

## Comparative Performance Testing

DECEMBER 2016

### Genuine Lexmark Unison Toner versus Third-Party Toners in the Lexmark MS610 Printer

#### Test Objective

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Buyers Laboratory LLC (BLI) was commissioned by Lexmark International Inc. (Lexmark) to conduct an independent lab evaluation testing the performance of genuine Lexmark Unison Toner cartridges against third-party toner cartridges in Lexmark MS610 mono laser printers. To give a global representation of third-party toner, Lexmark selected third-party brands from North America, Europe, South America and Asia. Three of these brands were remanufactured cartridges, while the fourth brand was a clone cartridge (newly manufactured). Cartridges from all four brands of third-party toner cartridges were purchased for BLI by secret shoppers in retail channels. The 80-day test was conducted at BLI's 13,500-square-foot test lab located in Fairfield, NJ (USA; [www.buyerslab.com](http://www.buyerslab.com)).

More than 1 million pages were printed during the test. The test was run using new Lexmark MS610 printers in "Factory Default" mode, with each printer dedicated to testing a specific cartridge brand to preserve data integrity and avoid cross contamination of toner. All printers used genuine Lexmark Imaging Units throughout the test. Identical two-sided (duplex) print jobs with 2.8% page coverage were run using genuine Lexmark Unison Toner cartridges and third-party toner cartridges. Printers were run until they displayed a cartridge or imaging unit replacement message on their display panel. When the message appeared, either the toner cartridge or imaging unit was replaced, and the test continued. To determine overall value, the Lexmark Unison Print system was evaluated throughout the test in the following areas: page yield, toner containment, paper feed reliability, print quality, toner cartridge installation and communication.

#### Performance Summary

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In BLI's evaluation, the genuine Lexmark Unison Toner cartridges provided performance that was consistently superior overall to that of all third-party brands tested in key areas evaluated by BLI technicians and analysts. While at least one cartridge from each of the four third-party brands experienced leakage, jamming and/or other failures, every genuine Lexmark cartridge operated consistently and reliably throughout testing.

### **Page Yield Performance**

o On average, genuine Lexmark Unison Toner cartridges printed approximately 42.0% more pages than all third-party cartridges tested.

### **Toner Containment**

o 100% of the third-party cartridge brands exhibited toner leaks throughout the Lexmark Unison Print System. All third-party brands caused leaks so significant that loose toner was found outside of the printer which contaminated the surrounding office environment. Toner leaks inside the printer contributed to both poor print quality and paper jams.

### **Paper Feed Reliability**

o Printers running third-party toner cartridges were 25 times more likely to experience a paper jam than printers using genuine Lexmark Unison Toner cartridges. Paper jams can result in significant downtime, frustration and lost productivity for users, and even a service call.

### **Print Quality**

o Genuine Lexmark Unison Toner cartridges consistently delivered print quality that was superior to all third-party brands tested.

### **Toner Cartridge Installation and Communication**

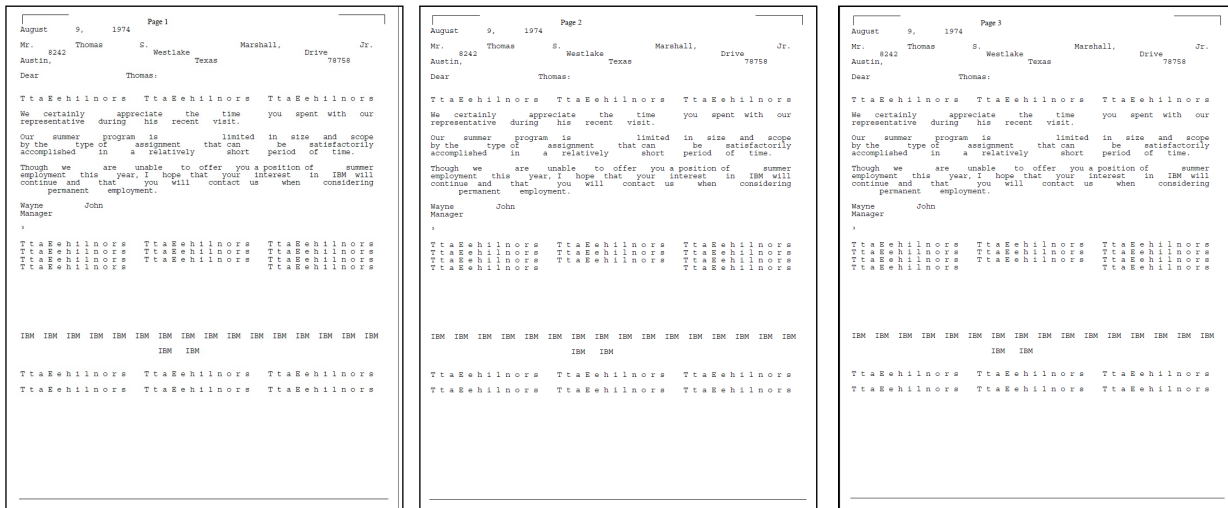
o Two of the four third-party brands tested, including 80% of Brand #1 cartridges, stopped printing prematurely because of cartridge communication errors. 100% of the genuine Lexmark Unison Toner cartridges continued to print throughout the test without these errors.

