Revised Performance Features
The revised Standards provide new or expanded coverage of the following functional and technical system capabilities:

- **Election Management Functions**: Performance requirements are specified for components that define, develop and maintain election databases; perform election definition and setup functions; format ballots; count votes; consolidate and report results; and maintain audit trails.

- **Feedback to Voter**: Performance requirements are defined for DRE systems and for paper-based precinct-based systems in order to provide direct feedback to the voter that indicates when an undervote or overvote is detected.

- **Accessibility**: Performance requirements are defined for voting systems so that a system can meet the specific needs of voters with disabilities. These requirements were developed by the Access Board, a federal agency responsible for developing accessibility standards. The requirements are based on the accessibility standards for electronic and information technology established in 36 CFR Part 1194 - Electronic and Information Technology Accessibility Standards, which implement Section 508 of the Rehabilitation Act Amendments of 1998. The requirements provide common standards that must be met by all voting devices claiming accessibility and specific standards related to various types of DRE voting systems.

- **Audit Trails**: Performance requirements for audit trails are strengthened to address the full range of election management functions, including such functions as ballot definition and election programming.

- **Telecommunications**: Performance requirements are defined for hardware and software components of voting systems that transmit voting-related information using public telecommunications components. These requirements apply to systems where data is carried between devices at a single site, and systems where data is carried between devices in two geographically distinct locations. Systems must be designed to provide the secure transfer of many distinct types of data, including lists of eligible voters, voter authentication information, ballot definition information, and vote transmission and tabulation information. Due to the limits of existing technology to prevent unauthorized use of data, the Standards include some blanket prohibitions against the communication or transfer of certain types of data via telecommunications under any circumstances.

- **Broadcasting of Unofficial Results**: Performance requirements are defined for the content and labeling of data provided to the media and other organizations (in reports, data files, or postings to official Web sites) prior to the canvass and certification of election results.

Revised Test Features
The revised Standards also provide a restructured and expanded description of the tests performed by ITAs:

- **Expanded Testing Standards**: Additional tests are defined to address the expanded functional and technical requirements for voting systems.

- **Stages in the Test Process**: The test process is re-defined in terms of pre-testing, testing, and post-testing activities.
Voting Systems Standards: An Overview

Issues Not Addressed by the Revised Standards

This revision to the Standards do not provide sufficient guidance for a number of important issues. Some of these issues are outside the scope of the Standards, some are only partially addressed by the Standards, and some will be addressed in future modules of the Standards. These issues include:

- Administrative Functions: The revised Standards do not address administrative and managerial practices outside the direct control of the vendor. Election officials have long recognized that adequate Standards and test criteria are only part of the formula for ensuring that votes are cast and counted in an accurate manner. The other key component that is often overlooked in the rush to embrace technological solutions to election problems is efficient and consistent administration and management. Effective administration at the local level requires the adoption and implementation of consistent and effective procedures for acquiring, securing, operating and maintaining a voting system. Although the Standards mandate that vendors document many components of optimal managerial practices, the execution of such procedures are not included in a Standards document that focuses on the system itself.

- Integration with the Voter Registration Database: Local and statewide automated voter registration databases have become more common in recent years as election officials throughout the country attempt to harness innovations in network computing to address the needs of increasingly complex voter registration information requirements. In some instances, a voter registration database will contain many data fields common to other election administration applications. These applications include campaign finance reporting, election worker management, and the reporting of election results. Although many of these applications are interdependent, the design and interface between the voting system and the voter registration database has been specifically excluded from this update of the Standards for practical reasons. First, because there is a variety of databases and interfaces being used among the various states and within the localities of each individual state, there is no practical and systematic way to test a voting system against all possible combinations and configurations. Second, many of the voting systems being used today still do not include an electronic interface with the voter registration database. At such time when the majority of voting systems and voter registration databases become more seamlessly integrated, a module will be added to the Standards covering their performance, functionality, and testing.

- Commercial Off-the-Shelf (COTS) Products: Some voting systems use one or more readily available COTS hardware devices (such as card readers, printers, or personal computers) or software products (such as operating systems, programming language compilers, or database management systems). These devices and software are exempted from certain portions of the qualification testing process so long as such products are not modified in any manner for use in a voting system.

- Internet Voting: A recent report conducted by the Internet Policy Institute and sponsored by the National Science Foundation in cooperation with the University of Maryland stated:


The findings of this and other studies on internet voting have led the FEC and NASED to conclude that controls cannot be developed at the present time to make remote internet voting sufficiently risk-resistant to be considered used by election officials and the voting public. Therefore, the Standards do not prohibit the use of these systems for special populations such as military and civilian government employees stationed outside the United States. In addition to Federal Voting Assistance Program use of Internet voting, states are encouraged to conduct pilot tests and demonstration projects in accordance with applicable state regulations.

The Standards contemplate the development of systems that integrate public telecommunications networks other than the Internet at the point of sale. These voting systems are considered public network direct recording electronic (DRE) voting systems and must meet the same revised Standards for security, accuracy, and reliability as other similarly defined voting systems. Such systems must additionally meet requirements specific to systems that integrate certain telecommunications components.

- Human Error Rate vs. System Error Rate: In the Standards, the term "error rate" applies to errors introduced by the system and not by a voter's action, such as the failure to mark a ballot in accordance with instructions. The updated accuracy standard is defined as a ballot position error rate. The error rate applies to specific system functions, such as recording a vote, storing a vote and consolidating votes into vote totals. Each location on a paper ballot card or electronic ballot image where a vote may be entered represents a ballot position. The Standards set two error rates:

1. Target error rate: a maximum of one error in 10,000,000 ballot positions, and
2. Testing error rate: a maximum acceptable rate in the test process of one error in 500,000 positions.

This system error rate applies to data that is entered into the system in conformance with the applicable instructions and specifications. Further research on human interface and usability issues is needed to enable the development of Standards for error rates that account for human error.

Summary of Content of Volume I

Volume I contains performance standards for electronic components of voting systems. In addition to containing a glossary (Appendix A) and applicable references (Appendix B), Volume I is divided into nine sections:
Section 1 - Introduction: This section provides an introduction to the Standards, addressing the following topics:

- Objectives and usage of the Standards;
- Development history for initial Standards;
- Update of the Standards;
- Accessibility for individuals with disabilities;
- Definitions of key terms;
- Application of the Standards and test specifications; and
- Outline of contents.

Section 2 - Functional Capabilities: This section contains standards detailing the functional capabilities required of a voting system. This section sets out precisely what it is that a voting system is required to do. In addition, this section sets forth the minimum actions a voting system must be able to perform to be eligible for qualification. For organizational purposes, functional capabilities are categorized by the phase of election activity in which they are required:

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

For each functional capability, common standards are specified. In recognition of the diversity of voting systems, some of the standards have additional requirements that apply only if the system incorporates certain functions (for example, voting systems employing telecommunications to transmit voting data) or configurations (for example, a central count component). Where system-specific standards are appropriate, common standards are followed by standards applicable to specific technologies (i.e., paper-based or DRIR) or intended use (i.e., central or precinct count).

The requirement that voting systems provide access to individuals with disabilities is one of the most significant additions to the Standards. The FEC has incorporated specifications that were developed by the Access Board and are based on the accessibility standards for electronic and information technology established in 56 CFR Part 1194 - Electronic and Information Technology Accessibility Standards, which implement Section 508 of the Rehabilitation Act Amendments of 1998.

