MARICOPA COUNTY

ELECTIONS

A Department of the Board of Supervisors

2022 General Election Internal Review

POST-ELECTION BALLOT ON DEMAND PRINTER ANALYSIS

July 26, 2023

Maricopa County Elections
2022 General Election BOD Report

Table of Contents

Glossary

Ballot On Demand: (BOD) Printer, laptop computer and software configuration that creates the opportunity to print thousands of ballot styles onsite at Vote Center locations. This technology allows voters to visit any Vote Center location and be issued a ballot specific to their assigned precinct and contests.	
Cold Printing: A single print from a BOD Printer that is newly pulled from the storage shelf, and a single ballot packet printed.	
Timing Marks: Printed markings on each ballot the Dominion ICP2 precinct tabulator uses to identify the print alignment and proper ballot style identification.	
Dominion: Elections equipment and services vendor.	
Election Day Settings: Settings (media weight) that were used to temporarily resolve the print issues on Election Day.	
Fit to page: A printer configuration where the print driver arbitrarily tries to fit what is being printed within the specific printer margins, as defined by the printer manufacturer. For the BOD systems, the ballot styles are purposefully designed to print closer to the edge of the paper, rather than staying in the prescribed margins.	
Interval printing: Printing ballot packets (ballots, control slips, affidavit envelopes) at inconsistent timings, between 30 – 300 seconds, which more closely aligns with the check-in patterns of voters and sequence of BOD printing at Vote Centers.	
Media Weight: A printer setting to indicate what kind of paper stock the printer should account for.	
Original Settings: The printer and BOD settings as they were during testing and upon leaving the MCTEC building	
Pre-Election Testing: All testing that was done prior to deployment of the BOD printers to the Vote Centers.	
Runbeck: Print Vendor that Maricopa County uses to print and mail all Early Vote Ballots. They also provide BOD systems equipment and software.	
Sequential printing: Printing ballot packets at a consistent rate for a period. Prints queued up one after another allow the fuser to stay at a consistent temperature, with minimal fluctuations.	
Service Level Targets: (SLT) Identified performance levels that are acceptable and expected for the BOD systems. EX: All BOD printers must have 98% print success rate during all stress tests to pass.	
Side File: A file is uploaded for every election that contains the ballot styles.	
SiteBook: Real-time voter check-in stations located in each Vote Center.	
Stress Testing: Several printers are selected to undergo additional testing and have hundreds of ballots run through sequential testing scenarios.	
Recorders and Election's Technology Department: (MC-ITD) Technology department for the Maricopa County Recorders Department	
Vote Center: Location a voter can go within Maricopa County to cast their ballot in person.	
Votesecure Paper: The established paper type MCRO used for the 2022 Election season. This paper type comes in different weights and paper sizes.	
Maricopa County Tabulation and Elections Center: (MCTEC) Primary location for Maricopa Elections readiness, tabulation and storage.	
Spoil Test: Printer tests conducted in Vote Centers upon BOD hardware setup completion. Test ballots are run from BOD printing system to ensure connectivity of system components.	

Objective

The objective of the post-election Ballot on Demand printer analysis was to identify the factors that contributed to the onsite printing issues that occurred at Vote Centers on Election Day during the November 2022 General Election. The analysis also evaluated the stress and pre-election testing procedures that the Elections Department performed to assess the readiness of the Elections Department's Ballot on Demand (BOD) printing system. Testing was performed by the Recorders Offices' and Elections Department's Technology Department that supports in-person voting operations. The report provides recommendations and options for the Elections Department to consider for improving the Ballot on Demand printing system and pre-election readiness testing.

Executive Summary

Post-election testing of ten randomly selected Oki B432 Ballot on Demand (BOD) printers identified four factors (1: 100lb paper, 2: 20-inch ballot, 3: Interval printing, 4: Oki B432 Printer) that contributed to the printing of light or speckled ballot timing marks. When all four factors were present, 32 – 34% of printed test ballots timing marks could not be read by Vote Center tabulators. In most cases, the lighter or speckled timing marks would not have been easily noticeable to a voter or poll worker unless they were trained to specifically look for the issue.