### **Overall Value**

o Each third-party cartridge brand experienced performance-related issues in all of the five categories described above. In contrast, genuine Lexmark Unison Toner cartridges performed consistently better throughout testing across all categories, providing full yield without wasting toner, paper or time due to compromised print quality.

## Page Yield Performance

In order to determine yield performance, BLI technicians ran each cartridge brand in a dedicated Lexmark MS610 printer to avoid crosscontamination. Cartridges were installed in the printer, meter count recorded and multiple copies of a three-page document were printed until the cartridge supply was exhausted. While the cartridge yields are quoted using the ISO/IEC 19752 document, which has between 4 and 6 percent page coverage, BLI instead used a document with roughly 2.8 percent page coverage. As would be expected, tested yields were significantly higher than claimed yields due to the difference in page coverage.



A three-page document with roughly 2.8% coverage was used throughout BLI's cartridge testing.

In BLI's 80-day test, the genuine Lexmark Unison Toner cartridges consistently outperformed the other brands, printing an average of 42.0% more pages per cartridge than all third-party cartridges tested. Throughout testing, the genuine Lexmark cartridges provided full-yield results, operating properly from start to finish, producing a total of 244,325 pages. The third-party cartridges experienced failures and defects throughout testing, with totals ranging from 96,895 to 241,150 pages printed. Genuine Lexmark Unison Toner cartridges delivered an average yield of 52,294 test pages versus an average of 36,822 test pages printed by the third-party toner cartridge brands combined. Note that at the end of testing, cartridges not fully exhausted were included in total page count but not factored into the overall average cartridge yield.

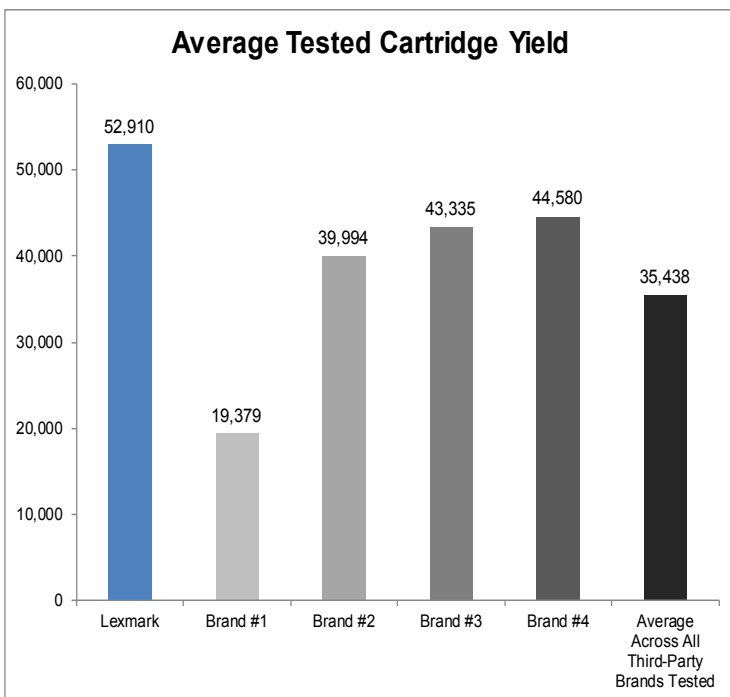
### Total Pages Printed Per Brand During 80-Day Test\*

|  | Total Pages Printed |
|--|---------------------|
| Lexmark                                      | 244,325             |
| Brand #1                                     | 96,895              |
| Brand #2                                     | 219,946             |
| Brand #3                                     | 241,150             |
| Brand #4                                     | 223,719             |
| Average Across All Third-Party Brands Tested | 195,428             |

\* Total page counts include all cartridges used in the 80-day test; at the end of testing, cartridges not fully exhausted were included in the totals but not incorporated into the page yield average. Three Brand #1 cartridges expired prematurely during testing and two cartridges were not recognized upon installation, with the final cartridge inserted rendering the printer dedicated to this brand inoperable (the printer would no longer recognize any cartridges, including genuine Lexmark cartridges at this point in testing).