Section 3 - Hardware Standards: This section describes the performance requirements, physical characteristics, and design, construction, and maintenance characteristics of the hardware and related components of a voting system. This section focuses on a broad range of devices used in the design and manufacture of voting systems, such as:

- For paper ballots: printers, cards, boxes, transfer boxes, and readers;
- For electronic systems: ballot displays, ballot recorders, precinct vote control units;
- For voting devices: punching and marking devices and electronic recording devices;
- Voting booths and enclosures;
- Equipment used to prepare ballots, program elections, count and report votes, and perform other election management activities;
- Fixed servers and removable electronic data storage media; and
- Printers.

The Standards specify the minimum values for the relevant attributes of hardware, such as:

- Accuracy;
- Reliability;
- Stability under normal environmental operating conditions and when equipment is in storage and transit;
- Power requirements and ability to respond to interruptions of power supply;
- Susceptibility to interference from static electricity and magnetic fields;
- Product marking; and
- Safety.

Section 4 - Software Standards: This section describes the design and performance characteristics of the software embodied in voting systems, addressing both system level software and voting system application software, whether COTS or proprietary. The requirements of this section are intended to ensure that the overall objectives of accuracy, logical correctness, privacy, system integrity, and reliability are achieved. Although this section emphasizes software, the software standards may influence hardware design in some voting systems.
The requirements of this section apply to all software developed for use in voting systems, including:

- Software provided by the voting system vendor and its component suppliers; and
- Software furnished by an external provider where the software is potentially used in any way during voting system operation.

The general standards in this section apply to software used to support the broad range of voting system activities, including pre-voting, voting and post-voting activities. System specific standards are defined for ballot counting, vote processing, the creation of an unalterable audit trail, and the generation of output reports and files. Voting system software is also subject to the security requirements of Section 6.

- Section 5 - Telecommunications Standards: This section describes the requirements for telecommunications components of voting systems. Additionally, it defines the acceptable levels of performance against these characteristics. For the purpose of the Standards, telecommunications is defined as the capability to transmit and receive data electronically regardless of whether the transmission is localized within the polling place or the data is transmitted to a geographically distinct location. The requirements in this section represent functional and performance requirements for the transmission of data that is used to operate the system and report official election results. Where applicable, this section specifies minimum values for critical performance and functional attributes involving telecommunications hardware and software components.

This section addresses telecommunications hardware and software across a broad range of technologies such as dial-up communications technologies, high-speed telecommunications lines (public and private), cabling technologies, communications routers, modems, modems drivers, channel service units (CSU)/data service units (DSU), and dial-up networking applications software.

Additionally, this section applies to voting-related transmissions over public networks, such as those provided by regional telephone companies and long distance carriers. This section also applies to private networks regardless of whether the network is owned and operated by the election jurisdiction. For systems that transmit data over public networks, this section applies to telecommunications components installed and operated at settings supervised by election officials, such as polling places or central offices.

- Section 6 - Security Standards: This section describes the essential security capabilities for a voting system, encompassing the system’s hardware, software, communications, and documentation. The requirements of this section recognize that no predefined set of security standards will address and defeat all conceivable or theoretical threats. However, the Standards articulate requirements to achieve acceptable levels of integrity, reliability, and inviolability. Ultimately, the objectives of the security standards for voting systems are to:
  - Establish and maintain controls that can ensure that accidents, inadvertent mistakes, and errors are minimized;
  - Protect the system from intentional manipulation and fraud;
  - Protect the system from malicious mischief;
  - Identify fraudulent or erroneous changes to the system; and

- Protect secrecy in the voting process.

These Standards are intended to address a broad range of risks to the integrity of a voting system. While it is not possible to identify all potential risks, the Standards identify several types of risk that must be addressed, including:

- Unauthorized changes to system capabilities for defining ballot formats, casting and recording votes, calculating vote totals consistent with defined ballot formats, and reporting vote totals;
- Alteration of voting system audit trails;
- Altering a legitimately cast vote;
- Preventing the recording of a legitimately cast vote;
- Introducing data for a vote not cast by a registered voter;
- Changing calculated vote totals;
- Preventing access to vote data, including individual votes and vote totals, to unauthorized individuals; and
- Preventing access to voter identification data and data for votes cast by the voter such that an individual can determine the content of specific votes cast by the voter.

- Section 7 - Quality Assurance: In the Standards, quality assurance is a vendor function with associated practices that confirms throughout the system development and maintenance life-cycle that a voting system conforms with the Standards and other requirements of state and local jurisdictions. Quality assurance focuses on building quality into a system and reducing dependence on system tests at the end of the life-cycle to detect deficiencies.

This section describes the responsibilities of the voting system vendor for designing and implementing a quality assurance program to ensure that the design, workmanship, and performance requirements of the Standards are achieved in all delivered systems and components. These responsibilities include:

- Development of procedures for identifying and procuring parts and raw materials of the requisite quality, and for their inspection, acceptance, and control.
- Documentation of hardware and software development processes.
- Identification and enforcement of all requirements for in-process inspection and testing that the manufacturer deems necessary to ensure proper fabrication and assembly of hardware, as well as installation and operation of software or firmware.
- Procedures for maintaining all data and records required to document and verify the quality inspections and tests.

- Section 8 - Configuration Management: This section contains specific requirements for configuration management of voting systems. For the purposes of the Standards, configuration management is defined as a set of activities and associated practices that assure full knowledge and control of the components of a system, beginning with its initial development, progressing
Case 2:06-cv-00481-GLL     Document 70-46     Filed 04/25/2006     Page 6 of 30

Voting Systems Standards: An Overview

throughout its development and construction, and continuing with its ongoing maintenance and enhancement. This section describes activities in terms of their purpose and outcomes. It does not describe specific procedures or steps to be employed to accomplish them—these are left to the vendor to select.

The requirements of this section address a broad set of record keeping, audit, and reporting activities that include:

- Identifying discrete system components;
- Creating records of formal baselines of all components;
- Creating records of later versions of components;
- Controlling changes made to the system and its components;
- Submitting new versions of the system to ITAs;
- Releasing new versions of the system to customers;
- Auditing the system, including its documentation, against configuration management records;
- Controlling interfaces to other systems; and
- Identifying tools used to build and maintain the system.

Vendors are required to submit documentation of these procedures to the ITA as part of the Technical Data Package for system qualification testing. Additionally, as articulated in state or local election laws, regulations, or contractual agreements with vendors, authorized election officials or their representatives reserve the right to inspect vendor facilities and operations to determine conformance with the vendor's reported configuration management procedures.

Section 5 - Overview of Qualification Testing: This section provides an overview for the qualification testing of voting systems. Qualification testing is the process by which a voting system is shown to comply with the requirements of the Standards and the requirements of its own design and performance specifications. The testing also evaluates the completeness of the vendor's development test program, including the sufficiency of vendor tests conducted to demonstrate compliance with stated system design and performance specifications, and the vendor's documented quality assurance and configuration management practices.

The qualification test process is intended to discover errors that, should they occur in actual election use, could result in failure to complete election operations in a satisfactory manner. This section describes the scope of qualification testing, its applicability to voting system components, documentation that must be submitted by the vendor, and the flow of the test process. This section also describes differences between the test process for initial qualification testing of a system and the testing for modifications and re-qualification after a qualified system has been modified.

