Principle 1
HIGH QUALITY DESIGN

The voting system is designed to accurately, completely, and robustly carry out election processes.

1.1 – The voting system is designed using commonly-accepted election process specifications.

1.1-A – Election definition

An election definition must provide the information necessary to hold an election, including accurate information of election districts, contests, candidates, and ballot style information, along with the number of allowable votes for each contest and related rules for voting and tabulating the results.

> **Discussion**
>
> This requirement and its sub-requirements deal with the processes involved in election definition, including ballot definition and layout. It includes capability:
> - to import election definition data that can be stored in external databases, and
> - to export the same data.
>
> It includes the most commonly used voting methods in the U.S., including for write-ins, ballot questions, straight party voting, N-of-M contests, cumulative voting contests, proportional voting contests, and ranked choice voting contests.

1.1-A.1 – Election definition details

The election definition function must be capable of importing, defining, and maintaining:

1. contests and their associated labels and instructions

2. candidate names and their associated labels

3. ballot measures and their associated text

> **Discussion**
>
> Labels means any headers, footers or other text that appears on the ballot along with the contest or candidate's name. See Requirement 1.1.A.27, which requires that the NIST 1500-100 CDF be supported for imports, exports, and reports.

External reference:	NIST 1500-100 CDF
Related requirement:	1.1-A.27 – Election programming common data format input and output

1.1-A.2 – Define political geographies

An election definition must clearly describe the political geographies where the list of contests varies between subdivisions. The political geographies include:

1. election districts, including Congressional, state government, and local government that may overlap each other

2. county, city, town and township jurisdictions

3. precincts, splits, and combinations of precincts

4. user-defined geographies

> **Discussion**
> User-defined geographies could include non-election districts, such as, mosquito abatement districts.

1.1-A.3 – Serve multiple or split precincts and election districts

An election definition must describe election districts and precincts in such a way that a given polling place may serve:

1. two or more election districts

2. combinations of precincts and split precincts

> **Discussion**
> This requirement addresses the capability of precinct devices to be flexible in accommodating multiple ballot styles depending on the political geography being served by a polling place.

1.1-A.4 – Identifiers

An election definition must enable election officials (EOs) to associate multiple identifiers that can be cross-referenced with each other for administrative subdivisions, election districts, contests, and candidates, including for:

1. locally-defined identifiers

2. state-wide-defined identifiers

3. Open Civic Data Identifiers (OCD-IDs)

> **Discussion**
> This is based on the need to support cross-referencing of statewide identifier schemes or schemes such as OCD-IDs with those used on a more local level.

1.1-A.5 – Definition of parties and contests

An election definition must allow for:

1. the definition of political parties and indicate the affiliation or endorsements of each contest option

2. information on both party-specific and non-party-specific contests, with the capability to include both contests on the same ballot

3. contests that include ballot positions with write-in opportunities

1.1-A.6 – Voting methods

An election definition must enable EOs to define and identify contests, contest options, candidates, and ballot questions using all voting methods indicated in the manufacturer-provided implementation statement.

1. For N-of-M contests, an election definition must be capable of defining contests where the voter is allowed to choose up to a specified number of contest options from a list of options.

2. For ballot questions, an election definition must include the ability to create ballot questions where the voter is allowed to vote yes or no on a question.

3. For ballot questions, an election definition must include the ability to create ballot questions where the voter is allowed to vote on one or more from a list of possible choices on a question.

4. For the cumulative voting method, an election definition must include the ability to create ballot questions where the voter is allowed to allocate up to a specified number of votes over a list of contest options, possibly giving more than one vote to a given option.

5. For the proportional voting method, an election definition must include the ability to create ballot questions where the candidate gets the number of votes equal to those allowed divided by number of selections.

6. For the ranked choice voting method, an election definition must include the ability to create ballot questions where the voter is allowed to rank contest options in order of preference, as first choice, second choice, etc.

7. For the cross-party endorsement voting method, an election definition must include the ability to create ballot questions about the necessary straight party contest and record the endorsements made by each party in the election definition, for the purpose of supporting gathering and recording votes for the slate of contest options

endorsed by a given political party when a given contest option is endorsed by two or more different political parties.

1.1-A.7 – Election definition accuracy

An election definition must record the election contests, contest options, issues, and political and administrative subdivisions exactly as defined by EOs.

1.1-A.8 – Voting options accuracy

An election definition must record the options for casting and recording votes exactly as defined by EOs.

1.1-A.9 – Confirm recording of election definition

An election definition must check and confirm that its data is correctly recorded to persistent storage.

Discussion
"Persistent storage" includes storage systems such as nonvolatile memory, hard disks, and optical disks.

1.1-A.10 – Election definition distribution

An election definition must provide for the generation of master and distributed copies of election definitions as needed to configure each voting device in the system.

1.1-A.11 – Define ballot styles

An election definition must enable EOs to define ballot styles.

1.1-A.12 – Auto-format

An election definition must be capable of automatically formatting ballots according to jurisdictional requirements for office and contest options qualified to be placed on the ballot for each political subdivision and election district.

1.1-A.13 – Include votable contests

An election definition must provide for the inclusion in a given ballot style of all contests in which the voter would be entitled to vote.

1.1-A.14 – Exclude nonvotable contests

An election definition must provide for the exclusion from a given ballot style of any contest in which the voter would be prohibited from voting because of place of residence or other such administrative criteria.

> **Discussion**
> In systems supporting primary elections, this would include the exclusion of party-specific contests that voters in a particular political party are not eligible to vote in.

1.1-A.15 – Nonpartisan formatting

An election definition must support the uniform allocation of space and fonts used for each office, contest option, and contest so the voter does not perceive that one contest option is preferred over any other.

1.1-A.16 – Jurisdiction-dependent content

An election definition must enable EOs to add jurisdiction-dependent text, line art, logos, and images to ballot styles.