**Average Tested Toner Yield (based on fully-exhausted cartridges)**

|  | Average Tested Yield | % More Pages Printed by Genuine Lexmark Cartridges |
|--|----------------------|--|
| Lexmark                                      | 52,294               | --   |
| Brand #1                                     | 19,379               | 169.8%   |
| Brand #2                                     | 39,994               | 30.8%  |
| Brand #3                                     | 43,335               | 20.7%  |
| Brand #4                                     | 44,580               | 17.3%  |
| Average Across All Third-Party Brands Tested | 36,822               | 42.0%  |



To determine whether a correlation exists between the amount of toner in the cartridge and the number of pages printed, all toner cartridges were weighed at the beginning and end of life. The difference between these two weights is the net toner consumed (see Average Impressions per Gram table on page 5). On average, third-party toner cartridges had starting and ending weights higher than those of genuine Lexmark Unison Toner cartridges. However, each third-party brand produced fewer pages per cartridge than the genuine Lexmark Unison Toner cartridges, meaning the extra toner present in third-party toner cartridges did not translate into increased page yields, and likely indicates decreased toner system efficiency. As such, BLI analysts feel that cartridge starting/ending weight, or net toner consumed can not be used to estimate page yield when comparing different brands of cartridges.

### Average Impressions per Gram

|  | Average Full Weight (in grams) | Average Empty Weight (in grams) | Average Net Toner Consumed (in grams) | Average Test Pages per Cartridge | Impressions per Gram |
|--|--------------------------------|---------------------------------|---------------------------------------|----------------------------------|----------------------|
| Lexmark                                      | 839.80                         | 378.38                          | 461.43                                | 52,294                           | 113.31               |
| Brand #1                                     | 929.40                         | 667.54                          | 261.86                                | 19,379                           | 70.63                |
| Brand #2                                     | 881.26                         | 385.36                          | 495.90                                | 39,994                           | 80.62                |
| Brand #3*                                    | 920.82                         | 389.40                          | 531.42                                | 43,335                           | 81.55                |
| Brand #4                                     | 917.75                         | 387.20                          | 530.55                                | 44,580                           | 84.00                |
| Average Across All Third-Party Brands Tested | 912.31                         | 457.38                          | 454.93                                | 36,822                           | 79.20                |

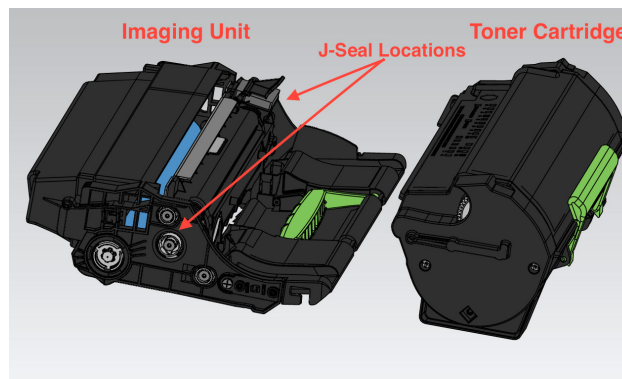
\* Three Brand #1 cartridges expired prematurely during testing and two cartridges were not recognized upon installation, with the final cartridge inserted rendering the printer dedicated to this brand inoperable (the printer would no longer recognize any cartridges, including genuine Lexmark cartridges at this point in testing).

### Toner Containment

Throughout BLI's testing, genuine Lexmark Unison Toner cartridges maintained proper toner containment throughout testing, with minimal or no toner leakage within the print system or outside of the printer. In contrast, all third-party toner cartridge brands tested exhibited significant toner leakage and contamination. Throughout the test, third-party toner leaked out of the cartridges during printing, accumulating both inside and outside the printer. Both remanufactured and clone third-party cartridges exhibited the same types of toner containment issues. So, according to Lexmark engineers, it can be concluded that the physical characteristics of the toner – not the functional design differences of the cartridge – contributes to these toner containment issues seen from third-party cartridges used within the Lexmark Unison Print System.



