Meeting: Voting Systems Manufacturer Roundtable Discussion*, February 29, 2008, pp. 10-11, 16-20.

[111] Some states have withdrawn or considered withdrawing from the federal voting system testing and certification program in the past, when they felt it was not sufficiently meeting their needs. See, for example, EAC, *Reforming the Testing and Certification Process*, June 12, 2014, pp. 74-75; EAC, *United States Election Assistance Commission Public Meeting*, April 23, 2019, pp. 129-130; EAC, *United States Election Assistance Commission Public Hearing*, April 10, 2019, pp. 92-93, at https://www.eac.gov/sites/default/files/event_document/files/EAC041019Verbatim.pdf; and EAC, *United States Election Assistance Commission Standards Board*, February 26, 2009, pp. 119-121, at https://www.eac.gov/sites/default/files/event_document/files/transcript%20standards%20board%20february%2026%202009.pdf.

[112] As noted in the "Introduction" to this report, the VVSG currently have significant influence in practice due to widespread adoption of the federal testing and certification program by the states. Decisions by states to opt out of the program could undermine that effect, reducing the incentive for vendors to build their voting systems to the VVSG or pursue federal certification. See, for example, EAC, *United States Election Assistance Commission Public Meeting: Interdisciplinary Roundtable Discussion*, May 5, 2008, p. 28.

[113] For discussions of this distinction in the context of the VVSG, see EAC, *Reforming the Testing and Certification*
(continued...)

Another possible option for Members interested in engaging with voting system policy might be to explore avenues other than standards and guidelines. Some have proposed using other legislative tools to advance voting system priorities, such as

- **Funding.** Congress can use federal funding to facilitate or incentivize choices about voting systems, including by limiting use of funding to systems with certain features or to systems or services from vendors who meet certain criteria. For example, multiple bills in the 117th Congress, including the Election Security Act of 2022 (S. 5332) and the For the People Act of 2021 (H.R. 1/S. 1/S. 2093), would have authorized funding for voting systems that met certain conditions or goods and services from "qualified election infrastructure vendors" who complied with certain requirements.

  Funding might also be used to shape the voting system market itself. Some bills, such as the Freedom to Vote Act (S. 2747) and the Freedom to Vote: John R. Lewis Act (H.R. 5746) in the 117th Congress and the Sustaining Our Democracy Act (S. 630) in the 118th Congress, would provide for ongoing funding states could use to upgrade their voting systems. Such a consistent stream of federal funding might shift dynamics of the current voting system market that are shaped by the limited and irregular demand for new equipment.[114]
- **Research.** Federal agency research, or agency-funded research, can help identify both general improvements to voting systems and solutions to specific voting system-related problems. For example, HAVA authorized a pair of election technology research grant programs at the EAC that have been used for Accessible Voting Technology, Military Heroes, and Pre-Election Logic and Accuracy Testing and Post-Election Audit initiatives, and NIST led development of common formats for elections data.[115] The Defense Advanced Research Projects Agency (DARPA) has also contributed to advancing development of a secure, open-source voting system, and the National Science Foundation (NSF) has awarded grants for voting technology research.[116]

  Some Members have introduced bills that would provide for other voting system research or research grant programs. Those bills include the NIST research proposals described in the "VVSG Development, Testing, and Certification

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Process, June 12, 2014; Sharon J. Laskowski et al., *Improving the Usability and Accessibility of Voting Systems and Products*, NIST, May 2004, at https://tsapps.nist.gov/publication/get_pdf.cfm?pub_id=906168; and AEI-Brookings Election Reform Project VVSG Task Force, *A Review of Proposed Voluntary Voting System Guidelines: A Report of the AEI-Brookings Election Reform Project VVSG Task Force*, May 8, 2008, https://www.brookings.edu/wp-content/uploads/2016/06/0520_voting.pdf.