1.1-A.17 – Primary elections, associate contests with parties

When implementing primary elections, an election definition must support the association of different contests with different political parties.

1.1-A.18 – Ballot rotation

When implementing ballot rotation, an election definition must support producing rotated ballots or activating ballot rotation functions in vote-capture devices by including relevant metadata in distributed election definitions and ballot styles.

> Related requirement: 1.1-E.8 – Ballot rotation for contest options

1.1-A.19 – Ballot configuration in combined or split precincts

When implementing combined or split precincts, an election definition must include the ability to create distinct ballot configurations for voters from two or more election districts that are served by a given polling place.

1.1-A.20 – No advertising

The ballot presented to the voter must not display or link to any advertising or commercial logos of any kind, whether public service, commercial, or political.

1.1-A.21 – Ballot style distribution

An election definition must include the option to generate master and distributed copies of ballot styles as needed to configure each voting device in the system.

1.1-A.22 – Ballot style identification

An election definition must generate codes or marks as needed to uniquely identify the ballot style associated with any ballot.

Discussion

In paper-based systems, identifying marks would appear on the actual ballots. Electronic ballot markers would make internal use of unique identifiers for ballot styles but would not necessarily present these where the voter would see them. In both cases, the identifying mark also could be recorded in the cast vote record.

1.1-A.23 – Reuse of definitions

An election definition must support retaining, modifying, and reusing general districting or precinct definitions and ballot formatting parameters within the same election and from one election to the next.

1.1-A.24 – Ballot style protection

An election definition must prevent unauthorized modification of any ballot styles.

Discussion

See security requirements XXX for information on techniques to prevent unauthorized modifications.

1.1-A.25 – Data inputs and outputs

An election definition must include support for the NIST 1500-100 CDF specification for election programming data inputs and outputs, including for:

1. import of election programming data

2. export of election programming data

3. reports of election programming data to ensure the data is inspected and verified

Discussion

Item 1 concerns import of pre-election data such as for identification of political geography, contest, candidate, ballot data, and other pre-election information used to setup an election and produce ballots. It also concerns export and reporting of the pre-election data from the election definition device so that it can be checked for accuracy or exchanged as needed.

External reference: NIST 1500-100 CDF

1.1-B – Equipment setup

The voting system must provide the capabilities to verify:

1. that all voting devices are properly prepared for an election using real world scenarios and collect data that verify equipment readiness

2. the correct installation and interface of all system equipment

3. that hardware and software function correctly

Discussion

This requirement and its sub-requirements deal with equipment setup prior to the election. They deal primarily with logic and accuracy testing (L&A), whose purpose is to detect malfunctioning and misconfigured devices before polls are opened. Election personnel conduct equipment and system readiness tests before an election:

- to ensure that the voting system functions properly,
- to confirm that system equipment has been properly integrated, and
- to obtain equipment status and readiness reports.

The intent is that the voting system and devices be configured so real-world configuration scenarios will be supported and testable.

1.1-B.1 – Built-in self-test and diagnostics

The voting system must include built-in measurement, self-testing, and diagnostic software and hardware for monitoring and reporting the system's status and degree of operability.

1.1-B.2 – Verify proper preparation of ballot styles

An election definition must allow for EOs to test that ballot styles and programs have been properly prepared.

1.1-B.3 – Verify proper installation of ballot styles

The voting system must include the capability to automatically verify that the software and ballot styles have been properly selected and installed in the equipment and can immediately notify an EO of any errors.

Discussion

At a minimum, notification means an error message, a log entry, and a "failed" result on this portion of the L&A test. Examples of detectable errors include use of software or data intended for a different type of device and operational failures in transferring the software or data.

1.1-B.4 – Verify compatibility between software and ballot styles

The voting system must include the ability to automatically verify that software correctly matches the ballot styles that it is intended to process and immediately notify an EO of any errors.

> **Discussion**
> At a minimum, notification means an error message, a log entry, and a "failed" result on this portion of the L&A test.

1.1-B.5 – Test ballots

The voting system must allow for EOs to submit test ballots for use in verifying the integrity of the system.

1.1-B.6 – Test all ballot positions

Scanners must allow for testing that uses all potential ballot positions as active positions.

1.1-B.7 – Test Cast Vote Records (CVRs)

The voting system must include the ability to verify that CVRs are created and tabulated correctly by permitting EOs to compare the created CVRs with the test ballots.

> **Discussion**
> This requires providing a capability such as an export of CVRs and a tabulated summary that can be compared manually against their test ballot counterparts.

1.1-B.8 – Test codes and images

The voting system must include the ability to verify that any encoded version or images of voter selections on a ballot are created correctly.

> **Discussion**
> The purpose is to ensure that an encoded version of voter selections such as provided by a ballot marking device (BMD) using QR codes contains the voter's selections exactly as made.   It will also ensure that any image of the ballot made by a scanner correctly matches the ballot. BMDs may encode other items as appropriate in codes, for example, ballot style ID.

1.1-B.9 – Testing calibration

Scanners must support the use of test ballots to test the calibration of the paper-to-digital conversion (such as the calibration of optical sensors, the density threshold, and the logical reduction of scanned images to binary values, as applicable).

1.1-B.10– Ballot marker readiness

Ballot marking must allow for a way to verify that the ballot marking mechanism is properly prepared and ready to use.

1.1-B.11 – L&A testing, no side-effects

Logic and accuracy testing functions must introduce no lasting effects on operation during the election other than:

1. audit log entries

2. status changes to note that the tests have been run with a successful or failed result

3. separate storage of test results

4. changes in the protective counter or life-cycle counter (if the device has one)

5. normal wear and tear

Discussion

Subsequent requirements preclude the device from actually serving in the election unless these tests are successful. Apart from that safeguard, it should be impossible (by design) for the L&A testing to have any influence on the operation of the device during the election or on the results that are reported for the election. Most notably, election results can never include any test votes that were counted during L&A testing.