During the 2022 General Election, the Elections Department used the same heat settings as used during prior Elections, including the 2022 August Primary and 2020 General Elections. The most significant change implemented for the 2022 General Election was the use of a 20-inch ballot in conjunction with 100lb paper.

Prior to the 2022 General Election, the Elections Department performed testing of the BOD printers including the 20-inch 100lb paper. Pre-election testing also included running Oki B432 printed ballots through central count and Vote Center tabulators. However, most of the pre-election testing included the tabulation of test ballots and relied on sequential printing rather than interval printing. Sequential printing occurs when the ballots, paper control slips, and affidavit envelopes are printed at frequent and consistent periods of time. Interval printing includes using variances between the printing time periods to match real world voting patterns more closely.

The Elections Department also performed the same post-election testing of Lexmark C4150 Ballot on Demand printers. The Lexmark printers performed well, and no printing issues were identified.

Recommendations

To ensure BOD printer readiness for future elections, the Elections Department should include pre-election testing of Ballot on Demand printers that more closely matches voter check-in and printing sequence patterns. If longer ballots and 100lb paper are needed for future elections, the Elections Department should identify alternatives to the Oki B432 BOD printers.

Comprehensive Review

BOD Printing System

The BOD system Maricopa County Elections uses at Vote Center locations, includes two different printer types, the OKI B432 and Lexmark C4150 shown below.

OKI B432

Lexmark C4150

To function as a BOD printer, a Windows based laptop is connected to each printer along with three separate paper trays. The three separate paper trays allow for paper types (e.g., ballots, paper control slips, and affidavit envelopes) to be assigned their own tray and specific settings. The BOD laptop runs a Runbeck provided software package, Sentio Ballot Printing System, and includes a secure series of PDF files of every unique ballot style. Both printer types of support configuration changes directly on the printer and configuration changes from the connected laptop.

Each BOD laptop is configured using a registry file that is customized based on the printer type (Lexmark or OKI), the ballot size, and duplex or simplex print options. This allows for a template to be used to install the configuration settings rather than manually make each setting change on each printer. Windows registry configuration files create the setting options for each logical printer that is configured on each laptop. Paper tray associations for the ballots and envelopes are an example of what these registry configurations manage. The table below includes the Registry configurations.

Lexmark Registry Configurations		OKI Registry Configurations	
███████████ &	████████████	███████████ &	████████
███████████		████████ &	████████
		████████ &	████████
		████████	

Some specific configurations like paper size, media weight and type are configured on the printers using a standard configuration file. Checklists are used by the MC-ITD to confirm the settings were uploaded properly.

Supporting Documents

- 16 #2022 General Prep Oki 458_R.pdf
- 30 #OkiB432Configuration_R.pdf
- 31 #LexmarkC4150PrinterSettingsChecklist_R.pdf
- 32 #Lexmark C4150 Printer Full Settings_R.pdf

Pre-Election BOD Testing Procedures

2022 General Election: Pre-Election Stress Testing of Ballot on Demand Printers

In accordance with the Maricopa County Elections Policy (*11 #MCRO_BOD_Stress_Testing_20220811-001.pdf*), the MC-ITD performed a series of pre-election stress tests of the Ballot-on-Demand printers. For the 2022 General Election, there were two specific tests conducted for each selected printer. (See EXHIBITS: 12 #2020_Primary_Stress_Test_Results_R.pdf, 13 #2022_General_Stress_Test_Results.pdf). The purpose was to stress test the toner, fuser, and paper feed configurations to determine if there are specific issues with the printer hardware or processes.

2022 General Election BOD Pre-Election Tests
1. 100 – 150 double-sided ballots w/o envelope or receipt for each printer selected
2. 100 – 150 double-side ballot w/ envelope and receipt for each printer selected

2022 General Election BOD Pre-Election Questions
- **Paper Path (PP):** Did printing of the ballot packets result in issues or paper jams?
- **Fuser (F):** Is the fuser setting too hot or not hot enough?
- **Overheat (O):** Did the printer overheat?
- **Printing Delay (PD):** How long did it take to print 1- set/5- sets/10- sets of Election Day English and Provisional English?
- **Curling (CB):** Is there a curling issue on the ballot?
- **Consumables (TF):** Did it use more toner/fuser than expected?
- **Fuser Quality (OQ):** Any print quality issue, fade on top/center/bottom/left/right/chip/rub off?