Since 1994, the testing described in this section has been performed by an ITA that is certified by NASED. The testing may be conducted by one or more ITAs for a given system, depending on the nature of tests to be conducted and the expertise of the certified ITA. The testing process involves the assessment of:

- Absolute correctness of all ballot processing software, for which no margin for error exists;
- Operational accuracy in the recording and processing of voting data, as measured by the error rate articulated in Volume I, Section 3;
- Operational failure or the number of uncorrectable failures under conditions simulating the intended storage, operation, transportation, and maintenance environments for voting systems, using an actual time-based period of processing test ballots;
- System performance and function under normal and abnormal conditions; and
- Completeness and accuracy of the system documentation and configuration management records to enable purchasing jurisdictions to effectively install, test, and operate the system.

Summary of Volume II Content

- Section 1 - Introduction: This section provides an overview of Volume II, addressing the following topics:
  - The objectives of Volume II;
  - The general contents of Volume II;
  - The qualification testing focus;
  - The qualification testing sequence;
  - The evolution of testing; and
  - The outline of contents

- Section 2 - Technical Data Package: This section contains a description of vendor documentation relating to the voting system that shall be submitted with the system as a precondition for qualification testing. These items are necessary to define the product and its method of operation; to provide the vendor's technical and test data supporting the claims of the system's functional capabilities and performance levels; and to document instructions and procedures governing system operation and field maintenance.

The content of the Technical Data Package (TDP) is intended to contain a complete description of the following information about the system:

- Overall system design, including sub-systems, modules, and interfaces;
- Specific functional capabilities;
- Performance and design specifications;
- Design constraints and compatibility requirements;
- Personnel, equipment, and facilities necessary for system operation, maintenance, and logistical support;
Case 2:06-cv-00481-GLL     Document 70-46     Filed 04/25/2006     Page 7 of 30

Voting Systems Standards: An Overview

- Vendor practices for assuring system quality during the system's development and subsequent maintenance; and
- Vendor practices for managing the configuration of the system during development and for modifications to the system throughout its life-cycle.

- Section 3 - Functionality Testing: This section contains a description of the testing to be performed by the ITAs to confirm the functional capabilities of a voting system submitted for qualification testing. It describes the scope and basis for functional testing, the general sequence of tests within the overall test process, and provides guidance on testing for accessibility. It also discusses testing of functionality of systems that operate on personal computers.

- Section 4 - Hardware Testing: This section contains a description of the testing to be performed by the ITAs to confirm the proper functioning of the hardware components of a voting system submitted for qualification testing. This section requires ITAs to design and perform procedures that test the voting system hardware for both operating and non-operating environmental tests.

Hardware testing begins with non-operating tests that require the use of an environmental test facility. These are followed by operating tests that are performed partly in an environmental facility and partly in a standard test laboratory or shop environment. The non-operating tests are intended to evaluate the ability of the system hardware to withstand exposure to various environmental conditions incidental to voting system storage, maintenance, and transportation. The procedures are based on test methods contained in Military Standards (MIL-STD) 810D, modified where appropriate, and include such tests as: bench handling, vibration, low and high temperature, and humidity.

The operating tests involve running the system for an extended period of time under varying temperatures and voltages. This ensures that the hardware meets or exceeds the minimum requirements for reliability, data recording, and processing accuracy contained in Section 3 of Volume I. Although the procedure emphasizes equipment operability and data accuracy, it is not an exhaustive evaluation of all system functions. Moreover, the severity of the test conditions has in most cases been reduced from that specified in the Military Standards to reflect commercial, rather than military, practice.

- Section 5 - Software Testing: This section contains a description of the testing to be performed by the ITAs to confirm the proper functioning of the software components of a voting system submitted for qualification testing. It describes the scope and basis for software testing, the initial review of documentation to support software testing, and the review of voting system source code.

The software qualification tests encompass a number of interrelated examinations. The examinations include: selective review of source code for conformance with the vendor's stated standards, and other system documentation provided by the vendor. The code inspection is complemented by a series of functional tests to verify the proper performance of all system functions controlled by the software.

- Section 6 - System Level Integration Testing: This section contains a description of the testing conducted by the ITAs to confirm the proper functioning of the fully integrated components of a voting system submitted for qualification testing. It describes the scope and basis for integration testing, testing of internal and external system interfaces, testing of security capabilities, testing of accessibility features, and the configuration audits, including the evaluation of claims made in the system documentation.

System-level qualification tests address the integrated operation of hardware, software, and telecommunications capabilities (where applicable) to assess the system's response to a range of both normal and abnormal conditions in an attempt to compromise the system.

- Section 7 - Examination of Vendor Practices for Configuration Management and Quality Assurance: This section contains a description of examinations conducted by the ITAs to evaluate the extent to which vendors meet the requirements for configuration management and quality assurance. It describes the scope and basis for the examinations and the general sequence of the examinations. It also provides guidance on the substantive focus of these examinations.

In reviewing configuration management practices, the ITAs examine the vendor's:
- configuration management policy;
- configuration identification policy;
- baseline, promotion, and release procedures;
- configuration control procedures;
- release process and procedures; and
- configuration audit procedures.

In reviewing quality assurance practices, the ITAs examine the vendor's:
- quality assurance policy;
- parts and material tests and examinations;
- quality conformance plans, procedures and inspection results; and
- voting system documentation.

Conclusion

Almost eighty percent of the States have adopted the Standards. The Commission recommends that individual States continue to decide how best to adopt and implement the Standards to aid in the procurement of electronic voting systems. States are also encouraged to develop and implement individual certification processes to make sure that qualified voting systems can meet the unique and particular demands of the purchasing jurisdiction.

As a whole, implementation of the original Standards, combined with NASED's national testing program, has allowed election officials to be more confident than ever that the voting systems they procure will work accurately and reliably. Although the requirements for voting systems and the technologies used to build them have evolved over the past decade, the revised Standards will close the gaps in the Standards for system performance and testing. In order to prevent technology gaps in the future, the ERC and NASED are committed to making the Standards a living document capable of being updated in an expeditious manner to respond to constantly evolving technology. Such technological innovation should be embraced in order to maintain a sophisticated and robust voting systems industry.
# Table of Contents

## 1 Introduction

1.1 Objectives and Usage of the Voting System Standards .................................................. 1-1

1.2 Development History for Initial Standards ........................................................................ 1-2

1.3 Update of the Standards .................................................................................................... 1-3

1.4 Accessibility for Individuals with Disabilities .................................................................... 1-3

1.5 Definitions ........................................................................................................................ 1-4

1.5.1 Voting System ............................................................................................................. 1-4

1.5.2 Paper-Based Voting System ....................................................................................... 1-5

1.5.3 Direct Record Electronic (DRE) Voting System ......................................................... 1-5

1.5.4 Public Network Direct Record Electronic (DRE) Voting System ......................... 1-6

1.5.5 Precinct Count Voting System .................................................................................. 1-6

1.5.6 Central Count Voting System .................................................................................... 1-6

1.6 Application of the Standards and Test Specifications ..................................................... 1-7

1.6.1 Qualification Tests ...................................................................................................... 1-8

1.6.2 Certification Tests ...................................................................................................... 1-9

1.6.3 Acceptance Tests ....................................................................................................... 1-10

1.7 Outline of Contents ......................................................................................................... 1-10
Introduction

1.1 Objectives and Usage of the Voting System Standards

State and local officials today are confronted with increasingly complex voting system technology and an increased risk of voting system failure. Responding to calls for assistance from the states, the United States Congress authorized the Federal Election Commission (FEC) to develop voluntary national voting system standards for computer-based systems. The resulting FEC Voting System Standards (the Standards) seek to aid state and local election officials in ensuring that new voting systems are designed to function accurately and reliably, thus ensuring the system's integrity. States are free to adopt the Standards in whole or in part. States also may choose to enact stricter performance requirements for systems used in their jurisdictions.