1.1-C – Opening the polls

The voting system must provide functions to enter and exit a voting mode in which voting is permitted.

> **Discussion**
>
> This and following sub-requirements deal with the process of enabling voting to occur by placing the voting system in a voting mode.

1.1-C.1 – Verify L&A performed

The voting system must provide internal test or diagnostic capabilities to verify that the applicable tests specified in the equipment setup requirements have been successfully completed.

> **Discussion**
>
> When an L&A test is conducted, that test will indicate whether any aspects of the test were successful or failed. Requirement 1.1-C.2 allows or prevents entering into an election mode depending on the success or failure of the test.

1.1-C.2 – Prevent opening the polls

The voting system must not enter the voting mode unless and until the readiness test has been performed successfully and any steps necessary to isolate test data from election data have been performed successfully.

> **Discussion**
>
> If a device has not been tested, has failed its L&A test, or the test data have not been isolated (that is, test votes could end up being included in election results), then the device is not ready for use in the election.

1.1-C.3 – Non-zero totals

Tabulation must not enter the voting mode unless and until the L& A test has been performed successfully, any steps necessary to isolate test data from election data have been performed successfully, and all vote counters have been zeroed. An attempt to open polls with non-zero totals:

1. must be recorded in the audit log

2. an EO must be clearly notified of the event

> **Discussion**
>
> Jurisdictions that allow early voting before the traditional election day should note that a distinction is made between the opening and closure of polls, which can occur only once per election, and the suspension and resumption of voting between days of early voting. The open-polls operation, which

requires zeroed counters, is performed only when early voting commences; the resumption of voting that was suspended overnight does not require that counters be zeroed again.

1.1-C.4 – Scanners and ballot marking devices -verify activation

Scanners and ballot marking devices must include a means of verifying that they have been correctly activated and are functioning properly.

1.1-C.5 – Scanners and ballot marking devices - enter voting mode

Scanners and ballot marking devices must provide designated functions for entering voting mode.

1. They must include access control to prevent the inadvertent or unauthorized activation of the poll-opening function.

2. They must include a means of enforcing the execution of poll-opening steps in the proper sequence if more than one step is required.

3. They must include a means of verifying that the system has been correctly activated.

1.1-D – Ballot activation

The voting system must support ballot activation.

> **Discussion**
>
> This requirement and its sub-requirements deal with activating the ballot.

1.1-D.1 – One cast ballot per session

The voting system must enable election workers either to initiate or to provide the voter with the credentials sufficient to initiate a voting session in which the voter may cast or print at most one ballot.

> **Discussion**
>
> A voting session on a BMD may end with the printing of the voter's contest selections, that is, scanning contest selections need not be considered part of the voting session.

1.1-D.2 – Contemporaneous record

The voting system must create contemporaneous records of the credentials issued to a voter. The record, once made, will not be able to be modified by the voting system.

> **Discussion**
>
> The voting system creates a record at the time when credentials are issued to voters so that the records collected can be compared to the number of ballots voted. This may be done if the activation device prints a record or by using a paper pollbook.

1.1-D.3 – Control ballot configuration

The voting system must enable election workers to control the ballot configurations made available to the voter, whether presented in printed form or electronic display, so that each voter is permitted to record votes only in contests in which that voter is authorized to vote.

1. The voting system must activate all portions of the ballot the voter is entitled to vote on.

2. The voting system must disable all portions of the ballot the voter is not entitled to vote on.

3. The voting system must enable the selection of the ballot configuration that is appropriate to the party affiliation declared by the voter in a primary election.

> **Discussion**
>
> For an electronic display, poll workers control the ballot configuration using an activation device and issuing credentials. In paper-based systems, open primaries have sometimes been handled by printing a single ballot style that merges the contests from all parties, instructing the voter to vote

only in the contests applicable to a single party, and rejecting or discarding votes that violate this instruction. To use that approach on a paper-based BMD would violate this requirement.

1.1-E – Voting methods when casting

The voting system must record all individual contest options for each contest using all voting methods indicated for them in the implementation statement.

> **Discussion**
>
> This requirement and its sub-requirements deal with general support for casting ballots using the most common voting methods used in the U.S. (Voting methods are otherwise known as voting variations.). When a ballot is cast, the voting system will create an electronic record of the voter's selections, that is, a cast vote record. The cast vote record need not include those contest options not selected by the voter; their absence in the cast vote record indicates their non-selection.

1.1-E.1 – N-of-M voting

For the N-of-M voting method, the voting system must be capable of gathering and recording votes in contests where the voter is allowed to choose up to a specified number of contests from a list of contest options.

1.1-E.2 – Yes/no measures and multiple-choice measures

For ballot measures, the voting system must be capable of gathering and recording votes in contests where the voter is allowed to:

1. vote yes or no on a measure

2. vote for selections from a list of choices

1.1-E.3 – Indicate party affiliations and endorsements

The voting system must be capable of indicating the affiliation or endorsements of each contest option.

1.1-E.4 – Closed primaries

For closed primaries, the voting system must be capable of gathering and recording votes within a voting process that:

1. assigns different ballot styles depending on the registered political party affiliation of the voter

2. supports both party-specific and non-party-specific contests

1.1-E.5 – Open primaries

For open primaries, the voting system must be capable of gathering and recording votes within a voting process that assigns different ballot styles depending on the political party

chosen by the voter at the time of voting and supports both party-specific and non-party-specific contests.

> **Discussion**
>
> In paper-based systems, open primaries have sometimes been handled by printing a single ballot style that merges the contests from all parties, instructing the voter to vote only in the contests applicable to a single party, and rejecting or discarding votes that violate this instruction.

