Texas Secretary of State

Logic and Accuracy Testing

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Logic and Accuracy Testing

- The general custodian of election records shall conduct both a Logic and Accuracy Test and a Test of Tabulation Equipment

- **Logic and Accuracy Test**: Prior to the commencement of voting and no later than 48 hours before voting begins on the equipment, the designated general custodian of election records shall conduct the public Logic and Accuracy Test (Sec. 129.023)

- The general custodian must also demonstrate, using a representative sample of the voting system equipment, that the source code of the equipment has not been altered (Sec. 129.023(c-1))

Test of Tabulation Equipment

- **Test of Tabulation Equipment:** The tabulation supervisor and counting station manager of the central counting station shall prepare and test the central accumulator system three times as required by Chapter 127, Subchapter D. The test shall be conducted as part of the Logic and Accuracy Test. The test shall be conducted three times for each election
  - The first test shall be conducted at least 48 hours before the automatic tabulating equipment is used to count ballots voted in the election. The first test is open to the public. (Sec. 127.096(b))
  - The second test shall be conducted immediately before the counting of ballots with the equipment begins.
  - The third test shall be conducted immediately after the counting of ballots with the equipment is completed.

Sec. 127.093

Notice Requirements

- Public notice of the L&A test must be published on the county's Internet website, if the county maintains an Internet website, or on the bulletin board used for posting notice of meetings of the commissioners court if the county does not maintain an Internet website, at least 48 hours before the test begins, and the test must be open to the public. (Sec. 129.023)
- If the L&A test is being conducted for a primary election, the general custodian must notify the county chair at least 48 hours before the date of the test. (Sec. 129.023(b-1)). If the test is being conducted for an election in which a county election board has been established, the general custodian of election records shall notify each member of the board of the test at least 48 hours before the date of the test. (Sec. 129.023(b-2))
- The general custodian of election records shall publish notice for the Test of Tabulation Equipment. The notice must include the date, hour, and place of the first test conducted under Section 127.093(b) in a newspaper, as provided by general law for official publications by political subdivisions, at least 48 hours before the date of the test. (This is the same notice as your public L&A test.) (Sec. 127.096(a))

Records Retention

- On completing each test, the general custodian of election records shall place the test materials in a container provided for that purpose and seal the container in a manner that prevents opening without breaking the seal. The general custodian and at least two members of the testing board shall sign the seal.
- The test materials shall remain sealed for the period for preserving the precinct election records (22 months). (Secs. 66.058, 129.024)

Hash Validation

Four types of voting system testing shall be performed for each election

1. Hardware Diagnostic Test (Chapter 129, Subchapter B)

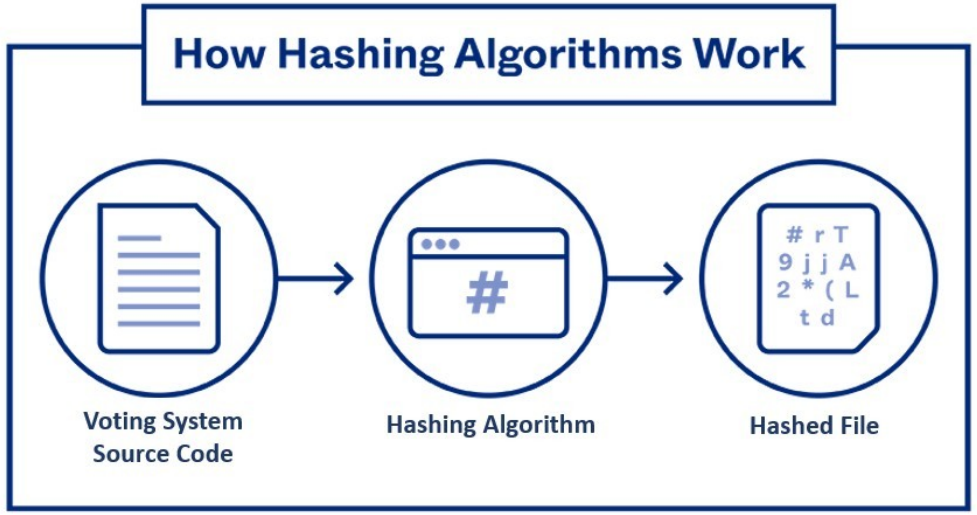
2. Hash Validation/Logic and Accuracy (L&A) Test (Chapter 129, Subchapter B)

3. Testing of Tabulation Equipment (Chapter 127, Subchapter D)

4. Post-Election Audit (Partial Manual Count) (Chapter 127, Subchapter H)

What is a Hash?

- A hash is a mathematical function that, when applied to a file, creates a **unique** string of letters and numbers.
- A specific hashing algorithm will **always** create the same string.
- This method allows vendors and elections officials to compare a hash generated by the voting system to a trusted hash provided by the SOS or the Election Assistance Commission (EAC)
- If the hash values are identical, **the process confirms that the voting system and its source code has not been altered.**



Hash Validation Requirements

- Each county and entity conducting an election **must perform hash validation for every election.**
- Entities **must perform** hash validation **in conjunction with the Public L&A testing.**
- Hash validation must be performed **prior to casting of test ballots.**
- Hash validation test **must be successful in order to proceed with L&A testing.**

Representative Sample

At least one piece of equipment per device type and version.

- Election Management Computers
- Ballot Marking Devices (to include for accessible use)
- Ballot Scanners (precinct)
- Central Scanners
- Tabulation computers

Hash Validation Assurance

Trusted Hash Values have been previously validated three times:

1. Hash values are generated and confirmed by independent lab testing
2. Hash values are generated and confirmed during state certification testing
3. Hash values are generated and confirmed during Acceptance Testing (TEC, Chapter 129.021)

You will be able to verify integrity by confirming two factors:

1. Trusted hash files came from a **trusted source.**
2. The file comparison between the trusted files and the generated files is **an exact match.**

NOTE: A voting system that is unable to generate a hash value to verify the programming cannot meet this requirement and therefore will not be certified by the SOS. (Secs. 122.003, 122.032).

Resources Used for Testing

Dedicated Testing Computer/Laptop

1. It should not be connected to the Internet during testing.
2. It should not be used for any purposes other than testing.

USB Drives/Media Sticks

1. Vendor-provided USB Media is preferred and highly recommended.
2. New/Unused USB Sticks are recommended to be used for this purpose.

File Integrity/Hashing Tool

1. Software must be from an independent, and preferably, open source.*
2. Software must be able to operate offline with no connection to the Internet.

Open Source means that the software and its source code are openly available to the public.

Procedures Overview for Hash Validation

1. Obtain trusted hashes from the Secretary of State.

2. Contact your voting system vendor for instructions on how to generate hashes and how to perform the comparison with the trusted hashes.

3. Generate a hash from a representative sample of the voting system equipment.

4. Identify the files corresponding to the equipment you are testing.

5. Compare the generated hashes to the trusted hashes provided by the SOS or the EAC to verify that those hashes are identical.