2022 General Election BOD Pre-Election Stress Test Results

The stress test of four Oki B432 and four Lexmark C4150 printers was completed on September 6, 2022. The test concluded both Oki BODs and Lexmark BODs can use 20-inch 100 lb. ballot secure paper with no problems. It prints double-sided ballots free of defects on both front and back sides, there is a minor toner issue on the short (top) side but does not damage the ballot's overall integrity. The current input tray extension can hold 20-inch 100 lb. paper. There is small curling from Oki BODs which is consistent with any ballot printed from an OKI printer.

2022 General Election: Additional Pre-Election BOD Testing

Prior to use during an election, each BOD system goes through a series of testing processes that has been in place since 2019. These processes are described below.
1. Every laptop and printer setup runs through a series of tests and configuration checks, with the results recorded on individual reports for each election testing session.
2. When the BOD systems are set up at their respective vote centers for each election, the settings are checked, and test prints are made to each printer from each SiteBook.
3. Each printer has at least two test print checklists and prints cycled through.
   a. Pre-deployment test
   (18 #2022 BOD March_R.pdf)
   (19 #2022 General Prep Fixes)
   (20 #2022 General Prep Lexmark_R.pdf)
   (21 #IT QA.pdf)
   (22 #SampleDocumentation_R.pdf)
      i. Sample Cold Ballot Print
         (23 #2022 General QA Examples_R.pdf)

ii. Print Settings and Setup Report
   (16 #2022 General Prep Oki 458_R.pdf)
   (17 #2022 Primary Prep Oki 458_R.pdf)
iii. BOD setup checklist
   (14 #BOD QA.pdf)
b. Ballot Style loading test
   (15 #2022 General Load Ballot Oki 458_R.pdf)
   i. Same pre-deployment tests, but also includes uploading the ballot "side file" that is unique for each election.
c. On-location deployment test:
   i. Site Setup Test
   ii. One ballot print is sent to the printer from every SiteBook to test for connectivity. Print quality is not explicitly mentioned for this test and this test would also be considered a Cold Print.
4. The resulting test printed ballots, checklists and supporting materials are then digitally scanned for archiving.

100 lb. Votesecure Paper

MC-ITD team performed the standard testing procedures for the 100 lb. paper on both the OKI B432 and Lexmark C4150. Both tests resulted in satisfactory print quality and performance, without reservations related to the capability of the fuser on the OKI B432 printers. The 100 lb. paper was also used during the 2022 Primary election, which did not result in the same reported issues with tabulation performance as the 2022 General election. This could be due to the change in the paper length, from 19" to 20". However, the testing performed prior to the 2022 General indicated no reduced performance on any OKI B432 or Lexmark C4150 printer.

Supporting Documents

- 25 #BOD Test History_R.pdf
- 26 #Lexmark C4150 BOD Windows Configs_R.pdf
- 27 #Lexmark C4150 Printer Configs_R.pdf
- 28 #OKI B432 BOD Windows Configs_R.pdf
- 29 #OKI B432 Printer Configs_R.pdf

OKI B432 User Manual

During the post-election analysis, the MC-ITD team identified that the OKI B432 manual has conflicting information about what paper specifications are supported. When reviewing one section of the OKI B432 user manual, it stated custom sizing supported paper weight of $60 - 163$ g/m^2, which is within specifications of 100 lb. Votesecure paper stock, which is 150 g/m^2.