1.1-E.6 – Write-ins

The voting system must record the voter's write-in of candidates whose names do not appear on the ballot and record as many write-in votes as the voter is allowed.

1.1-E.7 – Write-in reconciliation

The voting system must be capable of gathering and recording votes within a voting process that allows for reconciliation of aliases and double votes resulting from write-ins.

> **Discussion**
>
> Reconciliation of aliases means allowing EOs to declare two different spellings of a candidate's name to be equivalent (or not), as could happen from write-ins. Reconciliation of double votes means handling the case where, in an N-of-M contest, a voter has attempted to cast multiple votes for the same candidate using the write-in mechanism.

1.1-E.8 – Ballot rotation for contest options

For ballot rotation, the voting system must be capable of gathering and recording votes when the ordering of contest options in ballot positions within each contest is variable in such a manner that does not show bias to any contest option.

> **Discussion**
>
> The intent is to ensure that the manner in which the rotation algorithm works does not show bias towards any candidate, i.e., all contest options appear equally in rotated positions to the extent possible.

1.1-E.9 – Straight party voting

For straight party voting, the voting system must be capable of gathering and recording votes for a special contest in which the selection of a political party implies votes for the contest options endorsed by that party in all straight-party-votable contests on the ballot.

1.1-E.10 – Cross-party endorsement

For cross-party endorsement, the voting system must be capable of gathering and recording straight-party votes when a given contest option is endorsed by two or more different political parties.

1.1-E.11 – Precinct splits

The voting system must be capable of gathering and recording votes in a polling place where there are distinct ballot styles for voters from two or more political geographies.

1.1-E.12 – Cumulative voting

For cumulative voting, the voting system must be capable of gathering and recording votes in contests where the voter is allowed to allocate up to a specified number of votes over a list of contest options, possibly giving more than one vote to a given contest option.

1.1-E.13 – Ranked choice voting

For ranked choice voting, the voting system must be capable of gathering and recording votes in contests where the voter is allowed to rank contest options in a contest in order of preference, as first choice, second choice, etc.

1.1-E.14 – Recallable ballots

The voting system must be capable of gathering and recording votes within a voting process that allows the decision of whether to count a particular ballot to be deferred until after election day.

Discussion

Unique identification of each recallable ballot is needed; security-related requirements dealing with this identification are in TBD.

1.1-E.15 – Review-required ballots

The voting system must be capable of gathering and recording votes within a voting process that requires certain ballots to be flagged or separated for review.

Discussion

In some systems and jurisdictions, all ballots containing write-in votes require flagging or separation for review. Support for this indicates that the system can flag or separate ballots in this manner and include the results of the review in the reported totals. Other reasons for which ballots are flagged or separated are jurisdiction-dependent.

1.1-F – Casting and recording

All systems must support the casting of a ballot and recording of each vote precisely as indicated by the voter, subject to the rules of the election jurisdiction.

> **Discussion**
>
> This requirement and its sub-requirements deal with casting ballots and how equipment should handle ballots as they are cast, including the processes involved in recording votes in cast vote records. They mandate recording the selected contest options, as well as other information needed for linking the CVR with the device that is creating the CVRs and for auditing.

1.1-F.1 – Secure ballot boxes

Voting systems that include paper ballots must include secure receptacles for holding cast ballots.

1.1-F.2 – Prevent counter overflow

When the voting system can no longer accept another ballot without the potential of overflowing a vote counter or otherwise compromising the integrity of the counts, it must notify the user or operator and cease to accept new ballots.

> **Discussion**
>
> Assuming that the counter size is large enough such that the value will never be reached is an not adequate safeguard. Systems are required to detect and prevent an impending overflow condition. This requirement is in response to past issues in which devices would use up available memory but give no warning and continue to permit voters to cast ballots.

1.1-F.3 – Ballot orientation

Ballot marking devices that use pre-printed ballots must either:

1. correctly mark pre-printed ballots regardless whether they are loaded upside down, right side up, forward, or reversed

2. detect and reject pre-printed ballots that are oriented incorrectly

1.1-F.4 – Records consistent with feedback to voter

All CVRs and logs must be consistent with the feedback they give to the voter.

> **Discussion**
>
> This does not mean that every message displayed to the voter during an interactive session will be included in every CVR or log. It means that the records and the interactive messages will not be in conflict with one another. For example, it is not permissible to show a vote for candidate X on the display, and then record a vote for candidate Y.

1.1-F.5 – Record contest selection information

The voting system must record contest selection information in the CVR that includes:

1. all contest selections made by the voter for all supported vote variations

2. positions on the ballot associated with each contest selection made by the voter, including when multiple selections are permitted, if applicable

Discussion
For a BMD or other device that marks the ballot for the voter, items 2 and 3 will not be applicable.

1.1-F.6 – Record write-in information

The voting system must record write-in information in the CVR that includes:

1. identification of write-in selections made by the voter

2. the text of the write-in, when using a BMD or other device that marks the ballot for the voter

3. an image or other indication of the voter's write-in markings, when using a scanner

4. an indication whether the write-in has been adjudicated and constitutes a tabulatable vote

5. the total number of write-ins in the CVR

1.1-F.7 – Record election and contest information

The voting system must record additional contest information in the CVR that includes:

1. identification of all contests in which voter has made a contest selection

2. identification of the contest vote method including number of votes allowed in the contest and the maximum number of valid contest selections

3. identification of all overvoted and undervoted contests

4. the number of write-ins recorded for the contest

5. identification of the party for partisan ballots or partisan contests

Discussion
For the last item, a ballot in a partisan primary may in some cases contain contests for different parties. Thus, an indication as to whether the contest is partisan is required.