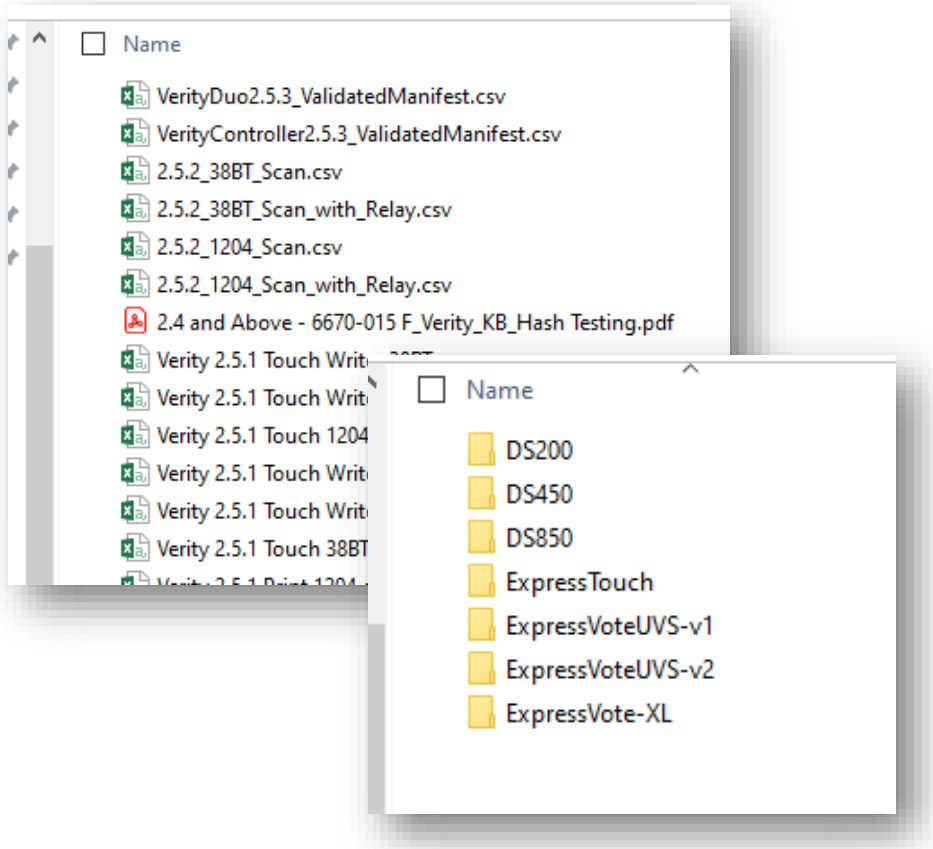
6. If the generated hash and the trusted hash are **identical**, the test is successful.

Obtaining Trusted Hashes

1. In order to compare hashes, you must first obtain the trusted hashes from the SOS. When requesting hashes, please send the following information to the SOS at ElectionSecurity@sos.texas.gov:
    a. Voting System Vendor (Hart or ES&S)
    b. Vendor Specific Software Version (Verity 2.X, EVS 6.X.X.X, etc.)
2. You will receive two e-mail messages. The first one includes an **encrypted**, **password protected** compressed folder. The **decrypting passcode** will be included in the second e-mail message.
3. **Download** the encrypted file to your computer or an external storage device in order to extract and obtain the folder containing the trusted hashes.
4. In order to extract and gain access to the files, enter the **passcode provided** in the second e-mail message.
5. Once extracted, transfer the trusted hash files to the designated computer where the comparison will be performed.

Generating your Equipment Hashes

1. **Follow your vendor-provided specific instructions** when generating the hashes. Hash generation procedures vary depending on the software version, equipment, and vendor. Typically, a file containing the hashes is generated on the voting system and exported to an external drive for comparison.
2. Transfer the files to the dedicated computer or laptop to perform the validation.
3. Identify the files specific to your equipment inside the folder with the trusted hashes. Consult your vendor for assistance in this step, if needed.

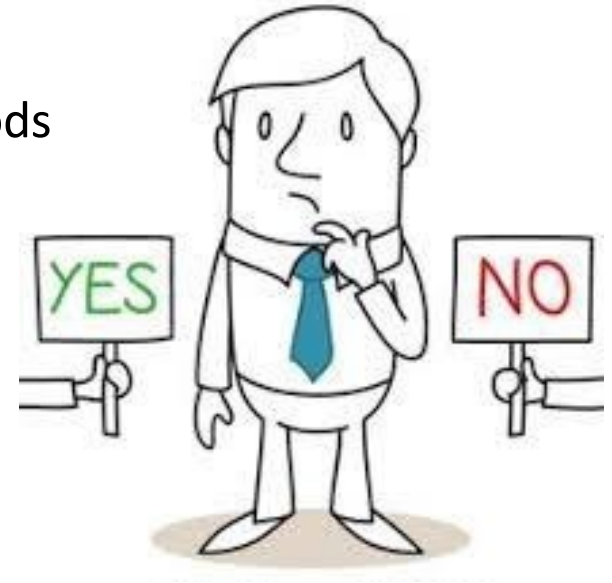


Performing the Comparison

1. Perform your hash comparison of the string of characters from your generated hash against the string of characters from your trusted hash.
2. Each determined device **must be tested individually**.
3. To ensure accuracy, we recommend a software tool to perform the comparison. (i.e., file integrity checker, hashing tool)
4. If the two sets of characters are **identical**, then the hash validation is successful.
5. If the comparison **does not match,** verify that you are using the correct hashed files, check your method instructions, request assistance from your vendor, or contact our office at ElectionSecurity@sos.texas.gov.
6. Create a record of the test results and maintain it with the corresponding test records. (printed or PDF report, screenshot, printout, photo, etc.)

File Integrity Checkers

- Several counties have identified freeware* products that have been effective when comparing files for the purpose of hash validation.
- Such products might not be compatible to use with all voting systems' methods of hash comparison.
- It is your responsibility to verify and investigate software before you download and install it on your dedicated testing computer.
- Please consult your IT security personnel for guidance concerning the use of freeware for this purpose.
- EAC has published a list of available file checkers: https://www.makeuseof.com/tag/free-hash-checkers-file-integrity/?newsletter_popup=1.



"Freeware" is a program or software that is available free of cost.

Trusted Hash Files

- If your voting system's version **has not changed** from the last time you obtained trusted hashes from the SOS, you may utilize the same files to perform the hash validation testing. You may submit another request if the previous files are unavailable.

Voting Systems Certification

- A voting system that is unable to generate a hash value to verify the programming cannot meet this requirement and therefore will not be certified by the SOS. (Secs. 122.003, 122.032).
- Voting system vendors are aware of this statutory requirement and must provide their customers with documentation that outlines the procedures for generating a hash from their system.