[114] See, for example, The Wharton School of the University of Pennsylvania, *The Business of Voting: Market Structure and Innovation in the Election Technology Industry*, March 15, 2017, p. 33; and U.S. Congress, Committee on House Administration, *2020 Election Security—Perspectives from Voting System Vendors and Experts*, 116th Cong., 2nd sess., January 9, 2020, p. 272. For more on federal funding for elections in general, see CRS Report R46646, *Election Administration: Federal Grant Funding for States and Localities*, by Karen L. Shanton; and CRS Report WPD00035, *Federal Role in Elections Funding*, by Karen L. Shanton.

[115] 52 U.S.C. §§21041-21043; 52 U.S.C. §§21051-21053; EAC, "Discretionary Grants," at https://web.archive.org/web/20200622235023/https://www.eac.gov/payments-and-grants/discretionary-grants/; and NIST, "Interoperability," at https://www.nist.gov/itl/voting/interoperability.

[116] See, for example, U.S. Congress, House Committee on Science, Space, and Technology, Subcommittee on Investigations and Oversight and Subcommittee on Research and Technology, *Election Security: Voting Technology Vulnerabilities*, 116th Cong., 1st sess., June 25, 2019, pp. 168-169.

Processes" section of this report, as well as the proposals to assign voting system research or research grant programs to other agencies in legislation like the 115th Congress's Protecting the American Process for Election Results (PAPER) Act (H.R. 3751) and Election Infrastructure and Security Promotion Act of 2017 (H.R. 1907); the 116th Congress's Election Security Assistance Act (H.R. 3412) and Election Technology Research Act of 2020 (H.R. 4990); and the 117th Congress's Accessible Voting Act of 2021 (H.R. 2941/S. 1470), Securing America's Elections Act of 2021 (H.R. 4384), and Election Security Act of 2022 (S. 5332).[117]

- **Technical assistance.** Technical assistance from federal agencies can help states, localities, and vendors carry out work on their voting systems that they might not choose to do—or lack the technical or financial capacity to do—on their own. For example, the EAC has initiated a Field Services Program to help states and localities monitor the quality of their voting systems and provided assistance with implementing risk-limiting audits.[118] CISA has offered states, localities, and vendors a range of election security services, such as risk and vulnerability assessments, cyber hygiene scans, and the open-ended vulnerability assessments available under its Critical Product Evaluation Program.[119]

  Some Members have proposed codifying some of the assistance federal agencies currently offer or establishing new kinds of agency support. The 116th Congress's Election Security Act of 2019 (H.R. 2660/S. 1540) and the 117th Congress's For the People Act of 2021 (H.R. 1/S. 1/S. 2093) would have codified CISA's risk and vulnerability assessments, for example, and the 117th Congress's American Confidence in Elections (ACE) Act (H.R. 8528) would have provided for voluntary cybersecurity vulnerability testing by CISA and the EAC. The 116th Congress's Election Security Assistance Act (H.R. 3412) would have established an Election Cyber Assistance Unit at the EAC, and the 117th Congress's Accessible Voting Act of 2021 (H.R. 2941/S. 1470) would have created an EAC Office of Accessibility and National Resource Center on Accessible Voting.

Members might also choose to consider acting on other congressional authorities, such as oversight or appointment authorities, instead of or in addition to pursuing legislation. For example, as noted in the "Voluntary Guidelines" section of this report, updates to the VVSG and accreditation of labs to test systems to the guidelines require approval by a three-vote majority of the EAC's commissioners, and lack of a quorum has sometimes delayed that work. HAVA assigns Congress roles in recommending and confirming candidates for the commission, and some Members might choose to focus on ensuring the continued availability of a quorum.

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[117] See also, for example, National Academies of Sciences, Engineering, and Medicine, *Securing the Vote: Protecting American Democracy*, 2018, p. 123.