1.1-F.8 – Record ballot selection override information

Scanners, if tabulating voter selections differently than as marked due to election or contest rules in effect, must record information in the CVR that includes:

1. identification of the original ballot selections made by the voter

2. identification of the changed voter selections

3. identification of the reasons for the changes

Discussion

When marking a ballot directly, a voter may vote in contests in which the voter is not allowed to make contest selections. For example, a voter may elect to vote straight party, but then make contest selections in contests anyway. Election or contest rules may cause a scanner to invalidate the contest markings or require other actions.

1.1-F.9 – Record detected mark information

Scanners must record, for each mark detected on the ballot, information in the CVR that includes:

1. indications of marginal marks that are made by the voter or that are due to imperfections on the ballot

2. mark quality information for each detected mark

Discussion

This applies to contest selections recognized as valid as well as to marginal marks or other detected facets of contest selection positions that are detected by the scanner. For example, a crease in the ballot may be detected by the scanner as a marginal mark. The measurement of mark quality may be specific to manufacturer and model of scanner.

1.1-F.10 – Record audit information

The voting system must be capable of recording audit-related information in the CVR or collection of CVRs as they are created, that includes:

1. identification of the specific creating device such as a serial number

2. identification of the geographical location of the device

3. Identification of the ballot style corresponding to the CVR

4. identification of the corresponding voted ballot

5. for multi-sheet ballots, identification of the individual sheet corresponding to the CVR, along with the identification of the ballot style

6. identification of the batch containing the corresponding voted ballot, when applicable

7. sequence of the corresponding voted ballot in the batch, when applicable

> **Discussion**
>
> Item 4 can be satisfied by printing a unique ID on the ballot as it is scanned and including that ID in the corresponding CVR.
>
> Item 5 ensures that every sheet of a multi-sheet ballot contains the sheet number as well as the ballot style ID. This way, a ballot style ID could be defined to include all sheets, or each sheet could be defined with a unique ballot style.
>
> Items 6 and 7 are necessary when ballot batching is in effect.

1.1-F.11 – Use of cast vote record common data format for recording CVR

The voting system must include support for recording CVRs using the NIST 1500-102 CVR CDF specification.

> **Discussion**
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> This requirement can be met by supporting the CVR CDF when exporting CVRs.

External reference: NIST 1500-102 CVR CDF

1.1-G – Closing the polls

The voting system must provide designated functions for exiting election mode and stopping voting.

Discussion

This requirement and its sub-requirements deal with exiting voting mode (closing the polls), that is, stopping voting and preventing further voting. This applies to those systems located at a remote location such as the polling place. When voting is conducted across multiple days, for example, for early voting, these requirements are still applicable even though the election itself may not be over, with the exception of requirement 1.1-G.4, which deals with preventing, on election day, re-opening of the polls once they have been closed.

1.1-G.1 – No voting when polls are closed

The voting system must prevent the further enabling, activation, marking, or casting of ballots by any device once the polls have closed.

Discussion

A BMD cannot prevent a voter from marking a paper ballot with a writing utensil after polls have closed. This needs to be prevented through procedures.

1.1-G.2 – Poll closing integrity check

The voting system must provide an internal test that verifies that the prescribed closing procedure has been followed and that the device status is normal.

1.1-G.3 – Report on poll closing process

The voting system must provide a means to produce a diagnostic test record that verifies the sequence of events and indicates that the poll closing process has been activated.

1.1-G.4 – Prevent reopening polls

The voting system must prevent reopening of the polls once the poll closing has been completed for an election.

Discussion

For early voting conducted across multiple days, this requirement does not prevent reopening of the polls on the following day. This requirement is only applicable on the final day of election

1.1-G.5 – Post-election reports

The voting system must provide designated the capability to generate precinct post-election reports.

1.1-G.6 – Post-election reports in common data format

The voting system must include support for the NIST 1500-100 CDF specification for post-election reports.

External reference: NIST 1500-100 CDF

1.1-G.7 – Use of CVR common data format for CVR export

The voting system must include support for the NIST 1500-102 CDF specification for cast vote records for exporting a collection of CVRs from the device that created the CVRs.

Discussion

This requirement concerns export of CVRs from devices such as scanners or code and bar-code reading devices.

External reference: NIST 1500-102 CDF

1.1-H – Ballot handling functions for scanners

Scanners must provide features for handling ballots when they are scanned individually using voter-facing scanners or scanned in batches using batch-fed scanners.

> **Discussion**
>
> This requirement and its sub-requirements deal with functions that scanners will provide, including for separating ballots for various reasons, for example, because of write-ins on manually-marked paper ballots and handling mis-fed ballots. They deal with the behavior of batch-fed scanners and voter-facing scanners when scanning ballots that need manual handling or inspection, such as for write-ins or unreadable ballots.

1.1-H.1 – Detect and prevent ballot style mismatches

All voting systems must detect ballot style mismatches and prevent votes from being tabulated or reported incorrectly due to a mismatch.

> **Discussion**
>
> For example, if the ballot styles loaded on a scanner disagree with the ballot styles that were used by vote-capture devices, the system will raise an alarm and prevent the incorrect ballot styles from being used during tabulation. Otherwise, votes could be ascribed to the wrong contest options. Such a mismatch should have been detected and prevented in L&A testing but if it was not, it needs to be be detected and prevented before tabulation commences.

1.1-H.2 – Detect and reject ballots that are oriented incorrectly

Scanners must do one of the following:

1. correctly count ballots regardless of whether they are fed upside down, right side up, forward, or reversed

2. detect and reject ballots that are oriented incorrectly

1.1-H.3 – Ballot separation when batch feeding

In response to unreadable ballots, write-ins, and other designated conditions, batch-fed scanners must do one of the following:

1. out stack the ballot (that is, divert to a stack separate from the ballots that were normally processed)

2. stop the ballot reader and display a message prompting the EO to remove the ballot

3. mark the ballot with an identifying mark to facilitate its later identification

> **Discussion**

1.1-H.4 – Overvotes, undervotes, blank ballots

Voter-facing scanners must provide a capability that can be activated by EOs to stop the scanning and display a message to the EO to remove and correct the ballot in response to the following ballot conditions:

1. ballots containing overvotes in a designated contest

2. ballots containing undervotes in a designated contest

3. ballots containing contests that were not voted

4. blank ballots

1.1-H.5 – Write-ins

When scanning a ballot containing a write-in vote, voter-facing scanners must segregate the ballot in a manner that facilitate its later identification.