Records Management

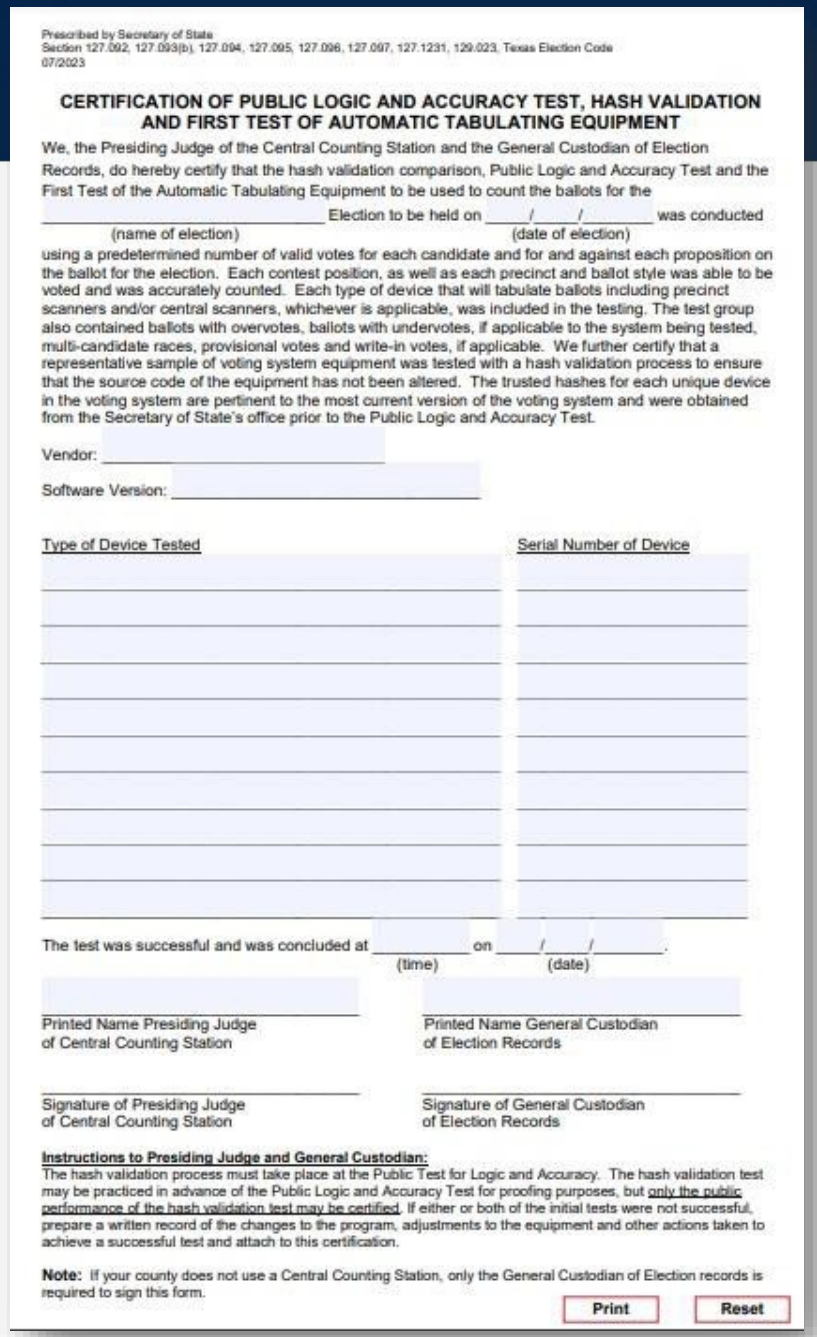
- The materials and results of the hash validation portion of the test must be stored with the testing materials corresponding to that election and may be subject to the corresponding retention periods. These may include media drives, digital (screenshots, computer generated reports, etc.) or printed copies of the results.

Texas Secretary of State

Certification Of Hash Validation, Public Logic And Accuracy Test And First Test Of Automatic Tabulating Equipment

This **NEW** form will certify that Hash Validation was conducted.

- Name and Date of the Election
- Name, Model and Version Number of devices tested
- Serial Number of each device tested
- Completion time and date of successful test
- Presiding Judge of Central Count information
- General Custodian of Election Records information



Prescribed by Secretary of State
Section 127.092, 127.093(b), 127.094, 127.095, 127.096, 127.097, 127.1231, 129.023, Texas Election Code
07/2023

CERTIFICATION OF PUBLIC LOGIC AND ACCURACY TEST, HASH VALIDATION AND FIRST TEST OF AUTOMATIC TABULATING EQUIPMENT

We, the Presiding Judge of the Central Counting Station and the General Custodian of Election Records, do hereby certify that the hash validation comparison, Public Logic and Accuracy Test and the First Test of the Automatic Tabulating Equipment to be used to count the ballots for the _____ Election to be held on ____/____/_____ was conducted
(name of election) (date of election)
using a predetermined number of valid votes for each candidate and for and against each proposition on the ballot for the election. Each contest position, as well as each precinct and ballot style was able to be voted and was accurately counted. Each type of device that will tabulate ballots including precinct scanners and/or central scanners, whichever is applicable, was included in the testing. The test group also contained ballots with overvotes, ballots with undervotes, if applicable to the system being tested, multi-candidate races, provisional votes and write-in votes, if applicable. We further certify that a representative sample of voting system equipment was tested with a hash validation process to ensure that the source code of the equipment has not been altered. The trusted hashes for each unique device in the voting system are pertinent to the most current version of the voting system and were obtained from the Secretary of State's office prior to the Public Logic and Accuracy Test.

Vendor: _____

Software Version: _____

Type of Device Tested	Serial Number of Device

The test was successful and was concluded at _____ on ____/____/_____.
(time) (date)

Printed Name Presiding Judge of Central Counting Station

Printed Name General Custodian of Election Records

Signature of Presiding Judge of Central Counting Station

Signature of General Custodian of Election Records

Instructions to Presiding Judge and General Custodian:
The hash validation process must take place at the Public Test for Logic and Accuracy. The hash validation test may be practiced in advance of the Public Logic and Accuracy Test for proofing purposes, but only the public performance of the hash validation test may be certified. If either or both of the initial tests were not successful, prepare a written record of the changes to the program, adjustments to the equipment and other actions taken to achieve a successful test and attach to this certification.

Note: If your county does not use a Central Counting Station, only the General Custodian of Election records is required to sign this form.