Custom*[1]*[2]*[3]	Width: 86 to 216 Length: 140 to 1321	Paper weight 60 to 163 g/m^2 *[1]: Tray 1 supports a paper width of 100 to 216 mm and a paper length of 148 to 356 mm. *[2]: Tray 2 supports a paper width of 148 to 216 mm and a paper length of 210 to 356 mm. *[3]: MP tray supports a paper width of 86 to 216 mm and a paper length of 140 to 1321 mm.
Banner 210 x 900 mm	210 x 900 mm	
Banner 215 x 900 mm	215 x 900 mm	
Banner 215 x 1200 mm	215 x 1200 mm	
Hagaki	100 x 148 mm	
Oufuku Hagaki	148 x 200 mm	

PAPER SPECIFICATIONS FOR CUSTOM PAPER SIZES
2022 GENERAL VOTESECURE BALLOT PAPER SIZE: 216MM X 508MM

Elsewhere in the OKI B432 user manual, there is a table that describes fixed paper sizes with supported paper dimensions and weights. In this table, the maximum supported paperweight for duplex printing is 120 g/m2, which can be converted using the chart to 80 lb. paper stock.

Type	Size Unit: mm (inch)		Weight
Plain paper	A4	210 x 297	Paper weight 60 to 163 g/m^2 For duplex printing: Paper weight 60 to 120 g/m^2
	A5	148 x 210	
	A6	105 x 148	
	B5	182 x 257	
	Letter	215.9 x 279.4 (8.5 x 11)	
	Legal (13 inches)	215.9 x 330.2 (8.5 x 13)	

DUPLEX PAPER WEIGHT SPECIFICATIONS FOR STANDARD PAPER SIZES

Paper Weight & Size (Votesecure ballot paper 8.5" x XX")

G/M^2	Lb.	Length mm	Length Inches
60	40	356	14
75	50	381	15
90	60	407	16
105	70	432	17
120	80	458	18
135	90	483	19
150	101	508	20
165	111	559	22

Election Day Printing Issue Review

Maricopa County had 223 Vote Center locations opened for Election Day, November 8th, 2022 *(EXHIBIT - 07 #VOTE CENTER LOG.pdf)*. Each Vote Center has equipment to allow for Real-Time Voter Check-In (SiteBook) and has BOD systems to print the 12,936 ballot styles required for the 2022 November General election in real time. On Election Day, Vote Center personnel reported that some printed ballots were not successfully being tabulated by the onsite Dominion Imagecast Precinct Tabulators (ICP2). The ICP2 devices are configured to allow any of the 12,936 ballot styles to be tabulated onsite at any of the 223 vote center facilities using an optical scanner.

The most common reported issues originated from the OKI B432 (OKI) BOD laser printers, which were first used in Maricopa County elections in 2018. Some ballots printed from these OKI devices had issues with light or improperly adhered toner, that caused the OKI printed ballots to not read correctly in the ICP2 tabulator machines.

When the County received these reports from Vote Centers, the Hotline directed poll workers to use Door 3 for voters to deposit their ballot into the secure ballot box. The secure Door 3 option has been used in Maricopa County since the mid-1990s and is the only option for voters in 8[1] of the other 15 Arizona Counties.

As shown in the timeline, the MC-ITD, in conjunction with Runbeck and Dominion, began troubleshooting the issue. A resolution was found by mid-morning that involved changing the OKI B432 BOD printer fuser (heat) settings. The envelope and receipt printer settings were modified on the BOD laptops to match the "Media Weight" of the ballot paper stock to "Heavy". The settings change made the envelope (prior to ED), receipt and ballot to allow for a more consistent fuser temperature across various paper stocks. After this setting change, the print quality of some OKI printers improved, and ballots were able to tabulate on a more consistent basis.

Election Day Response Timeline	
Time	**Activity**
6:20-6:30 am	A few Vote Centers begin informing the hotline that tabulators were not reading ballots. The County reminded poll workers of the Door 3 option.
6:25-9am	County dispatches T-techs, tabulation technicians, and printer technicians into the field to troubleshoot the issue. Techs report back that installed printer settings were the uniform approved settings used in prior elections and stress tested (Fuser Settings: Control Slip Media Weight = Medium; Ballot Media Weight = Heavy; Envelope Media Weight = Medium) - (See Exhibits: 04 #2022 GE LOAD BALLOT OKI 458_R.pdf, 05 #2022 GE PREP OKI 458_R.pdf, 06 #2022 PE PREP OKI 458_R.pdf)
8:30-9am	Technicians begin reporting that some of the impacted sites were experiencing lighter or speckled timing marks printed on the back of the ballot. The County concludes it is not a tabulator issue and continues troubleshooting to find a solution to the printers.
8:30-10:45am	Hotline technicians and printer technicians work in tandem to test potential solutions.