Discussion

The requirement to separate ballots containing write-in votes is not applicable in systems in which a BMD encodes write-in votes in machine-readable form and a scanner generates individual tallies for all written-in candidates automatically. Separation of ballots containing write-in votes is only necessary in systems that require the allocation of write-in votes to specific candidates to be performed manually.

1.1-H.6 – Ability to clear misfeed

If multiple feed or misfeed (jamming) occurs, a batch-fed scanner must:

1. halt in a manner that permits the operator to remove the ballots causing the error and reinsert them in the input hopper (if unread) or insert them in the ballot box (if read)

2. indicate whether or not the ballots causing the error has been read

Discussion the second bullet deals with whether a CVR has been created for the ballots that jammed; EOs needs to know whether to re-feed the ballot.

1.1-I – Scan to manufacturer specifications

Scanners must detect marks made on paper ballots according to non-proprietary, published manufacturer specifications.

> **Discussion**
> Manufacturers will publish their specifications for detecting marks and these specifications will be publicly available. Because voters may make any number of mistakes when marking a ballot, canners need to interpret the marks according to these published specifications as well as possible. Requirements in the Casting section require the manufacturer to include, in the CVR, an indication of mark quality for each detected mark.

1.1-I.1 – Ignore unmarked contest option positions

Scanners must ignore (that is, not record as votes) unmarked contest option positions.

> **Discussion**
> "Unmarked" in this requirement means containing no marks of any kind other than those designed to be present as part of the ballot style. This includes extraneous perforations, smudges, folds, and blemishes in the ballot stock.

1.1-I.2 – Accurately detect perfect marks

Scanners must detect marks that conform to manufacturer specifications.

1.1-I.3 – Accurately detect imperfect marks

Scanners must detect a 1 mm thick line that:

1. is made with a #2 pencil that crosses the entirety of the contest option position on its long axis,

2. is centered on the contest option positio

3. is as dark as can practically be made with a #2 pencil

> **Discussion**
> Different optical scanning technologies will register imperfect marks in different ways. Variables include:
> * the size, shape, orientation, and darkness of the mark;
> * the location of the mark within the voting target;
> * the wavelength of light used by the scanner;
> * the size and shape of the scanner's aperture;
> * the color of the ink;
> * the sensed background-white and maximum-dark levels; and,
> * the calibration of the scanner.

The mark specified in this requirement is intended to be less than 100 % perfect, but reliably detectable, that is, not so marginal as to bring the uncontrolled variables to the forefront. In plain language: scanning technologies may vary, but as a minimum requirement, all of them should be capable of reliably reading *this* mark.

1.1-I.4 – Ignore extraneous marks outside contest option position

Scanners must not record as votes any marks, perforations, smudges, or folds appearing outside the boundaries of contest option positions.

1.1-I.5 – Ignore extraneous marks inside voting targets

Scanners must not record as votes any imperfections in the ballot stock, folds, and similar insignificant marks appearing inside voting targets.

Discussion

Insignificant marks appearing inside voting targets can be detected as votes. This problem should be minimized.

1.1-I.6 – Ignore hesitation marks

Scanners must not record as votes Error! Reference source not found.s and similar insignificant marks.

Discussion

It may be possible to reliably detect reasonable marks and reliably ignore Error! Reference source not found.s if the scanner is calibrated to a specific marking utensil. Unfortunately, in practice, scanners are required to tolerate the variations caused by the use of unapproved marking utensils. Thus, lighter marks of a significant size are detected at the cost of possibly detecting especially dark Error! Reference source not found.s.

1.1-I.7 – Marginal marks, no bias

The detection of marginal marks from manually-marked paper ballots must not show a bias.

Discussion

Bias errors are not permissible in any system. An example of bias would be if marginal marks in the first ballot position were detected differently than marginal marks in the second ballot position.

1.1-I.8 – Repeatability

The detection of marginal marks from manually-marked paper ballots must be repeatable.

Discussion

It is difficult to have confidence in the equipment if consecutive readings of the same ballots on the same equipment yield dramatically different results. However, it is technically impossible to achieve repeatable reading of ballots containing marks that fall precisely on the sensing threshold.

1.1-J – Voting methods when tabulating

Tabulation must support all voting methods indicated in the implementation statement.

Discussion

These requirements deal with how tabulation processes will handle voting methods, including those methods used most commonly across the U.S.

1.1-J.1 – N-of-M voting

For N-of-M voting, tabulation must be capable of tabulating votes, overvotes, and undervotes in contests where the voter is allowed to choose up to a specified number of contest options from a list of contest options.

1.1-J.2 – Yes/no measure and multiple-choice measure

For yes/no measures and multiple-choice measures, tabulation must be capable of tabulating votes, overvotes, and undervotes in contests where the voter is allowed to:

1. vote yes or no on a measure

2. choose from a list of multiple choices on a measure

1.1-J.3 – Recallable ballots

For recallable ballots, tabulation must be capable of tabulating votes, overvotes, and undervotes in contests where the decision whether to count a particular ballot is deferred until after election day.

1.1-J.4 – Accept or reject recallable ballots individually

For recallable ballots, tabulation must support the independent acceptance and rejection of individual recallables.