The Standards specify minimum functional requirements, performance characteristics, documentation requirements, and test evaluation criteria. For the most part, the Standards address what a voting system should reliably do, not how system components should be configured to meet these requirements. It is not the intent of the Standards to impose the design and development of new, innovative equipment by vendors. Furthermore, the Standards balance risk and cost by requiring voting systems to have essential, but not excessive, capabilities.

The Standards are not intended to define appropriate election administration practices. However, the total integrity of the election process can only be ensured if implementation of the Standards is coupled with effective election administration practices.

The Standards are intended for use by multiple audiences to support their respective roles in the development, testing, and acquisition of voting systems:

- Authorities responsible for the analysis and testing of such systems in support of qualification and/or certification of systems for purchase within a designated jurisdiction;
- State and local agencies evaluating voting systems to be procured within their jurisdictions; and
- Designers and manufacturers of voting systems.

1.2 Development History for Initial Standards

Much of the groundwork for the Standards' development was laid by a national study conducted in 1975 by the National Bureau of Standards, now known as the National Institute of Standards and Technology (NIST). This study was requested by the FEC's Office of Election Administration's predecessor, the Office of Federal Elections of the General Accounting Office. The report, "Effective Use of Computer Technology in Vote-Tallying," made a number of recommendations bearing directly on the Standards project. After analyzing computer-related election problems encountered in the past, the report concluded that one of the basic causes for these difficulties was the lack of appropriate technical skill at the state and local level for developing or implementing sophisticated and complex standards against which voting system hardware and software could be tested.

Following the release of this report, Congress mandated that the FEC, with the cooperation and assistance of the National Bureau of Standards, study and report on the feasibility of developing "voluntary engineering and procedural performance standards for voting systems used in the United States." (2 U.S.C. §431 Note) The resulting 1983 study cited a substantial number of technical and managerial problems that affected the integrity of the vote counting process. It also asserted the need for a federal agency to develop national performance standards that could be used as a tool by state and local election officials in the testing, certification, and procurement of computer-based voting systems. In 1984, Congress approved initial funding for the Standards.

The FEC held a series of public hearings in developing the initial Standards. State and local election officials, election system vendors, technical consultants, and others reviewed drafts of the proposed criteria. The FEC considered their many comments and made appropriate revisions. Before final issuance, the FEC publicly announced the availability of the latest draft of the Standards in the Federal Register and requested that all interested parties submit final comments. The FEC meticulously reviewed all responses to the notice and incorporated corrections and suitable suggestions. Ultimately, the final product was the result of considerable deliberation, close consultation with election officials, and careful consideration of comments from all interested parties.

In January 1990, the FEC issued the performance standards and testing procedures for punchcard, marksense, and direct recording electronic (DRE) voting systems. The Standards did not cover paper ballot and mechanical lever systems because paper ballots are sufficiently self-explanatory not to require technical standards and mechanical lever systems are no longer manufactured or sold in the United States. The FEC also did not incorporate requirements for mainframe computer hardware because it was reasonable to assume that sufficient engineering and performance
1.3 Update of the Standards

Today, over two-thirds of the States have adopted the Standards in whole or in part. As a result, the voting systems marketed today are dramatically improved. Election officials are better assured that the voting systems they procure will work securely and reliably. Voting system failures are declining, and now primarily involve pre-Standard equipment, untested equipment configurations, or the mismanagement of tested equipment. Overall, systems integrity and the election processes have improved markedly.

However, advances in voting technology, legislative changes, and the proliferation of electronic voting systems make an update of the Standards necessary. The industry has been marked by widespread integration of personal computer technology and non-mainframe servers into DRE voting systems.

In addition, voting systems need to be responsive to the Americans with Disabilities Act (ADA) of 1990 and guidelines developed to assist in implementing the ADA.

1.4 Accessibility for Individuals with Disabilities

Voters and election officials who use voting systems represent a broad spectrum of the population, and include individuals with disabilities who may have difficulty using traditional voting systems. In developing accessibility provisions for the Standards, the FEC requested assistance from the Access Board, the federal agency in the forefront of promulgating accessibility provisions. The Access Board submitted technical standards designed to meet the diverse needs of voters with a broad range of disabilities. The FEC has adopted the entirety of the Access Board’s recommendations and incorporated them into the Standards. These recommendations comprise the bulk of the accessibility provisions found in Sections 2.2.7.

Implementing these provisions, however, will not entirely eliminate the need to accommodate the needs of some disabled voters by human interface.

The FEC anticipates that during the lifetime of this version of the Standards increased obligations will be placed upon election officials at every jurisdictional level to provide voting equipment tailored to meet the needs of voters with disabilities. To facilitate jurisdictions in meeting accessibility needs, the Standards mandate that every voting system incorporate some accessible voting capabilities. The Standards also mandate that systems incorporating a DRE component meet specific technological requirements. To do so, it is anticipated that a vendor will have to either configure all of the system’s voting stations to meet the accessibility specifications or will have to design a unique station that conforms to the accessibility requirements and is part of the overall voting system configuration.

Under no circumstances should compliance with requirements for accessibility be viewed as mutually exclusive from compliance with any other provision of the Standards. If a voting system contains a machine uniquely designed to meet the accessibility requirements, such a machine will be tested for compliance with the accessibility requirements, as well as for compliance with all of the DRE standards, in order to ensure that an accessible machine does not unintentionally abrogate the mandates of the Standards.

1.5 Definitions

The Standards contain terms describing function, design, documentation, and testing attributes of equipment and computer programs. Unless otherwise specified, the intended sense of technical terms is that which is commonly used by the information technology industry. In some cases terminology is specific to elections or voting systems, and a glossary of those terms is contained in Appendix A. Non-technical terms not listed in Appendix A shall be interpreted according to their standard dictionary definitions.

Additionally, the following terms are defined below:

- Voting system;
- Paper-based voting system;
- Direct record electronic (DRE) voting system;
- Public network direct record electronic (DRE) voting systems;
- Precinct count voting system; and
- Central count voting system.

1.5.1 Voting System

A voting system is a combination of mechanical, electromechanical, or electronic equipment. It includes the software required to program, control, and support the equipment that is used to define ballots; to cast and count votes; to report and/or display election results; and to maintain and produce audit trail information. A voting system may also include the transmission of results over telecommunication networks.
Additionally, a voting system includes the associated documentation used to operate the system, maintain the system, identify system components and their fail-safes, test the system during its development and maintenance, maintain records of system errors and defects, and determine specific changes made after system qualification. By definition, this includes all documentation required in Section 9.4.

Traditionally, a voting system has been defined by the mechanisms the system uses to cast votes and further categorized by the location where the system tabulates ballots. However, the Standards recognize that as the industry develops unique solutions to various challenges and as voting systems become more responsive to the needs of election officials and voters, the rigid dichotomies between voting system types may be blurred. Innovations that use a fluid understanding of system types can greatly improve the voting system industry, but only if controls are in place to monitor and control integrity through the proper evaluation of the system brought for qualification.

As such, vendors that submit a system that integrates components from more than one traditional system type or a system that includes components not addressed in this standard shall submit the results of all beta tests of the new system. Vendors also shall submit a proposal test plan to the appropriate Independent Test Authority recognized by the National Association of State Election Directors (NASED) to conduct national qualification testing of voting systems. The Standards permit vendors to produce or utilize interoperable components of a voting system that are tested within the full voting system configuration.