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[1] Counties that place all Election Day ballots in a secure container at the voting location and tabulate those ballots at Central Count: Apache Co., Coconino Co., Gila Co., Mohave Co., Pima Co., Pinal Co., Santa Cruz Co., Yavapai Co

10:14am	Printer technicians identified a potential solution to adjust printer settings. (Fuser Settings: Control Slip Media Weight = Heavy; Ballot Media Weight = Heavy; Envelope Media Weight = Heavy). Confirmed successful print and tabulation at one site.
10:15-11:30am	Begin testing the proposed solution of using the Heavy settings for all media weights at additional sites to verify the solution could be successfully implemented at other Vote Centers.
11:30am	Issued guidance to all technicians in the field to make setting changes to the Oki printers.
11:30am – 7:00pm	Visited 71 impacted sites to make changes to printer settings.

On Election Day, the only approved and recommended changes for the Vote Center locations using OKI B432 printers were to adjust the Media Weight and Paper Type from the Ballot on Demand (BOD) laptop configurations, via Microsoft Windows. The direction from the command center to technicians was to make these changes directly through the printer control panel. The Sentio software would then use those configurations to override any printer settings directly configured on the printer.

Other Considerations

1. Not all reported Election Day issues with printing were specific to the OKI print quality issues. Any reported printing issues were evaluated on a case-by-case basis and determined to either be in-scope for this issue, or out of scope.
2. Not all reports of tabulation problems were due to this OKI printing issue.
   a. There were reports of Lexmark printers having incorrect settings (setup check records show good settings) that presented issues with tabulation.
   b. The ICP2 tabulators also sometimes present issues with the optical sensor needing to be cleaned that were mistaken for ballot printing problems. Some voters chose to use their own ballot marking devices, such as ballpoint pens, that have been known to cause issues on the ICP2 devices by smearing ink on the optical sensors.
3. All consumable components of the OKI and Lexmark printers were genuine and within specifications for usable life.

Post-Election Discovery & Testing

Goals for Discovery & Testing

1. Determine what caused some printed ballots to print at lower quality.
2. Were there known issues with printer hardware that were overlooked?

Previous Election Comparison

The BOD equipment has been successfully utilized in previous Elections. Typically, the BOD systems would only experience physical issues related to paper jams, toner cartridge faults, physical parts breakage, etc. The issues experienced in the 2022 General Election are not consistent with BOD performance in previous elections. In addition, between the August 2022 Primary election and the November 2022 General election, there were minimal changes to the OKI printer settings and ballot paper stock.

Election Day Settings vs Original Settings

Prints were performed on the ten identified test machines using the "Election Day Settings", which were the BOD System settings (both printer and laptop) as they were returned from the vote centers. The "Original Settings" consist of the settings the BOD systems were using during pre-election testing, and

during the vote center setup process. Variables were tested one at a time, with changes documented, to determine if a singular cause was responsible for the change in print quality.