[118] See, for example, Testimony of EAC Commissioner Donald Palmer, in U.S. Congress, Committee on House Administration, *2022 Midterms Look Back Series: Government Voter Suppression in Luzerne County, Pennsylvania*, 118th Cong., 1st sess., March 28, 2023, pp. 1-2; and EAC, *2020 Annual Report*, p. 47, at https://www.eac.gov/sites/default/files/document_library/files/EAC_2020_Annual_Report-508c.pdf.

[119] See, for example, Testimony of Matthew Masterson, in U.S. Congress, House Committee on Homeland Security, Subcommittee on Cybersecurity, Infrastructure Protection, and Innovation, *Securing Democracy: Protecting Against Threats to Election Infrastructure and Voter Confidence*, 117th Cong., 2nd sess., January 20, 2022, pp. 11-12; and CISA, "Election Security Services."

Appendix. Principles and Guidelines of Voluntary Voting System Guidelines 2.0 (VVSG 2.0)

Table A-1. Principles and Guidelines of Voluntary Voting System Guidelines 2.0 (VVSG 2.0)

Principles	Guidelines
Principle 1: High quality design The voting system is designed to accurately, completely, and robustly carry out election processes.	1.1—The voting system is designed using commonly accepted election process specifications. 1.2—The voting system is designed to function correctly under real-world operating conditions. 1.3—Voting system design supports evaluation methods enabling testers to clearly distinguish systems that correctly implement specified properties from those that do not.
Principle 2: High quality implementation The voting system is implemented using high quality best practices.	2.1—The voting system and its software are implemented using trustworthy materials and best practices in software development. 2.2—The voting system is implemented using best practice user-centered design methods that consider a wide range of representative voters, including those with and without disabilities, and election workers. 2.3—Voting system logic is clear, meaningful, and well-structured. 2.4—Voting system structure is modular, scalable, and robust. 2.5—The voting system supports system processes and data with integrity. 2.6—The voting system handles errors robustly and gracefully recovers from failure. 2.7—The voting system performs reliably in anticipated physical environments.
Principle 3: Transparent The voting system and voting processes are designed to provide transparency.	3.1—The documentation describing the voting system design, operation, accessibility features, security measures, and other aspects of the voting system can be read and understood. 3.2—The processes and transactions, both physical and digital, associated with the voting system are readily available for inspection. 3.3—The public can understand and verify the operations of the voting system throughout the entirety of the election.
Principle 4: Interoperable The voting system is designed to support interoperability in its interfaces to external systems, its interfaces to internal components, its data, and its peripherals.	4.1—Voting system data that is imported, exported, or otherwise reported, is in an interoperable format. 4.2—Standard, publicly available formats for other types of data are used, where available. 4.3—Widely-used hardware interfaces and communications protocols are used. 4.4—Commercial-off-the-shelf (COTS) devices can be used if they meet applicable VVSG requirements.
Principle 5: Equivalent and consistent voter access All voters can access and use the voting system regardless of their abilities.	5.1—Voters have a consistent experience throughout the voting process within any method of voting. 5.2—Voters receive equivalent information and options in all modes of voting.
Principle 6: Voter privacy	6.1—The voting process preserves the privacy of the voter's interaction with the ballot, modes of voting, and vote selections.