1.5.2 Paper-Based Voting System

A Paper-Based Voting System, (referred to in the initial Standards as a Punchboard and Markersense [P&M] Voting System) records votes, counts votes, and produces a tabulation of the vote count from votes cast on paper cards or sheets. A punchboard voting system allows a voter to record votes by means of holes punched in designated voting response locations. A markersense voting system allows a voter to record votes by means of marks made by the voter directly on the ballot, usually in voting response locations. Additionally, a paper-based system may record votes using other approaches whereby the voter’s selections are indicated by marks made on a paper ballot by an electronic input device, as long as such an input device does not independently record, store, or tabulate the voter’s selections.

1.5.3 Direct Record Electronic (DRE) Voting System

A Direct Record Electronic (DRE) Voting System records votes by means of a ballot display provided with mechanical or electro-optical components that can be activated by the voter; that processes data by means of a computer program; and that records voting data and ballot images in memory components. It produces a tabulation of the voting data stored in a removable memory component and as printed copy. The system may also provide means for transmitting individual ballots or vote totals to a central location for consolidating and reporting results from precincts at the central location.

1.5.4 Public Network Direct Record Electronic (DRE) Voting System

A Public Network Direct Record Electronic (DRE) Voting System is an election system that uses electronic ballots and transmits vote data from the polling place to another location over a public network as defined in Section 5.1.2. Vote data may be transmitted as individual ballots as they are cast, periodically as batches of ballots throughout the election day, or as one batch at the close of voting. For purposes of the Standards, Public Network DRE Voting Systems are considered a form of DRE Voting System and are subject to the standards applicable to DRE Voting Systems. However, because transmitting vote data over public networks relies on equipment beyond the control of the election authority, the system is subject to additional threats to system integrity and availability. Therefore, additional requirements discussed in Section 5 and 6 apply.

The use of public networks for transmitting vote data must provide the same level of integrity as other forms of voting systems, and must be accomplished in a manner that precludes three risks to the election process: automated canvassing of fraudulent votes, unauthorized manipulation of vote counts, and disruption of the voting process such that the system is unavailable to voters during the time period authorized for system use.

1.5.5 Precinct Count Voting System

A Precinct Count Voting System is a voting system that tabulates ballots at the polling place. These systems typically tabulate ballots as they are cast, and print the results after the close of polling. For DREs, and for some paper-based systems, these systems provide electronic storage of the vote count and may transmit results to a central location over public telecommunication networks.

1.5.6 Central Count Voting System

A Central Count Voting System is a voting system that tabulates ballots from multiple precincts at a central location. Voting ballots are typically placed into secure storage at
1.6 Application of the Standards and Test Specifications

The Standards apply to all system hardware, software, telecommunications, and documentation intended for use to:

- Prepare the voting system for use in an election;
- Produce the appropriate ballot forms;
- Test that the voting system and ballot materials have been properly prepared and are ready for use;
- Record and count votes;
- Consolidate and report results;
- Display results on-site or remotely; and
- Maintain and produce all audit trail information.

In general, the Standards define functional requirements and performance characteristics that can be assessed by a series of defined tests. Standards are mandatory requirements and are designated by use of the term “shall.”

Some voting systems use one or more readily available commercial off-the-shelf (COTS) devices (such as card readers, printers, or personal computers) or software products (such as operating systems, programming language compilers, or database management systems). COTS devices and software are exempted from certain portions of the qualification testing process as defined herein, as long as such products are not modified for use in a voting system.

Generally, voting systems are subject to the following three testing phases prior to being purchased or leased:

- Qualification tests;
- State certification tests; and
- State and/or local acceptance tests.

1.6.1 Qualification Tests

Qualification tests validate that a voting system meets the requirements of the Standards and performs according to the vendor’s specifications for the system. Such tests encompass the examination of software, the inspection and evaluation of system documentation; tests of hardware under conditions simulating the intended storage, operation, transportation, and maintenance environments; operational tests to validate system performance and function under normal and abnormal conditions; and examination of the vendor’s system development, testing, quality assurance, and configuration management practices. Qualification tests address individual system components or elements, as well as the integrated system as a whole.

Since 1994, qualification tests for voting systems have been performed by Independent Test Authorities (ITAs) certified by the National Association of State Election Directors (NASED). NASED has certified an ITA for either the full scope of qualification testing or a distinct subset of the total scope of testing. To date, ITAs have been certified only for distinct subsets of testing. Upon the successful completion of testing by an ITA, the ITA issues a Qualification Test Report to the vendor and NASED. The qualification test report remains valid for as long as the voting system remains unchanged.

Upon receipt of test reports that address the full scope of testing, NASED issues a Qualification Number that indicates the system has been tested by certified ITAs for compliance with the Standards and qualifies for the qualification process of states that have adopted the Standards. The Qualification Number applies to the system as a whole, and does not apply to individual system components or untested configurations.

After a system has completed qualification testing, further examination of a system is required if modifications are made to hardware, software, or telecommunications, including the installation of software on different hardware. Vendors request review of modifications by the appropriate ITA based on the nature and scope of changes made and the scope of the ITA’s role in NASED qualification. The ITA will determine the extent to which the modified system should be retested for qualification testing and the extent of testing to be conducted.

Generally, a voting system remains qualified under the standards against which it was tested, as long as no modifications not approved by an ITA are made to the system. However, if a new threat to a particular voting system is discovered, it is the prerogative of NASED to determine which qualified voting systems are vulnerable, whether those systems need to be retested, and the specific tests to be conducted. In addition, when new standards supersede the standards under which the system was qualified, it is the prerogative of NASED to determine when systems that were qualified under the earlier standards will lose their qualification, unless they are tested to meet current standards.
1.6.2 Certification Tests

Certification tests are performed by individual states, with or without the assistance of outside consultants, to:

- Confirm that the voting system presented is the same as the one qualified through the Standards;
- Test for the proper implementation of state-specific requirements;
- Establish a baseline for future evaluations or tests of the system, such as acceptance testing or state review after modifications have been made; and
- Define acceptance tests.

Precise certification test scripts are not included in the Standards, as they must be defined by the state, with its laws, election practices, and needs in mind. However, it is recommended that they not duplicate qualification tests, but instead focus on functional tests and qualitative assessment to ensure that the system operates in a manner that is acceptable under state law. If a voting system is modified after state certification, it is recommended that States reevaluate the system to determine if further certification testing is warranted.

Certification tests performed by individual states typically rely on information contained in documentation provided by the vendor for system design, installation, operations, required facilities and supplies, personnel support and other aspects of the voting system. States and jurisdictions may define information and documentation requirements additional to those defined in the Standards. By design, the Standards, and qualification testing of voting systems for compliance with the Standards, do not address these additional requirements. However, qualification testing addresses all capabilities of a voting system stated by the vendor in the system documentation submitted to an ITA, including additional capabilities that are not required by the Standards.

1.6.3 Acceptance Tests

Acceptance tests are performed at the state or local jurisdiction level upon system delivery by the vendor to:

- Confirm that the system delivered is the specific system qualified by NASED and, when applicable, certified by the state;
- Evaluate the degree to which delivered units conform to both the system characteristics specified in the procurement documentation, and those demonstrated in the qualification and certification tests; and
- Establish a baseline for any future required audits of the system.

Some of the operational tests conducted during qualification may be repeated during acceptance testing.

1.7 Outline of Contents

The organization of the Standards has been simplified to facilitate use. Volume I, Voting System Performance Standards, is intended for use by the broadest audience, including voting system developers, equipment manufacturers and suppliers, independent test authorities, local agencies that purchase and deploy voting systems, state organizations that certify a system prior to procurement by a local jurisdiction, and public interest organizations that have an interest in voting systems and voting systems standards.