OKI B432 System Settings

Name	2022 Primary	2022 General	Notes
Ballot Paper	19" 100 LBS Votesecure	20" 100 LBS Votesecure	Changed size to 20" to accommodate the required number of contests in some precincts
Laptop Changes	██████████	██████████	Adjusted the Microsoft Windows printer settings to accommodate the required 20" paper size
Printer Firmware	████	████	Updated to latest OKI firmware
Postscript Drivers	████	████	Updated to accommodate 20" ballot paper
USB Port	10mbps	480mbps	Updated to allow faster data transfer between BOD laptop and printer
Printer Workflow	Ballot > Receipt > Envelope	Receipt > Ballot > Envelope	This setting was changed to allow easier training for vote center personnel and ballot sorting.
Printer - Envelope Media Weight	Medium	Medium	Indicates the paper weight for the printed sheet
Printer - Ballot Media Weight	Heavy	Heavy	Indicates the paper weight for the printed sheet
Printer - Control Slip Media Weight	Medium	Medium	Indicates the paper weight for the printed sheet
Printer - Fit to Page	No	No	Prints ballots with original margins
Printer – Duplex	On	On	Support for double sided page
Laptop - Envelope Media Weight	PrinterSetting	PrinterSetting	Laptop defaults to printer settings
Laptop - Ballot Media Weight	PrinterSetting	PrinterSetting	Laptop defaults to printer settings
Laptop - Control Slip Media Weight	PrinterSetting	PrinterSetting	Laptop defaults to printer settings
Laptop – Fit to Page	No	No	ICP Tabulators are designed to work with specific page sizes. Will not work with fit to page setting enabled.

Lexmark C4150 System Settings

Name	2022 Primary	2022 General	Notes
Ballot Paper	19" 100 LBS Votesecure	20" 100 LBS Votesecure	Changed size to 20" to accommodate the required number of races in some precincts
Laptop Changes	██████████	██████████	Adjusted the Microsoft Windows printer settings to accommodate the required 20" paper size
USB Port	10mbps	480mbps	Updated to allow faster data transfer between BOD laptop and printer
Printer Workflow	Ballot > Receipt > Envelope	Receipt > Ballot > Envelope	This setting was changed to allow easier training for vote center personnel and ballot sorting.

Printer - Envelope Media Weight	Normal	Normal	Indicates the paper weight for the printed sheet
Printer - Ballot Media Weight	Normal	Normal	Indicates the paper weight for the printed sheet
Printer - Control Slip Media Weight	Normal	Normal	Indicates the paper weight for the printed sheet
Printer - Fit to Page	No	No	Prints ballots with original margins
Printer – Duplex	On	On	Support for double sided page
Laptop - Envelope Media Weight	PrinterSetting	PrinterSetting	Laptop defaults to printer settings
Laptop - Ballot Media Weight	PrinterSetting	PrinterSetting	Laptop defaults to printer settings
Laptop - Control Slip Media Weight	PrinterSetting	PrinterSetting	Laptop defaults to printer settings
Laptop – Fit to Page	SameSize	SameSize	ICP Tabulators are designed to work with specific page sizes. Will not work with fit to page setting enabled.

Issue Discovery Process

After the 2022 General Election, the MC-ITD launched an internal investigation to discover the source of the OKI printing issues and determine the best course of action for future Elections. MC-ITD partnered with Runbeck Election Services to understand the root cause of the reported OKI printing issues.

Testing Methodology

MC-ITD randomly selected a total of 20 printers, ten OKI B432 and ten Lexmark C4150 BOD systems from two separate categories.

- **Category 1:** 5 OKI and 5 Lexmark printers from vote centers that did not report any issues.
- **Category 2:** 5 OKI and 5 Lexmark printers from vote centers that reported issues.

The devices were sequestered, and inventories of device configurations, software updates, firmware versions, settings and consumable levels were gathered. Test prints were then conducted using independent variables to ascertain the root cause of the problems. Each paper type and printing method was run on the twenty test BOD systems.

Test Printer Selections

- **OKI B432 Asset ID:** 106, 112, 113, 138, 331, 381, 412, 458, 475, 533
- **Lexmark C4150 Asset ID:** 712, 716, 720, 723, 724, 729, 760, 780, 802, 803

Ballot Paper Sizes (Votesecure Paper)

Paper Type	Paper Weight (in lbs.)	Paper Size (in Inches)
Votesecure	80	8.5 x 19
Votesecure	100	8.5 x 19
Votesecure	80	8.5 x 20
Votesecure	100	8.5 x 20

Ballot Print Sequence

- Receipt > Ballot

*Envelopes were not printed for this test due to ED not printing envelopes by default.