Principles	Guidelines
Voters can mark, verify, and cast their ballot privately and independently.	6.2—Voters can mark, verify, and cast their ballot or other associated cast vote record, 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.	7.1—The default voting system settings present a ballot usable for the widest range of voters, and voters can adjust settings and preferences to meet their needs. 7.2—Voters and election workers can use all controls accurately, and voters have direct control of all ballot changes and selections. 7.3—Voters can understand all information as it is presented, including instructions, messages from the system, and error messages.
Principle 8: Robust, safe, usable, and accessible The voting system and voting processes provide a robust, safe, usable, and accessible experience.	8.1—The voting system's hardware, software, and accessories are robust and do not expose users to harmful conditions. 8.2—The voting system meets currently accepted federal standards for accessibility. 8.3—The voting system is evaluated for usability with a wide range of representative voters, including those with and without disabilities. 8.4—The voting system is evaluated for usability with election workers.
Principle 9: Auditable The voting system is auditable and enables evidence-based elections.	9.1—An error or fault in the voting system software or hardware cannot cause an undetectable change in election results. 9.2—The voting system produces readily available records that provide the ability to check whether the election outcome is correct and, to the extent possible, identify the root cause of any irregularities. 9.3—Voting system records are resilient in the presence of intentional forms of tampering and accidental errors. 9.4—The voting system supports efficient audits.
Principle 10: Ballot secrecy The voting system protects the secrecy of voters' ballot selections.	10.1—Ballot secrecy is maintained throughout the voting process. 10.2—The voting system does not contain nor produce records, notifications, information about the voter or other election artifacts that can be used to associate the voter's identity with the voter's intent, choices, or selections.
Principle 11: Access control The voting system authenticates administrators, users, devices, and services before granting access to sensitive functions.	11.1—The voting system enables logging, monitoring, reviewing, and modifying of access privileges, accounts, activities, and authorizations. 11.2—The voting system limits the access of users, roles, and processes to the specific functions and data to which each entity holds authorized access. 11.3—The voting system supports strong, configurable authentication mechanisms to verify the identities of authorized users and includes multi-factor authentication mechanisms for critical operations. 11.4—The voting system's default access control policies enforce the principles of least privilege and separation of duties. 11.5—Logical access to voting system assets are revoked when no longer required.
Principle 12: Physical security The voting system prevents or detects attempts to tamper with voting system hardware.	12.1—The voting system supports mechanisms to detect unauthorized physical access. 12.2—The voting system only exposes physical ports and access points that are essential to voting operations.
Principle 13: Data protection	13.1—The voting system prevents unauthorized access to or manipulation of configuration data, cast vote records, transmitted data, or audit records.

Principles	Guidelines
The voting system protects data from unauthorized access, modification, or deletion.	13.2—The source and integrity of electronic tabulation reports are verifiable.
	13.3—All cryptographic algorithms are public, well-vetted, and standardized.
	13.4—The voting system protects the integrity, authenticity, and confidentiality of sensitive data transmitted over all networks.
Principle 14: System integrity The voting system performs its intended function in an unimpaired manner, free from unauthorized manipulation of the system, whether intentional or accidental.	14.1—The voting system uses multiple layers of controls to provide resiliency against security failures or vulnerabilities.
	14.2—The voting system is designed to limit its attack surface by avoiding unnecessary code, data paths, connectivity, and physical ports, and by using other technical controls.
	14.3—The voting system maintains and verifies the integrity of software, firmware, and other critical components.
	14.4—Voting system software updates are authorized by an administrator prior to installation.
Principle 15: Detection and monitoring The voting system provides mechanisms to detect anomalous or malicious behavior.	15.1—Voting system equipment records important activities through event logging mechanisms, which are stored in a format suitable for automated processing.
	15.2—The voting system generates, stores, and reports all error messages as they occur.
	15.3—The voting system is designed to protect against malware.
	15.4—A voting system with networking capabilities employs appropriate, well-vetted modern defenses against network-based attacks, commensurate with current best practice.

Source: U.S. Election Assistance Commission, *Requirements for the Voluntary Voting System Guidelines 2.0*, February 10, 2021, pp. 21-25, at https://www.eac.gov/sites/default/files/TestingCertification/Voluntary_Voting_System_Guidelines_Version_2_0.pdf.

Notes: In addition to the high-level principles and guidelines listed in this table, VVSG 2.0 includes more detailed technical requirements voting systems must meet to receive federal certification. Additional guidance from the EAC on testing and certifying voting systems to VVSG 2.0 is also available in test assertions and program manuals for voting system vendors and test laboratories.

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