- Section 2 describes the functional capabilities required of voting systems.
- Sections 3 through 6 describe specific performance standards for election system hardware, software, telecommunications and security, respectively.
- Sections 7 and 8 describe practices for quality assurance and configuration management, respectively, to be used by vendors, and required information about vendor practices that will be reviewed in concert with system qualification and certification test processes and system purchase decisions.
- Section 9 provides an overview of the test and measurement process used by test authorities for qualification and re-qualification of voting systems.
- Appendix A provides a glossary of important terms used in Volume I.
- Appendix B lists the publications that were used for guidance in the preparation of the Standards. These publications contain information that is useful in interpreting and complying with the requirements of the Standards.
Appendix C addresses issues of usability of voting systems, commonly referred to as "human factors." This appendix does not represent mandates that voting systems will be tested against, but rather contain recommendations and best practices on usability issues designed to provide vendors and election officials with guidance on designing and procuring systems that are easy and intuitive to use by voters.

Volume II, Voting System Qualification Testing Standards describes the standards for the technical information submitted by the vendor to support testing: the development of test plans by the ITA for initial system testing and testing of system modifications; the conduct of system qualification tests by the ITA; and the test reports generated by the ITA. This volume complements the content of Volume I and it is intended primarily for use by ITAs, state organizations that certify a system, and vendors.

Volume I, Section 2
Table of Contents

2 Functional Capabilities
   2.1 Scope .................................................................................................................. 2-1
   2.2 Overall System Capabilities .............................................................................. 2-2
      2.2.1 Security ...................................................................................................... 2-2
      2.2.2 Accuracy..................................................................................................... 2-3
         2.2.2.1 Common Standards ............................................................................. 2-3
         2.2.2.2 DRE System Standards ..................................................................... 2-4
      2.2.3 Error Recovery ............................................................................................ 2-4
      2.2.4 Integrity ....................................................................................................... 2-4
         2.2.4.1 Common Standards ............................................................................. 2-4
         2.2.4.2 DRE Systems Standards ..................................................................... 2-5
      2.2.5 System Audit ................................................................................................. 2-5
         2.2.5.1 System Audit Purpose and Context ..................................................... 2-5
         2.2.5.2 Operational Requirements .................................................................... 2-6
            2.2.5.2.1 Time, Sequence, and Preservation of Audit Records .................. 2-6
            2.2.5.2.2 Error Messages ............................................................................. 2-7
            2.2.5.2.3 Status Messages .......................................................................... 2-8
         2.2.5.3 COTS General Purpose Computer System Requirements ................. 2-8
      2.2.6 Election Management System ..................................................................... 2-9
      2.2.7 Accessibility ................................................................................................ 2-10
         2.2.7.1 Common Standards ............................................................................. 2-10
         2.2.7.2 DRE Standards .................................................................................. 2-12
      2.2.8 Vote Tabulating Program ............................................................................. 2-14
         2.2.8.1 Functions 2-14
         2.2.8.2 Voting Variations ................................................................................ 2-15
      2.2.9 Ballot Counter .............................................................................................. 2-15
      2.2.10 Telecommunications .................................................................................. 2-16
      2.2.11 Data Retention ........................................................................................... 2-16
   2.3 Pre-voting Functions .......................................................................................... 2-17
      2.3.1 Ballot Preparation ....................................................................................... 2-18
         2.3.1.1 General Capabilities .......................................................................... 2-18
Functional Capabilities

2.1 Scope

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

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

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

In recognition of the diversity of voting systems, the Standards apply specific requirements to specific technologies. Some of the Standards apply only if the system incorporates certain optional functions (for example, voting systems employing...
telecommunications to transmit voting data). For each functional capability, common standards are specified. Where necessary, common standards are followed by standards applicable to specific technologies (i.e., paper-based or DRE) or intended use (i.e., central or precinct count).

2.2 Overall System Capabilities

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

- Security;
- Accuracy;
- Error recovery;
- Integrity;
- System auditability;
- Election management system;
- Accessibility;
- Vote tabulating;
- Ballot counters; and
- Data Retention.

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

2.2.1 Security

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

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

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

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

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

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

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

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

2.2.2 Accuracy

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

2.2.2.1 Common Standards

To ensure vote accuracy, all systems shall:

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

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

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

d. Include control logic and data processing methods incorporating parity and check-sum (or equivalent error detection and correction methods) to demonstrate that the system has been designed for accuracy; and

e. Provide software that monitors the overall quality of data read-write and transfer quality status, checking the number and type of errors that occur in any of the relevant operations on data and how they were corrected.
2.2.2.2 DRE System Standards

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

2.2.3 Error Recovery

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

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

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

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

2.2.4 Integrity

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

2.2.4.1 Common Standards

To ensure system integrity, all systems shall:

a. Protect, by a means compatible with these Standards, against a single point of failure that would prevent further voting at the polling place;

b. Protect against the interruption of electronic power;

c. Protect against generated or induced electromagnetic radiation;

d. Protect against sustained temperature and humidity fluctuations;

e. Protect against the failure of any data input or storage device;

f. Protect against any attempt at improper data entry or retrieval;

g. Record and report the date and time of normal and abnormal events;

h. Maintain a permanent record of all original audit data that cannot be modified or overridden but may be augmented by designated authorized officials in order to adjust for errors or omissions (e.g., during the canvassing process);

i. Detect and record every event, including the occurrence of an error condition that the system cannot overcome, and time-dependent or programmed events that occur without the intervention of the voter or a polling place operator; and

j. Include built-in measurement, self-test, and diagnostic software and hardware for detecting and reporting the system’s status and degree of operability.

2.2.4.2 DRE Systems Standards

In addition to the common standards, DRE systems shall:

a. Maintain a record of each ballot cast using a process and storage location that differs from the main vote selection, interpretation, processing, and reporting path; and

b. Provide a capability to retrieve ballot images in a form readable by humans.

2.2.5 System Audit

This section describes the context and purpose of voting system audits and sets forth specific functional requirements. Additional technical audit requirements are set forth in Section 4.

2.2.5.1 System Audit Purpose and Context

Election audit trails provide the supporting documentation for verifying the correctness of reported election results. They present a concrete, indelible record of all systems activity related to the vote tally, and are essential for public confidence in the accuracy of the tally, for recounts, and for evidence in the event of criminal or civil litigation.
The following audit trail requirements are based on the premise that system-generated creation and maintenance of audit records reduces the chance of error associated with manually generated audit records. Because most audit capability is automatic, the system operator has less information to track and record, and is less likely to make mistakes or omissions.

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

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

Documentation of items such as paper ballots delivered and collected, administrative procedures for system security, and maintenance performed on voting equipment are also part of the election audit trail, but are not covered in these technical standards. Future volumes of the Standards will address these other system operations practices. In the interim, useful guidance is provided by the Innovations in Election Administration #10, Ballot Security and Accountability, available from the FEC's Office of Election Administration.

2.2.5.2 Operational Requirements

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

2.2.5.2.1 Time, Sequence, and Preservation of Audit Records

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

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

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

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

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

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

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

1) The generation of audit trail records does not interfere with the production of output reports;

2) The entries can be identified so as to facilitate their recognition, segregation, and retention; and

3) The audit record entries are kept physically secure.