Printing Methods

1. **Cold Prints:** Single print from each system after being turned off overnight.
2. **Interval Prints:** 1-5 prints, every 30 – 300 seconds. This test mimics inconsistent print quantities and durations relative to ED printing situations.
3. **Sequential Prints:** 20-50 prints in rapid sequential order without pauses.

Testing

Ten OKI B432 printers and ten Lexmark C4150 were selected from the universe of Ballot on Demand (BOD) printers used in the 2022 November General Election. Print tests were performed using four different types of paper and two different settings configurations. Each print was scored based on visual inspection of print quality, and on the print's ability to tabulate in the Dominion ICP2 tabulators. Results show lower quality prints using 100 lb. Votesecure paper during interval printing led to a lower percent tabulation success rate.

Post-Election Test Print and Tabulation Results

Paper Size	Printing Mode	OKI B432		Lexmark C4150	
		Visual	Tabulated	Visual	Tabulated
80# x 19"	Interval	100%	100%	100%	100%
80# x 19"	Sequential	100%	100%	100%	100%
80# x 19"	Cold	100%	100%	100%	100%
80# x 20"	Interval	100%	100%	100%	100%
80# x 20"	Sequential	100%	100%	100%	100%
80# x 20"	Cold	100%	100%	100%	100%
100# x 19"	Interval	63%	85%	100%	100%
100# x 19"	Sequential	94%	97%	100%	100%
100# x 19"	Cold	100%	100%	100%	100%
100# x 20"	E-DAY Settings Interval	76%	68%	-	-
100# x 20"	E-DAY Settings Sequential	96%	87%	-	-
100# x 20"	Cold	100%	100%	100%	100%
100# x 20"	Interval	78%	66%	100%	99%
100# x 20"	Sequential	89%	88%	100%	100%
100# x 20"	Cold	100%	100%	100%	100%

*% SUCCESS RATE

Testing Results and Analysis

In the test group, the Election Day settings (e.g., all media types set to heavy heat settings) produced an additional 2% of positive ballot precinct tabulation success rates when compared to the original settings. Not all issues with the tabulation of ballots are related to print quality as indicated by some print tests showing 100% visual quality, and tabulation showing a lesser percentage. The Fuser temperature inconsistencies are further evident when comparing interval printing scenarios against sequential and cold printing scenarios, where the latter allows the print fuser to maintain a more consistent temperature and allows the print toner to adhere to the paper more consistently.

Results were recorded, and averages of the print's success were tallied based on the visual print quality and success of tabulation in ICP2 devices. Overall, the OKI B432 struggled to print consistently on 100 lb. paper stock, both 19" and 20", during the interval testing. The Lexmark C4150 did not have any substantial issues with this same test and printed at a consistent quality. The sequential tests were markedly better on the OKI B432, which could be due to the consistency in the fuser temperatures during the sequential and cold print tests.

When printing the interval ballot batches, the fuser (when on original settings) starts at a cooler temperature to print the ballot receipt (control slip), then ramps up to print the ballot at higher temperatures. After the first few prints in the interval test, the OKI B432 fuser would show print quality issues, which can be explained by the fuser's inability to ramp up to Media Weight Heavy paper temperature, before the print would start. This explanation is in-line with the sequential prints being significantly better on most prints due to the fuser not ramping up and down in temperature as often.

High Print Volume on Election Day

The MC-ITD team ran thousands of ballots, using different timings and variables, the issues are quantitatively related to the inconsistent print timings during interval printing scenarios. Quality on 10 sequential ballot package prints was satisfactory on all test systems. When the same 10 ballot packages were printed with a 30-300 second gap between each, print quality issues were consistently identified. The volume of voter check-ins on Election Day does not appear to be a factor during post-election testing. Issues could be seen in interval ballot package printing tests in as little as 10 test prints. Higher consistent volume made a positive difference in print quality due to the sequential nature of the prints from the Runbeck Sentio System, which allowed the OKI B432 fuser to stay at a consistent higher temperature for the heavy media weight setting. *(EXHIBIT - 24 #Runbeck Sentio.pdf)*

Fit to Page Settings

Although most print issues reported on Election Day were associated with the OKI B432 systems, there were some reports of print issues related to the Lexmark C4150 systems. These were not issues with fuser print quality, but isolated problems with print alignment and a few locations having their Lexmark C4150 printers being configured for "fit to page". This setting was not configured on the Lexmark C4150 BOD systems when they were deployed out to the vote center locations.