Print Reset

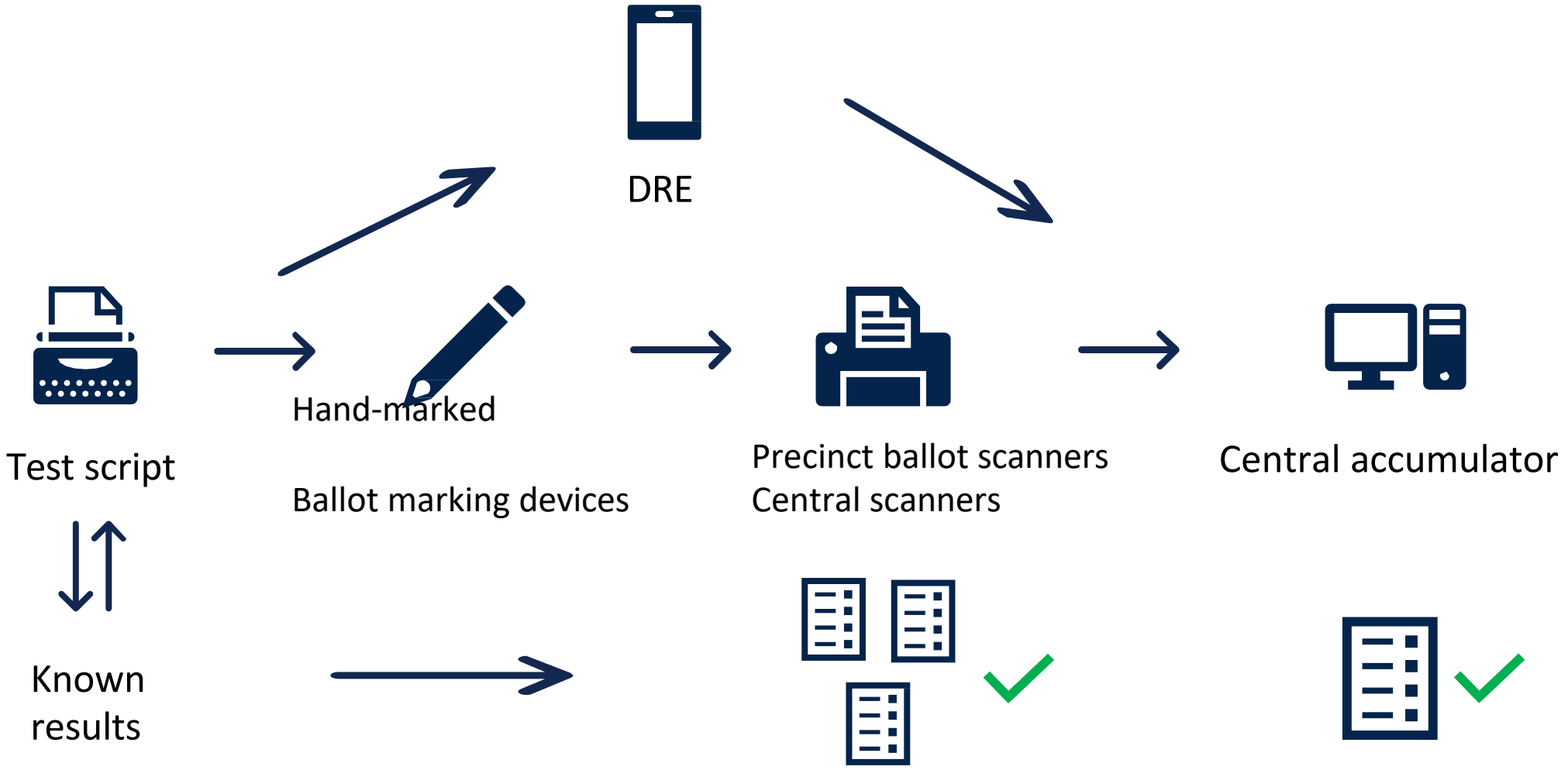
Hash Validation Summary

1. Trusted hashes must be obtained from the Office of the Secretary of State
   - Ensure the Secretary of State's email address is whitelisted and that you are allowed to receive compressed files by email.
2. Hash validation MUST be completed during Public L&A test.
   - Pre-testing is highly recommended, but only the public performance of the hash validation can be certified.
3. Hash validation MUST be conducted prior to casting test ballots.
   - If hash validation is not successful, the voting system may not be used or be repeated until successful.
4. Whenever possible, use an offline computer and new USB drives for testing.
5. Use an open source file integrity checker to compare your files
6. Document all proceedings and secure records and materials.

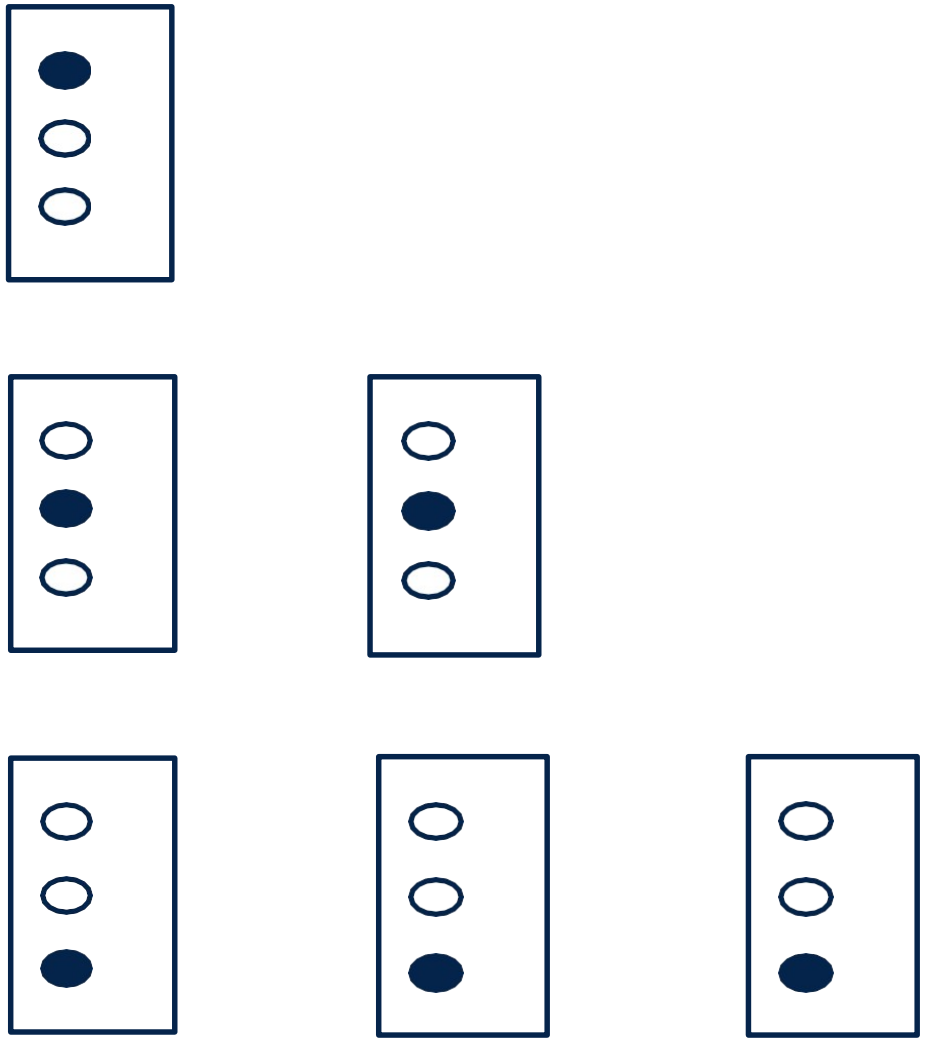
Logic and Accuracy Practice

Why do we L&A test?