2.2.5.2.2 Error Messages

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

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

b. All error messages requiring intervention by an operator or precinct official shall be displayed or printed unambiguously in easily understood language text, or by means of other suitable visual indicators;

c. When the system uses numerical error codes for trained technician maintenance or repair, the text corresponding to the code shall be self-contained, or affixed inside the unit device. This is intended to reduce inappropriate reactions to error conditions, and to allow for ready and effective problem correction.

d. All error messages for which correction impacts vote recording or vote processing shall be written in a manner that is understandable to an election
official who possesses training on system use and operation, but does not possess technical training on system servicing and repair;

a. The message use for all systems shall clearly state the action to be performed in the event that voter or operator response is required;

f. System design shall ensure that erroneous responses will not lead to irreversible error; and

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

2.2.5.2.3 Status Messages

The Standards provide latitude in software design so that vendors can consider various user processing and reporting needs. The jurisdiction may require some status and information messages to be displayed and reported in real-time. Messages that do not require operator intervention may be stored in memory to be recovered after ballot processing has been completed.

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

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

2.2.5.3 COTS General Purpose Computer System Requirements

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

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

To counter these vulnerabilities, these operating system protections are required on all systems on which election software is hosted. First, authentication shall be configured on the local terminal (display screen and keyboard) and on all external connection devices ("network cards" and "ports"). This ensures that only authorized and identified users affect the system while election software is running.

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

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

2.2.6 Election Management System

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

a. Define political subdivision boundaries and multiple election districts as indicated in the system documentation;

b. Identify contests, candidates, and issues

c. Define ballot formats and appropriate voting options;

d. Generate ballots and election-specific programs for vote recording and vote counting equipment;

e. Install ballots and election-specific programs;

f. Test that ballots and programs have been properly prepared and installed;

g. Accumulate vote totals at multiple reporting levels as indicated in the system documentation;
2.2.7 Accessibility

The Standards provide requirements for voting systems to meet the accessibility needs of a broad range of voters with disabilities. To do so, it is anticipated that a vendor will have to either configure all of the system’s voting stations to meet the accessibility specifications or will have to design a unique station that conforms to the accessibility requirements and is part of the overall voting system configuration. Efforts to meet the accessibility requirements shall not violate the privacy, secrecy, and integrity demands of the Standards.

2.2.7.1 Common Standards

To facilitate accessibility, all voting systems shall be capable of meeting the following conditions, as illustrated in Figures 2-1 through 2-4:

a. Where clear floor space only allows forward approach to an object, the maximum high forward reach allowed shall be 48 inches. The maximum low forward reach is 15 inches.

b. Where forward reach is over an obstruction with loose space below, the maximum level forward reach is 25 inches. When the obstruction is less than 20 inches deep, the maximum high forward reach is 48 inches. When the obstruction projects 20 to 25 inches, the maximum high forward reach is 44 inches.

c. The position of any operable control is determined with respect to a vertical plane that is 48 inches in length, centered on the operable control, and at the maximum protrusion of the product within the 48-inch length;

d. Where any operable control is 10 inches or less behind the reference plane, have a height that is between 15 inches and 54 inches above the floor;

e. Where any operable control is more than 10 inches and not more than 24 inches behind the reference plane, have a height between 15 inches and 46 inches above the floor; and

f. Have operable controls that are not more than 24 inches behind the reference plane.
b. Provide audio information and stimulus that:
   1) Communicates to the voter the complete content of the ballot;
   2) Provides instruction to the voter in operation of the voting device;
   3) Provides instruction so that the voter has the same vote capabilities and
      options as those provided by the system to individuals who are not using
      audio technology;
   4) For a system that supports write-in voting, enables the voter to review the
      voter’s write-in input, edit that input, and confirm that the edits meet the
      voter’s intent;
   5) Enables the voter to request repetition of any information provided by the
      system;
   6) Supports the use of headphones provided by the system that may be
      discarded after each use;
   7) Provides the audio signal through an industry standard connector for
      private listening using a 1/8 inch stereo headphone jack to allow
      individual voters to supply personal headsets; and
   8) Provides a volume control with an adjustable amplification up to a
      maximum of 195 dB that automatically resets to the default for each
      voter;

c. Provide, in conformance with FCC Part 68, a wireless coupling for assistive
   devices used by people who are hard of hearing when a system utilizes a
   telephone style handset to provide audio information;

d. Meet the requirements of ANSI C63.19-2001 Category 4 to avoid
   electromagnetic interference with assistive hearing devices;

e. For electronic image displays, permit the voter to:
   1) Adjust the contrast settings;
   2) Adjust color settings, when color is used; and
   3) Adjust the size of the text so that the height of capital letters varies over a
      range of 3 to 6.3 millimeters;

f. For a device with touch-screen or touch-sensitive controls, provide an input
   method using mechanically operated controls or keys that shall:
2.2.8.2 Voting Variations

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

a. Closed primaries;
b. Open primaries;
c. Partisan offices;
d. Non-partisan offices;
e. Write-in voting;
f. Primary presidential delegation nominations;
g. Ballot rotation;
h. Straight party voting;
i. Cross-party endorsement;
j. Split precincts;
k. Vote for N of M;
l. Recall issues, with options;
m. Cumulative voting;
n. Ranked order voting; and
o. Provisional or challenged ballots.

2.2.9 Ballot Counter

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

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

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

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

2.2.11 Data Retention

United States Code Title 42, Sections 1974 through 1974a, states that election administrators shall preserve for 22 months "all records and paper that comes into (their) possession relating to an application, registration, payment of poll tax, or other act requisite to voting." This retention requirement applies to systems that will be used at anytime for voting of candidates for Federal offices (e.g., Member of Congress, United States Senator, and/or Presidential Elector). Therefore, all systems shall provide for maintaining the integrity of voting and audit data during an election and for a period of at least 22 months thereafter.

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

For 22-month document retention, the general rule is that all printed copy records produced by the election database and ballot processing systems shall be so labeled and archived. Regardless of system type, all audit trail information spelled out in subsection 4.3 of the Standards shall be retained in its original format, whether that be real-time logs generated by the system, or manual logs maintained by election personnel. The election audit trail includes not only in-process logs of election-night (and subsequent processing of absentee or provisional ballots), but also logs of baseline ballot definition formats, and system readiness and testing results.

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

2.3 Pre-voting Functions

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

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

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

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

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

2.3.1.1 General Capabilities

All systems shall provide the general capabilities for ballot preparation.

2.3.1.1.1 Common Standards

All systems shall be capable of:

a. Enabling the automatic formatting of ballots in accordance with the requirements for offices, candidates, and measures as required to be placed on the ballot for each political subdivision and election district;

b. Collecting and maintaining the following data:
   1. Offices and their associated labels and instructions;
   2. Candidate names and their associated labels; and
   3. Issues or measures and their associated text;

c. Supporting the maximum number of potentially active voting positions as indicated in the system documentation;

d. For a primary election, generating ballots that segregate the choices in partisan races by party affiliation;

e. Generating ballots that contain identifying codes or marks uniquely associated with each format; and

f. Ensuring that vote response fields, selection buttons, or switches properly align with the specific candidate names and/or issues printed on the ballot display, ballot card or sheet, or separate ballot pages.

2.3.1.2 Paper-Based System Standards

In addition to the common standards, paper-based systems shall meet the following standards applicable to the technology used:

a. Enable voters to make selections by punching a hole or by making a mark in areas designated for this purpose upon each ballot card or sheet;

b. For punchcard systems, ensure that the vote response fields can be properly aligned with punching devices used to record votes; and

c. For marksheet systems, ensure that the timing marks align properly with the vote response fields.