Discussion

This is meant to rule out the mode of failure in which the IDs assigned to provisional ballots fail to be unique, rendering the system incapable of accepting one without also accepting the others with the same ID.

1.1-J.5 – Accept or reject recallable ballots by category

For recallable ballots, tabulation must support the acceptance and rejection of recallables by category.

1.1-J.6 – Primary elections

For primary elections, tabulation must be capable of keeping separate totals for each political party for the number of ballots read and counted.

Discussion

In paper-based systems, open primaries have sometimes been handled by printing a single ballot style that merges the contests from all parties and instructing the voter to vote only in the contests applicable to a single party. This approach requires additional logic in the tabulator to support rejecting or discarding votes that violate these special instructions, while the approach of assigning different ballot configurations to different parties does not. Support for the merged ballot approach is not required for a tabulator.

This requirement to separate by party applies only to the number of read ballots and counted ballots. It does not apply to contest option vote totals.

1.1-J.7 – Write-ins

For write-ins, tabulation must be capable of tabulating votes for write-in candidates, with separate totals for each candidate.

1.1-J.8 – Support write-in reconciliation

For write-ins, tabulation must be capable of tabulating votes within a voting process that allows for reconciliation of aliases and double votes.

Discussion

Reconciliation of aliases means allowing EOs to declare two different spellings of a candidate's name to be equivalent (or not). Reconciliation of double votes means handling the case where, in an N-of-M contest, a voter has attempted to cast multiple votes for the same candidate using the write-in mechanism.

1.1-J.9 – Ballot rotation

Tabulation must be capable of tabulating votes when the ordering of contest options in ballot positions within each contest is variable.

Discussion

This simply means that ballot rotation will not impact the correctness of the count.

1.1-J.10 – Straight party voting

Tabulation must be capable of tabulating straight party votes.

1.1-J.11 – Tabulating straight party votes

A straight party vote must be counted as a vote in favor of all contest options endorsed by the chosen party in each straight-party-votable contest in which the voter does not cast an explicit vote.

Discussion

This requirement intentionally says nothing about what happens when there is both a straight party endorsed contest option and an explicit vote in a given contest (a straight party override). Jurisdictions may handle this in various ways, including to void the ballot or contest.

1.1-J.12 – Cross-party endorsement

For cross-party endorsement, tabulation must be capable of tabulating straight-party votes when a given contest option is endorsed by two or more different political parties.

1.1-J.13 – Precinct splits

Tabulation must be capable of tabulating votes for precinct splits or combinations of precincts.

1.1-J.14 – Cumulative voting

For cumulative voting, tabulation must be capable of tabulating votes, overvotes, and undervotes in contests where the voter is allowed to allocate up to a specified number of votes over a list of contest options however they choose, possibly giving more than one vote to a given contest option.

1.1-J.15 – Ranked choice voting

For ranked choice voting, tabulation must be capable of determining the results of a ranked choice contest for each round of tabulation.

Discussion

This requirement is minimal. Since ranked choice voting is not currently in wide use, it is not clear what, other than the final result, will be computed.

1.1-K – General reporting functionality

The voting system must provide the capability to produce reports for:

1. audit (election event logs)

2. ballot data

3. system readiness and status

4. contest vote data

1.1-K.1 – Reporting device consolidation

When more than one vote-capture device or voter-facing scanner is used, it must be possible to consolidate the data contained in each unit into a single report for the polling place. If the consolidation of polling place data is done locally, the precinct reporting device needs to perform this consolidation in no more than 5 minutes per scanner.

Discussion
This requirement essentially requires precinct-based vote capture devices to be able to consolidate voting data for the purposes of issuing one consolidated report.

1.1-K.2 – Reports are time stamped

All reports must include the date and time of the report's generation, including hours, minutes, and seconds. Timestamps in reports need to comply with ISO 8601, provide all four digits of the year, and include the time zone.

External reference: ISO 8601

1.1-K.3 – Reporting is non-destructive

The voting system must prevent data, including data in transportable memory, from being altered or destroyed by report generation.

Discussion
Appending an audit record reflecting the fact that a report has been generated is not considered an alteration.

1.1-K.4 – Audit reports

The voting system must be capable of producing reports of election event logs.

1.1-K.5 – Event log reporting uses CDF input and output

The voting system must include support for the NIST 1500-101 CDF specifications for exports or reports of election event log reports.

    External reference: NIST 1500-101 CDF specifications

1.1-K.6 – Status and readiness reports

The voting system must provide the capability to produce status and equipment readiness reports.

Discussion
These reports typically are generated during pre-voting logic and accuracy testing.

1.1-K.7 – Pre-election reports

The voting system must provide the capability to produce a report that includes:

1. The allowable number of votes in each contest

2. The counting logic (for example, N-of-M, cumulative, or ranked choice) that is used for each contest

3. The inclusion or exclusion of contests as the result of precinct splits

4. Any other characteristics that may be peculiar to the jurisdiction, the election, or the precincts

5. Manual data maintained by election personnel

6. Samples of all final ballot styles

7. Ballot preparation edit listings

Discussion
The purpose of this requirement is for sanity checks of the election configuration. Previous requirements mandate support for the NIST 1500-100 CDF specification.