- Test voting system
- Public confidence
- Security


DRE
Test script
Hand-marked
Ballot marking devices
Precinct ballot scanners
Central scanners
Central accumulator
Known results

Test Script



1

2

3

Voting patterns

Candidate	Total
A	**1**
B	**2**
C	**3**

*

Voting patterns

Candidate	Total
A	**1**
B	**2**
C	**3**
D	**4**
E	**5**
F	**6**

* = Best Practice

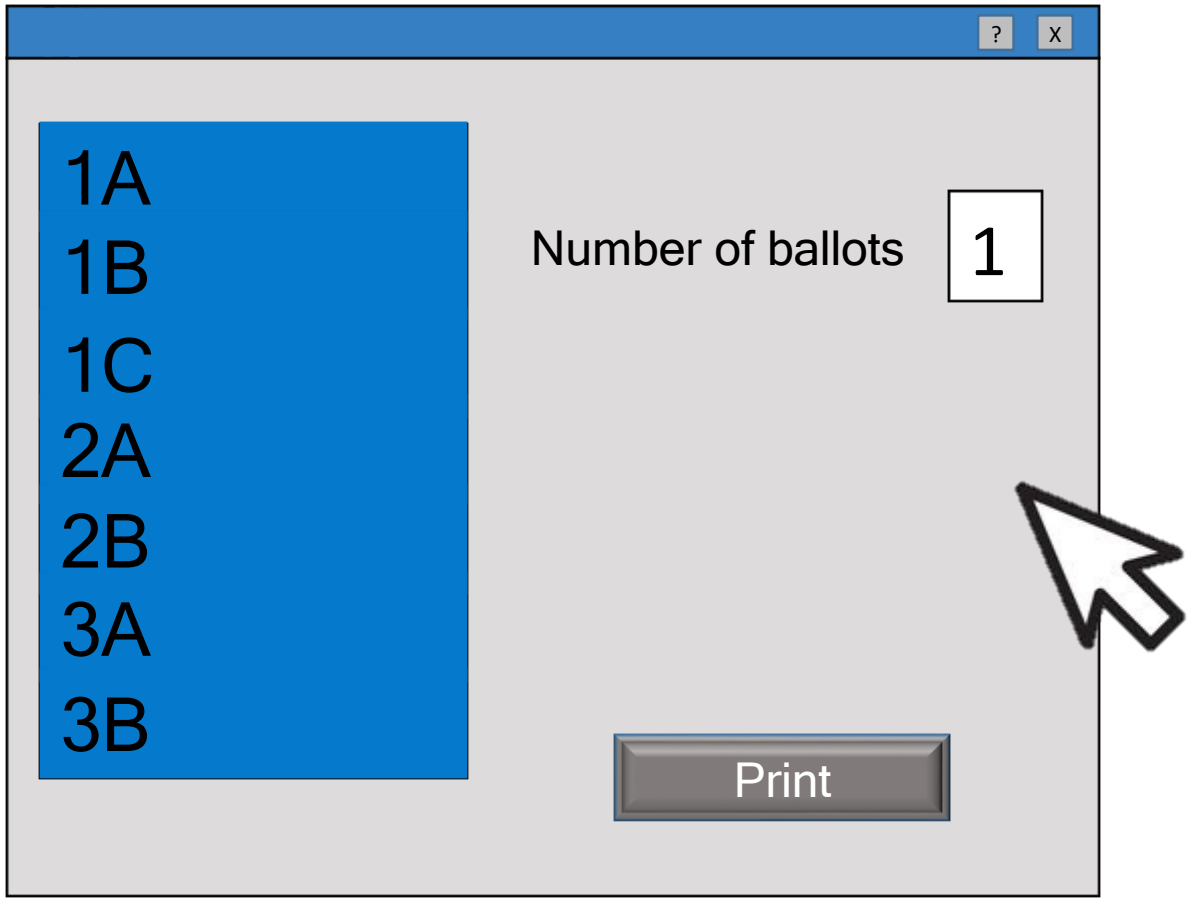
*

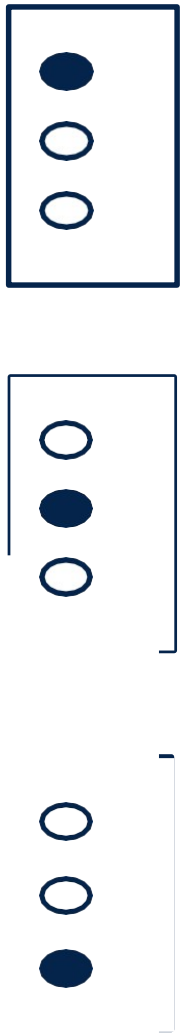
Voting patterns

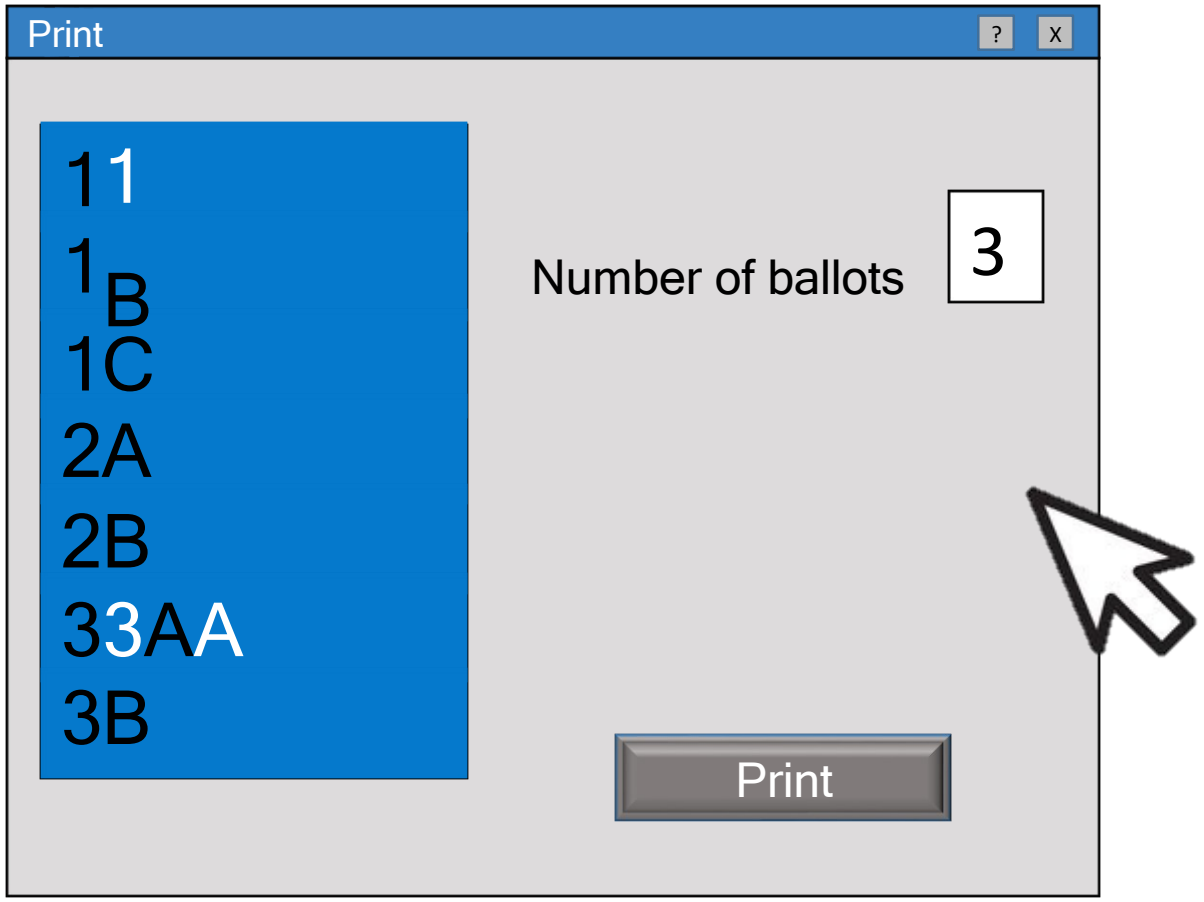
Candidate	Total
A	**1**
B	**2**
C	**3**
D	**1**
E	**2**
F	**3**