2.3.1.2 Ballot Formatting

Ballot formatting is the process by which election officials or their designees use election databases and vendor system software to define the specific contents and related instructions contained on the ballot and present them in a layout permitted by state law. All systems shall provide a capability for:

a. Creation of non-fixed election ballots;

b. Rapid and error-free definition of elections and their associated ballot layouts;

c. Uniform allocation of space and fonts used for each office, candidate, and contest such that the voter perceives no active voting position to be preferred to any other;

d. Simultaneous display of the maximum number of choices for a single contest as indicated by the vendor in the system documentation;

e. Retention of previously defined formats for an election;

f. Prevention of unauthorized modification of any ballot formats; and

g. Modification by authorized persons of a previously defined ballot format for use in a subsequent election.

2.3.1.3 Ballot Production

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

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

a. The electronic display or printed document on which the user views the ballot is capable of rendering an image of the ballot in any language or languages required by the Voting Rights Act of 1965, as amended;

b. The electronic display or printed document on which the user views the ballot does not show any advertising or promotional logos of any kind, whether public service, commercial, or political, unless specifically provided for in State law. Electronic displays shall not provide connection to such material through hyperlink; and

c. The ballot conforms to vendor specifications for type of paper stock, weight, size, shape, size and location of punches or ink fields used to record votes, folding, bleed through, and ink for printing if paper ballot documents or paper displays are part of the system.

2.3.1.3.2 Paper-Based System Standards

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

2.3.2 Election Programming

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

a. Logical definition of the ballot, including the definition of the number of allowable choices for each office and contest;

b. Logical definition of political and administrative subdivisions, where the list of candidates or contests varies between polling places;

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

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

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

2.3.3 Ballot and Program Installation and Control

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

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

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

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

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

2.3.4 Readiness Testing

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

2.3.4.1 Common Standards

All systems shall provide the capabilities to:

a. Verify that voting machines or vote recording and data processing equipment, precinct count equipment, and central count equipment are properly prepared for an election, and collect data that verifies equipment readiness; and

b. Obtain status and data reports from each set of equipment.
c. Verify the correct installation and interface of all system equipment;
d. Verify that hardware and software function correctly;
e. Generate consolidated data reports at the polling place and higher jurisdictional levels; and
f. Segment test data from actual voting data, either procedurally or by hardware/software features.

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

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

2.3.4.2 Paper-Based Systems

Paper-based systems shall:

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

2.3.5 Verification at the Polling Place

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

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

Other information needed to confirm the readiness of the equipment, and to accommodate administrative reporting requirements.

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

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

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

2.3.6 Verification at the Central Location

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

a. The election's identification data;
b. The contents of each active candidate register by office and of each active measure register at all storage locations (showing that they contain only zeros); and
c. Other information needed to ensure the readiness of the equipment and to accommodate administrative reporting requirements.

2.4 Voting Functions

All systems shall support:

* Opening the polls; and
2.4.1 Opening the Polls

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

2.4.1.1 Opening the Polling Place (Precinct Count Systems)

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

a. An internal test or diagnostic capability to verify that all of the polling place tests specified in Section 2.3.5 have been successfully completed; and

b. Automatic disabling any device that has not been tested until it has been tested.

2.4.1.2 Paper-Based System Standards

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

2.4.1.2.1 All Paper-Based Systems

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

a. A means of verifying that ballot punching or marking devices are properly prepared and ready to use;

b. A voting booth or similar facility, in which the voter may punch or mark the ballot in privacy; and

c. Secure receptacles for holding voted ballots.

2.4.1.2.2 Precinct Count Paper-Based Systems

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

a. Activating the ballot counting device;

b. Verifying that the device has been correctly activated and is functioning properly; and

c. Identifying device failure and corrective action needed.

2.4.1.3 DRE System Standards

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

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

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

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

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

2.4.2 Activating the Ballot (DRE Systems)

To activate the ballot, all DRE systems shall:

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

b. Allow each eligible voter to cast a ballot;

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

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

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

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

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

2.4.3.1 Common Standards

To facilitate casting a ballot, all systems shall:

a. Provide text that is at least 3 millimeters high and provide the capability to adjust or magnify the text to an apparent size of 6.3 millimeters;

b. Protect the secrecy of the vote such that the system cannot reveal any information about how a particular voter voted, except as otherwise required by individual State law;

c. Record the selection and non-selection of individual vote choices for each contest and ballot measure;

d. Record the voter's selection of candidates whose names do not appear on the ballot, if permitted under State law, and record as many write-in votes as the number of candidates the voter is allowed to select;

e. In the event of a failure of the main power supply external to the voting system, provide the capability for any voter who is voting at the time to complete casting a ballot, allow for the graceful shutdown of the voting system without loss or degradation of the voting and audit data, and allow voters to resume voting once the voting system has reverted to back-up power; and

f. Provide the capability for voters to continue casting ballots in the event of a failure of a telecommunications connection within the polling place or between the polling place and any other location.

2.4.3.2 Paper-Based Systems Standards

The standards for casting a ballot for paper-based systems consist of common standards and additional standards that apply to precinct count paper-based systems.
f. Prevent the voter from overvoting;
g. Notify the voter when the selection of candidates and measures is completed;
h. Allow the voter, before the ballot is cast, to review his or her choices and, if the voter desires, to delete or change his or her choices before the ballot is cast;
i. For electronic image displays, prompt the voter to confirm the voter's choices before casting his or her ballot, signifying to the voter that casting the ballot is irrevocable and directing the voter to confirm the voter's intention to cast the ballot;
j. Notify the voter after the vote has been stored successfully that the ballot has been cast;
k. Notify the voter that the ballot has not been cast successfully if it is not stored successfully, including storage of the ballot image, and provide clear instructions as to the steps the voter should take to cast his or her ballot should this event occur;
l. Provide sufficient computational performance to provide responses back to each voter entry in no more than three seconds;
m. Ensure that the votes stored accurately represent the actual votes cast;

2.5 Post-Voting Functions

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

2.5.1 Closing the Polling Place (Precinct Count)

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

a. Preventing the further casting of ballots once the polling place has closed;
b. Providing an internal test that verifies that the prescribed closing procedure has been followed, and that the device status is normal;
c. Incorporating a visible indication of system status;
d. Producing a diagnostic test record that verifies the sequence of events, and indicates that the extraction of voting data has been activated; and

e. Precluding the unauthorized reopening of the polls once the poll closing has been completed for that election.

2.5.2 Consolidating Vote Data

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

2.5.3 Producing Reports

All systems shall be able to create reports summarizing the data on multiple levels.

2.5.3.1 Common Standards

All systems shall provide capabilities to:

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

e. Be capable of producing a consolidated printed report of the combination of overvotes for any contest that is selected by an authorized official (e.g., the number of overvotes in a given contest combining candidate A and candidate B, combining candidate A and candidate C, etc.);

f. Produce all system audit information required in Section 4.5 in the form of printed reports, or in electronic memory for printing centrally; and

g. Prevent data from being altered or destroyed by report generation, or by the transmission of results over telecommunications lines.

2.6.3.2 Precinct Count Systems

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

a. Prevent the printing of reports and the unauthorized extraction of data prior to the official close of the polling place;

b. Provide a means to extract information from a transportable programmable memory device or data storage medium for vote consolidation;

c. Consolidate the data contained in each unit into a single report for the polling place when more than one voting machine or precinct tabulator is used; and

d. Prevent data in transportable memory from being altered or destroyed by report generation, or by the transmission of results over telecommunications lines.

2.6.4. Broadcasting Results

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

a. Provide only aggregated results, and not data from individual ballots;

b. Provide no access path from unofficial electronic reports or files to the storage devices for official data; and

c. Clearly indicate on each report or file that the results it contains are unofficial.