    External reference: NIST 1500-100 CDF specification

1.1-K.8 – Readiness reports for each polling place

Readiness reports must include at least the following information for each polling place:

1. The election's identification data

2. The identification of the precinct and polling place

3. The identification of all voting devices deployed in the precinct

4. The identification of all ballot styles used in that precinct

5. Confirmation that no hardware or software failures were detected during setup and testing, or a record of those that occurred

6. Confirmation that all vote-capture devices are ready for the opening of polls, or identification of those that are not

1.1-K.9 – Readiness reports, precinct tabulation

Readiness reports must include the following information for each voter-facing scanner or other precinct reporting device:

1. The election's identification data

2. The identification of the precinct and polling place

3. The identification of the voter-facing scanner

4. The contents of each active contest option register at all storage locations

5. Confirmation that no hardware or software failures were detected during setup and testing, or a record of those that occurred

6. Any other information needed to confirm the readiness of the equipment and to accommodate administrative reporting requirements

1.1-K.10 – Readiness reports, central tabulation

Readiness reports must include the following information for each batch-fed scanner or other central reporting device:

1. The election's identification data

2. The identification of the tabulator

3. The identification of all ballot styles used in the system extent

4. The contents of each active contest option register at all storage locations

5. Confirmation that no hardware or software failures were detected during setup and testing, or a record of those that occurred

6. Any other information needed to confirm the readiness of the equipment and to accommodate administrative reporting requirements

1.1-K.11 – Readiness reports, public network test ballots

Systems that send ballots over a public network must provide a report of test ballots that includes:

1. the number of test ballots sent

2. when each test ballot was sent

3. the identity of the machine from which each test ballot was sent

4. the specific votes contained in the test ballots

1.1-K.12 – Ballot and vote counts

The voting system must be capable of generating human-readable reports of the vote and ballot count, including the capability for:

1. alphanumeric headers

2. election, office and issue text

3. alphanumeric entries generated as part of the audit record

Discussion

This requirement and its sub-requirements specify a minimum set of information that a voting system will report. They do not prohibit any voting system from reporting additional information that may be required by jurisdictions or otherwise found to be useful.

1.1-K.13 – Report all votes cast

All systems must be able to produce an accurate, human-readable report of all votes cast.

Discussion

Binary document formats and text containing markup tags are not considered human-readable. The system may generate such documents, but it must also provide the functionality to render those documents in human-readable form (for example, by including the necessary reader application).

1.1-K.14 – Account for all cast ballots and all valid votes

All systems must produce vote data reports that account for all cast ballots and all valid votes.

1.1-K.15 Discrepancies detectable

Any discrepancy that is detectable by the system must be flagged in the system by an annotation or error message in the affected report or a separate discrepancy report.

Discussion

If this requirement is applicable, then the system has failed to satisfy Requirement 1.1-N.3 and is therefore non-conforming. Nevertheless, in practice it is essential that discrepancies be flagged by the system as much as possible so that they are not overlooked by election judges. The system cannot detect discrepancies if no single voting device is ever in possession of a sufficient set of data.

1.1.14-E – Reporting combined precincts

The voting system must be capable of generating reports that consolidate vote data from selected precincts.

Discussion

Jurisdictions in which more than one precinct may vote at the same location on either the same ballot style or a different ballot style may desire reports that consolidate the voting location.

1.1-K.15 – Precinct reporting devices, no tallies before polls close

The voting system must prevent the printing of vote data reports and extracting vote tally data before the polls close.

Discussion

Providing ballot counts does not violate this requirement. The prohibition is against providing vote totals. Ballot counts are required for ballot accounting, but early extraction of vote totals is an enabler of election fraud.

1.1-K.16 – Report categories of cast ballots

All voting systems must report the number of ballots both in total and broken down by ballot style and by selected units of political geography including county, city, town or township, ward, precinct, and precinct split, for the following categories of cast ballots:

1. All read ballots and all counted ballots

2. For multi-page ballots, the number of different pages read and number counted

3. Recallable read ballots and counted ballots

4. UOCAVA read ballots and counted ballots

5. Absentee read and counted ballots

6. Blank ballots (ballots containing no votes)

Discussion

There is no sub-requirement for separate reporting of provisional cast ballots because the system is unlikely to know whether a ballot is provisional until it is successfully read. Some jurisdictions find the number of blank ballots to be useful. Blank ballots sometimes represent a protest vote.

1.1-K.17 – Report read ballots by party

Systems must report separate totals for each party in primary elections when reporting categories of read and counted cast ballots.

1.1-K.18 – Report counted ballots by contest

All systems must report the number of counted ballots for each relevant N-of-M or cumulative voting contest.

> **Discussion**
> The count by contest could be inferred from the other counts that are broken down by ballot configuration, but providing this figure explicitly will make it easier to account for every vote. N-of-M in this requirement includes the most common type of contest, 1-of-M.

1.1-K.19 – Report votes for each contest option

All systems must report the vote totals for each contest option in each relevant N-of-M or cumulative voting contest.

> **Discussion**
> N-of-M in this requirement includes the most common type of contest, 1-of-M.

1.1-K.20 – Report overvotes for each contest

Systems must report the number of overvotes for each relevant N-of-M or cumulative voting contest.

> **Discussion**
> This count refers to votes lost to overvoting, not of ballots containing overvotes. This means that a ballot that overvotes an N-of-M contest would contribute N to the count of overvotes for that contest.

1.1-K.21 – Reporting overvotes, ad hoc queries

All systems must be capable of producing a consolidated report of the combination of overvotes for any contest that is selected by an authorized official (for example, the number of overvotes in a given contest combining candidate A and candidate B, or combining candidate A and candidate C).

1.1-K.22 – Report undervotes for each contest

All systems must report the number of undervotes for each relevant N-of-M or cumulative voting contest.

> **Discussion**

Counting ballots containing undervotes instead of votes lost to undervoting is insufficient.

1.1-K.23 – Ranked choice voting, report results

Systems implementing ranked choice voting must report the contest option vote totals for each ranked choice contest for each round of tabulation.

Discussion

This requirement is minimal. Since ranked choice voting is not currently in wide use, it is not clear what needs to be reported, how bogus orderings are reported, or how it would be done in multiple reporting contexts.

1.1-K.24 – Include in-person votes

Systems must report all following categories of votes in the consolidated reports:

1. In-person voting

2. Absentee voting

3. Write-ins

4. Accepted recallable ballots

5. Accepted reviewed ballots