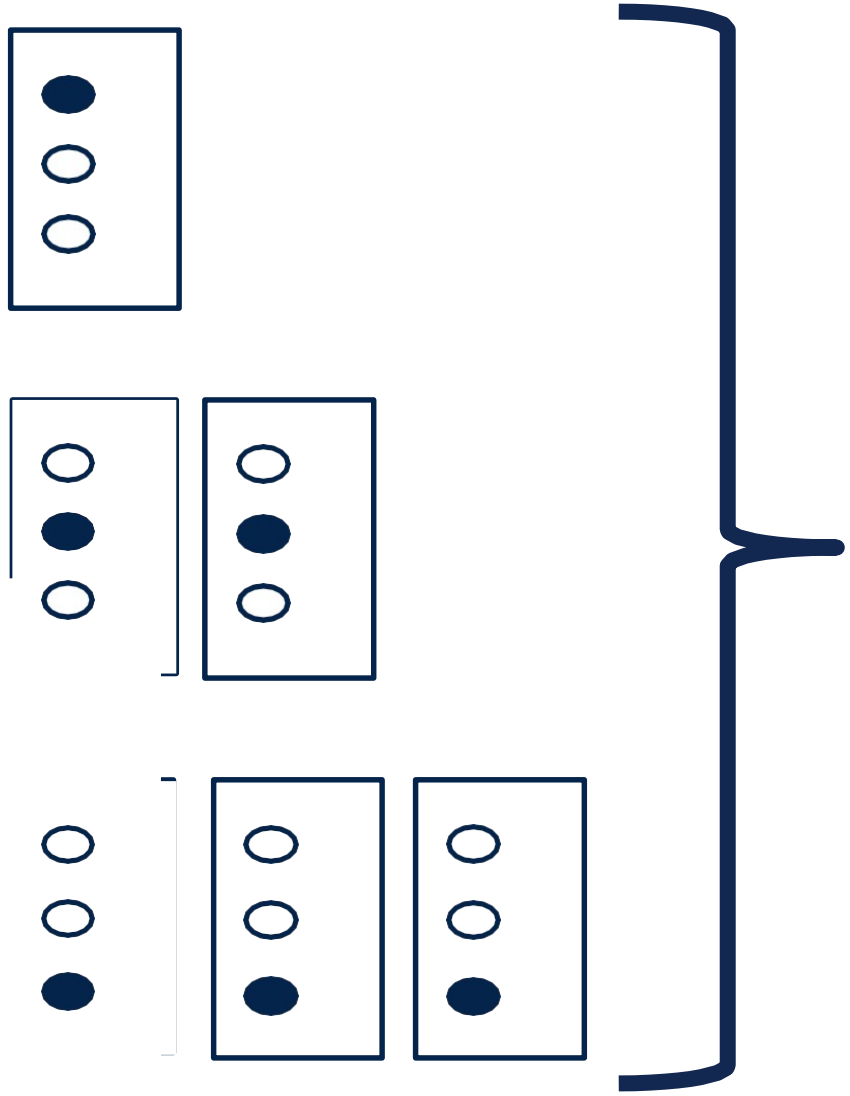
* = Best Practice

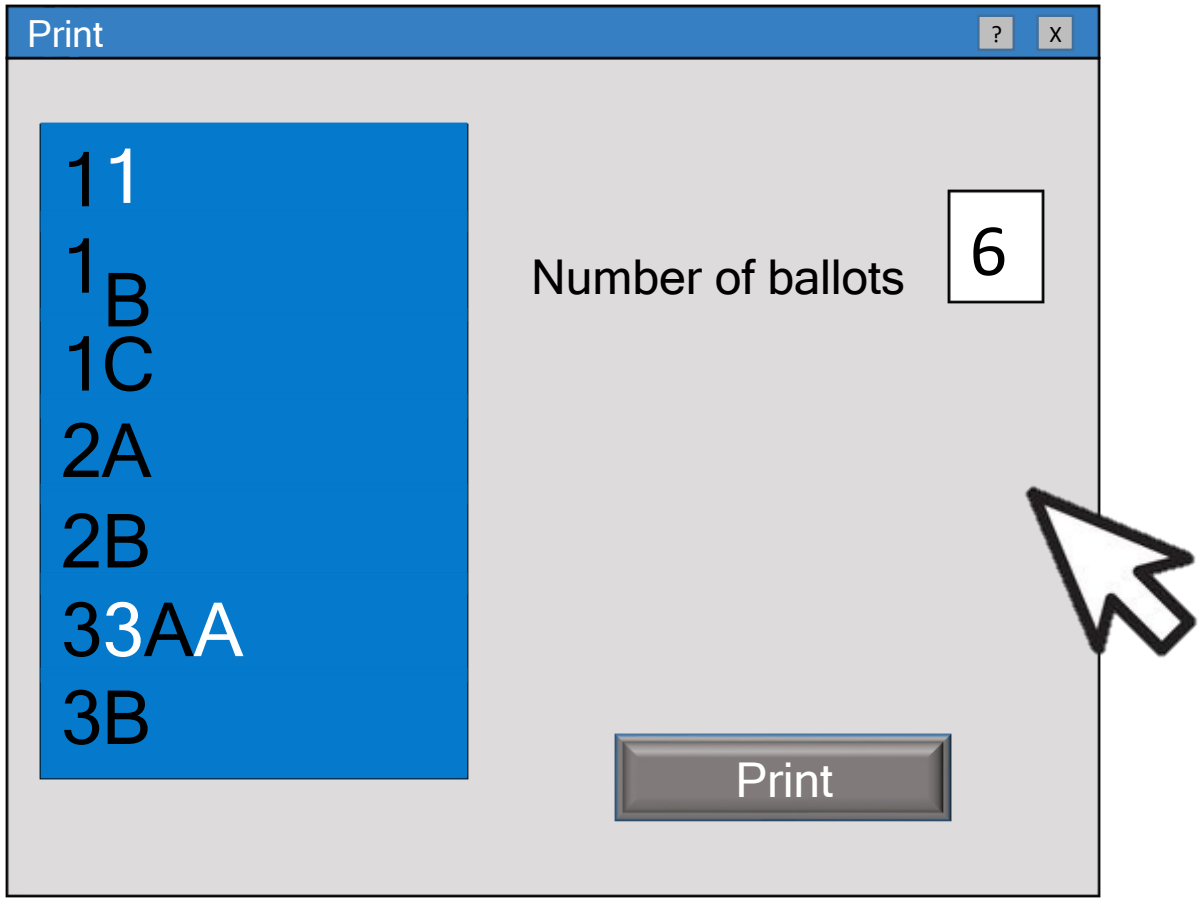
Every precinct/ballot style





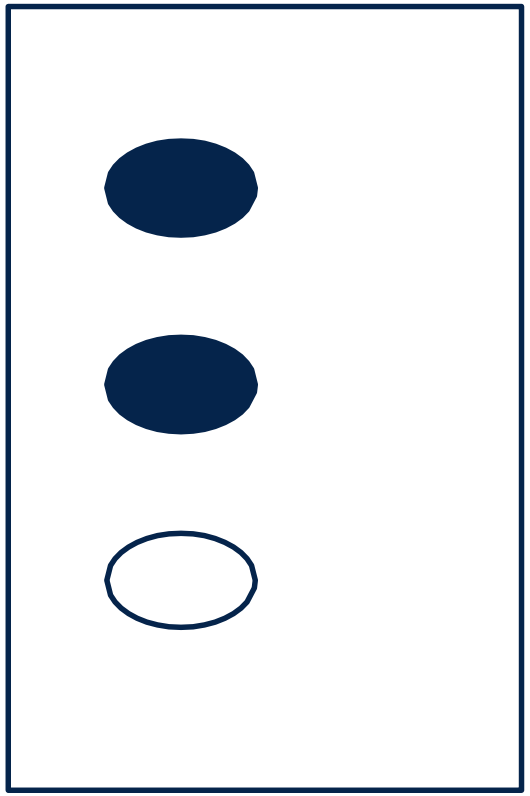

Print
?
X
11
1B
1C
2A
2B
33AA
3B
Number of ballots
3
Print



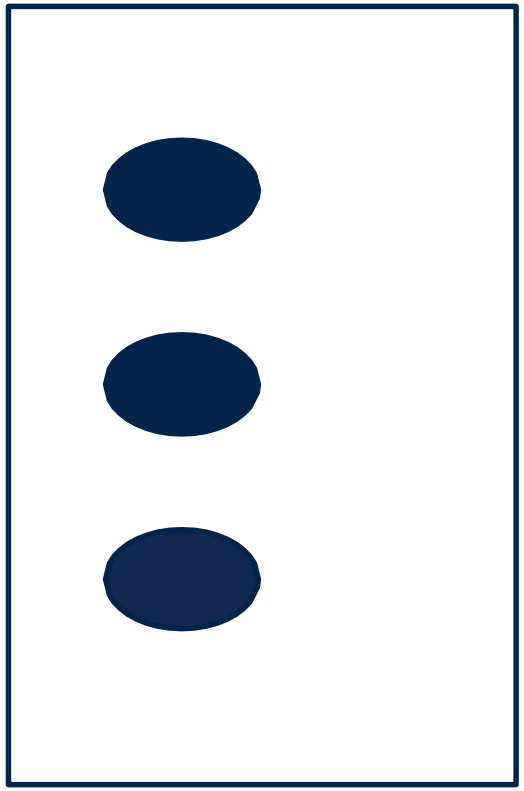

Print
?
X
11
1B
1C
2A
2B
33AA
3B
Number of ballots
6
Print

Overvotes

Vote for One

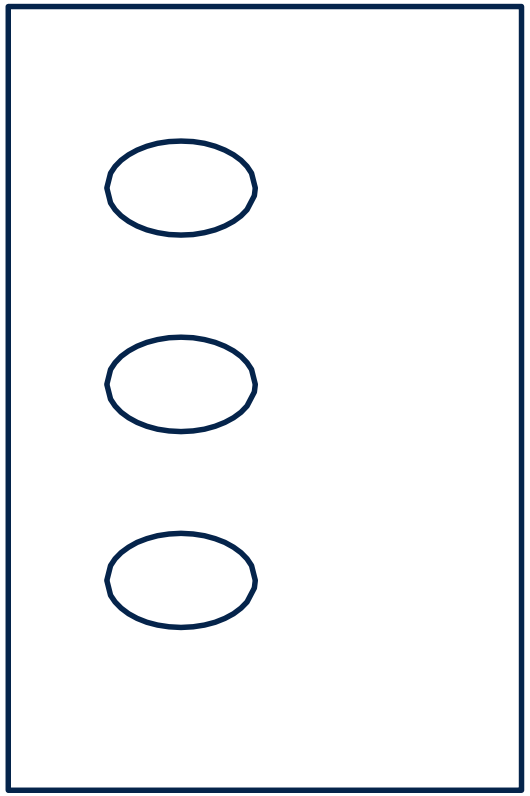


Vote for Two

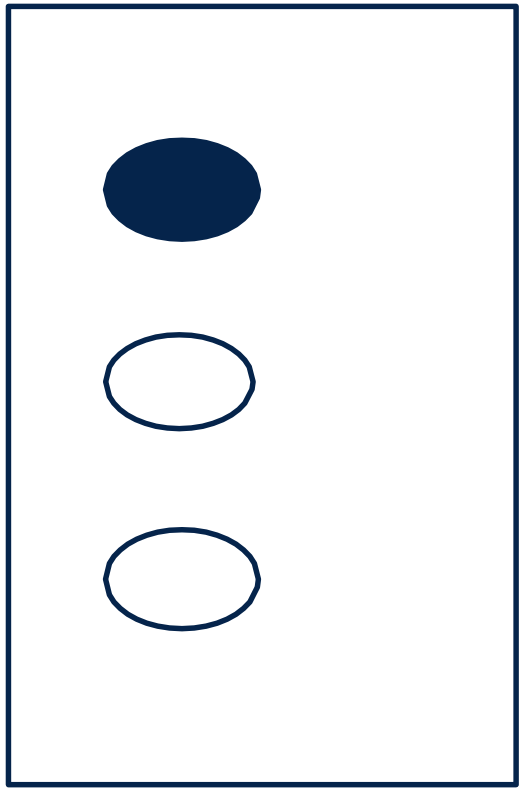


Undervotes

Vote for One

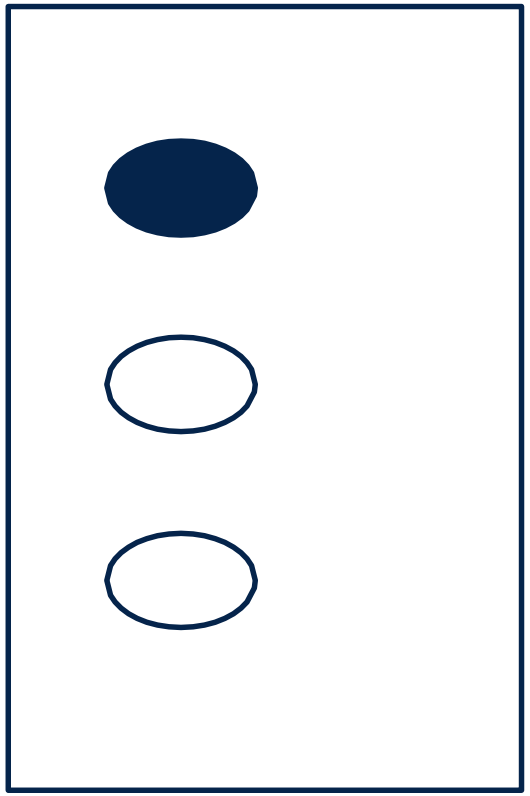


Vote for Two

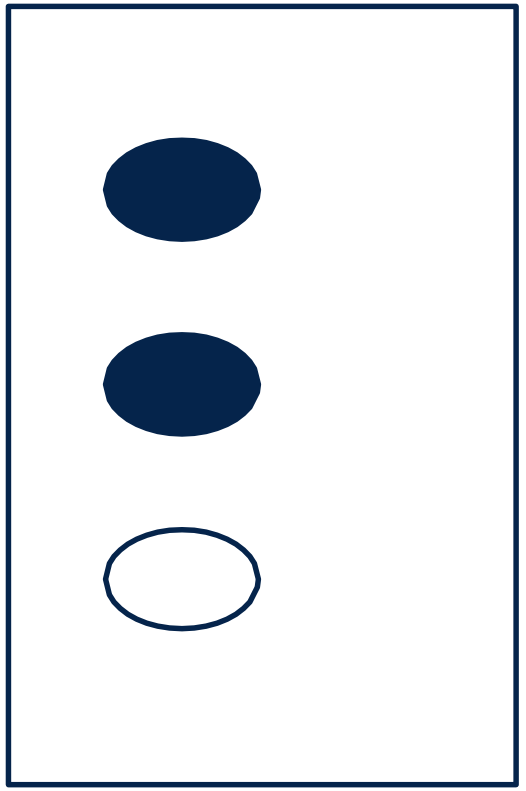


Maximum selections

Vote for One



Vote for Two



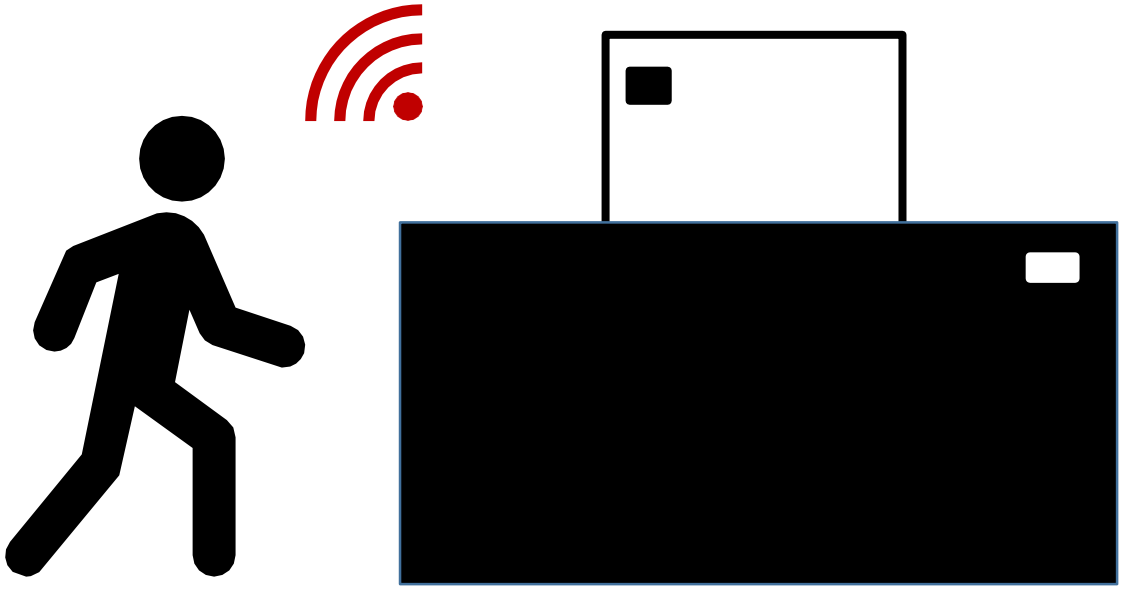
Write-ins

Write-ins

Vote for Three

- Write-in
- Write-in
- Write-in

Provisional ballots – at polls



Provisional ballots - accepted

Test script components

- Every choice
- Every precinct/ballot style
- Overvotes
- Undervotes
- Write-ins
- Provisional ballots

Testing

Preparation

Print ballots

- Same paper stock
- Label “Test”
- Same method of printing*
  - Ballot on Demand
  - Vendor

Preparation

Burn media

By Mail	Early Voting	Election Day

Preparation

Configure equipment

- How many pieces?
- Date and time
- Load election
- Equipment settings