The MC-ITD team reviewed test prints from each printer that were produced during vote center setups that show proper configuration where fit to page is not enabled. Maricopa Elections did not provide any formal instruction to change this setting on Election Day, nor is it in any training materials to perform this action (8 #PW TRAINING MANUAL.pdf). It is assumed a vote center technician changed the printer settings at these locations to use fit to page on their own accord. Once the setting was changed back, proper tabulation resumed. Ballots printed with this fit to page setting will not tabulate on the Dominion ICP2 devices properly and must be re-printed with proper settings at the Vote Center or duplicated for central count back at the MCTEC facility.

BOD Systems

A determination whether 100 lb. Paper stock is the priority for future Elections is needed. Based on the testing results for the OKI B432 BOD Systems, 80 lb. paper prints with more consistency and reliability. If 100 lb. paper stock is preferred, changing the OKI B432 printers to a different model with a more capable fuser is recommended.

- 09 #BOD Testing_R.xlsx
- 10 #ICP2 Testing_R.xlsx
- 25 #BOD Test History_R.pdf

Recommendations

Pre-Election

1. Include more individual machines in the stress-testing process.
   a. Current procedures require 4-5 BOD systems of each style, to be selected for additional testing. Expand this selection to 20-25 individual machines.
2. Create additional testing procedures that include interval printing scenarios that were previously missing from the testing methodology.
3. Include a higher percentage of BOD printed ballots in tabulation testing, including logic and accuracy tests.
4. Establish a robust printer rotation system to ensure even utilization across all BOD systems.
5. Record printer configurations, consumption levels and prints created for each BOD system during pre-elections testing.
6. Identify SLTs for the BOD systems that can account for some inconsistencies in the print functionality.

Vote Centers

1. If 20in 100lb paper ballots are needed for future elections, consider replacing OKI B432 with Lexmark 4150 printers.
2. Additional training should be developed to help vote center personnel identify the print quality issues that include fuser issues, alignment and fit to print problems. Further training for vote center inspectors to help them identify and fix any potential printer configuration issues.
3. Add more Election Day T-Techs to provide faster issue resolution to identified problems.

Conclusion

These results indicate either a quality control issue with the OKI B432 fuser modules, which are not replaceable units, or a settings issue where the ballot prints before the fuser is adequately heated enough for the 100 lb. paper stock. This inconsistent fuser performance was not identical across all OKI B432 printers. Some printers showed 100% visual print quality inspections and high rates of successful tabulation. The genuine OEM OKI B432 consumables; toner cartridge and drum, did not prove to be a factor in the testing. The issues were consistently related to the fuser performance.

The issues with interval printing were not identified during pre-election testing because the test prints, which were performed during the Vote Center "Spoil Tests", are visually inspected, and not tabulated. Pre-Election testing, at the MCTEC facility, primarily included cold print tests on all BOD systems and sequential prints on a selected number of test machines. These Pre-Election test prints were run through the ICP2 precinct tabulators and through the Central Count machines. The Pre-Election tests resulted in the print fuser maintaining temperatures more consistently during the testing schedule and did not result in degradation of print quality as seen with interval printing.

This print quality issue was likely present during the 27 days prior to election day, based on the postelection examination of the Vote Center BOD Printer Setup spoil tests. However, it was not identified prior to Election Day because early voted ballots were tabulated on Central Count equipment. The ICP2 tabulators, which have lower tolerances for print quality on the ballot timing marks, were only used on Election Day. The Post-Election spoil test ballot review shows an interval print characteristic like the ballot examples from vote centers and provides a view into the behavior of some printers that proved to be problematic. (Exhibit: 16 #2022 General Prep Oki 458_R.pdf).