Marking the Test Deck

Hand-marked

- Same pens*
- Fold ballots*

Marking the Test Deck

Ballot marking devices

- Activation*
- Accessibility features
- Names on printout

Marking the test deck

DREs – Cast in teams of 2

- Date and time
- Print zero report
- Activation*
- Accessibility features
- Print results report and compare
  - Polling place count – 1st Test of Tabulation system
- Central Count – media to accumulator

Scanning the test deck

Precinct ballot scanners

- Print zero report
- Scan ballots in all 4 orientations*
- Print results report and compare
  - Polling place count – 1st Test of Tabulation system
- Central Count – media to accumulator

Central scanners

ES&S

- Print results report
- Adjudicate in EMS

Hart

- No results report
- Adjudicate in Central
- Write-ins

Test every type of equipment

- Hand-marked
- Ballot Marking Devices
- DRE
- ePollbooks*
- Precinct ballot scanners
- Central scanners
- Central accumulator
- Election Night Reporting*
- Remote results*

Tabulation Tests

Tabulation tests

Central Count

- Presiding Judge conducts

Polling place count

- General Custodian conducts
- Test each piece of tabulating equipment

Central Count – 1st Test

- Print zero report
- Read media
- Adjudicate
- Print results and compare
- If results don’t match find and correct error

Tests 2 and 3 – Central Count only

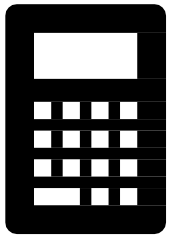
2nd Test

- Print zero report
- Read media from test 1
- Print results and compare

3rd Test

- Print zero report
- Read media from test 1
- Print results and compare

Before counting



After counting

Review

1. Create test script
2. Print, Burn, and Configure
3. Mark/Cast
4. Scan
5. Count and compare

Other Considerations

Ballot corrections

- Retest entire ballot
- Always notify SOS

Practice test

- Learn roles
- Identify ballot errors
- Verify known results
- Also called proofing, internal or pretest

Vendor test decks

- Can be valuable time savers
- But consider adding your own test deck*
  - Every choice in the election
  - Every precinct/style
  - Use other source materials to create test
    - SOS website – ballot certification information
    - Voter registration system

Advanced test decks

- Allow public observers to mark ballots
- Make selections using random number generator

Available Support

WEBINARS

TRAINING

RESOURCES

ELECTIONS DIVISION
Elections@sos.texas.gov
1.800.252.8683
ELECTION SECURITY TRAINERS
ElectionSecurity@sos.texas.gov