Halfway through BLI's testing, the machine dedicated to Brand #4 toner cartridges showed excessive toner spillage on the desktop around the device. Other third-party brands showed similar toner leakage during testing.



According to Lexmark engineers, this excessive toner leakage can likely be attributed to toner system inefficiency and failure of the J-seals in the imaging unit due to toner build-up, which bends the seals out of alignment, creating further contamination.

To fully document the degree of third-party toner contamination of relevant systems and potential damage caused by uncontrolled toner and toner leaks, after the tests were completed, Lexmark engineers dismantled the test printers which used the third-party cartridges (while BLI technicians observed the process to preserve the test integrity), photographed components and compared them to the test printer that used only genuine Lexmark Unison Toner cartridges. Engineers photographed both the areas that could be reached by a service technician for periodic cleaning and areas not accessible unless a printer is fully disassembled. In all cases, significant amounts of third-party toner were found throughout the printers using only third-party brand toner cartridges.

### Paper Path Comparison

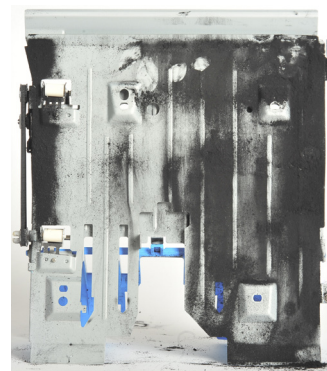
Toner contamination of the paper path cover appears to be a good indicator of overall contamination. The paper path cover sits directly below the imaging components, and it is not accessible unless the printer is disassembled. Note that, while most other brands generated more pages, Brand #1, shown below, experienced cartridge authentication and communication issues, limiting its test life to approximately half the total pages of the other brands tested.



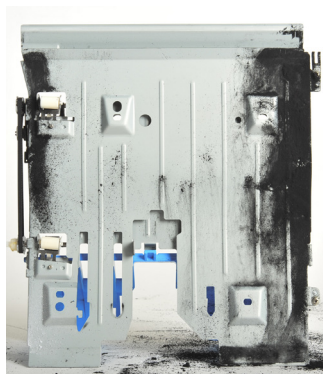
After printing 244,325 pages, the paper path from the printer using only genuine Lexmark Unison Toner was relatively clean, with very little toner spillage visible.



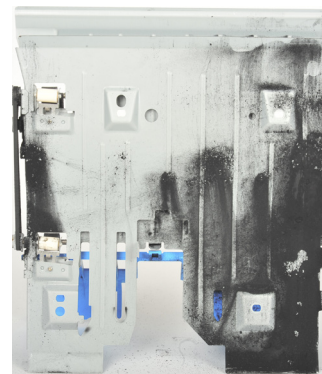
After printing 96,895 pages, the paper path from the printer using Brand #1 cartridges shows moderate toner leakage on one side and mild leakage on the other side.



After printing 219,946 pages, the printer using Brand #2 cartridges shows heavy toner leakage across both sides of the paper path.



After printing 241,150 pages, the paper path from the printer using Brand #3 cartridges shows mild toner leakage on one side and moderate to heavy leakage on the other side.



After printing 223,719 pages, the printer using Brand #4 cartridges shows mild toner leakage on one side and heavy leakage on the other side of the paper path.

### Paper Tray Comparison

Loose toner that migrated into the paper tray appeared to cause issues with both print quality and paper pick/feed reliability. Trace amounts of toner were found in the test printer using only genuine Lexmark Unison Toner. However, the paper trays of printers that used third-party toners exhibited significant amounts of loose toner. Loose toner contaminated the blank paper in the paper trays, which then caused print quality defects that were seen in the test pages.



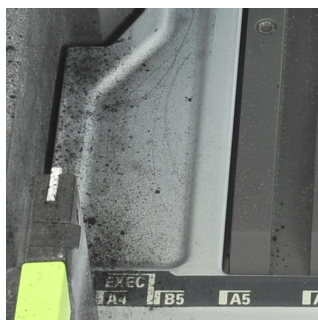
At the end of testing, the paper drawer from the printer using only genuine Lexmark Unison Toner was relatively clean, with very little toner spillage visible.



The printer using Brand #1 cartridges shows heavy toner leakage inside the paper drawer.



The printer using Brand #2 cartridges shows moderate toner leakage inside the paper drawer.



The printer using Brand #3 cartridges shows mild toner leakage inside the paper drawer.



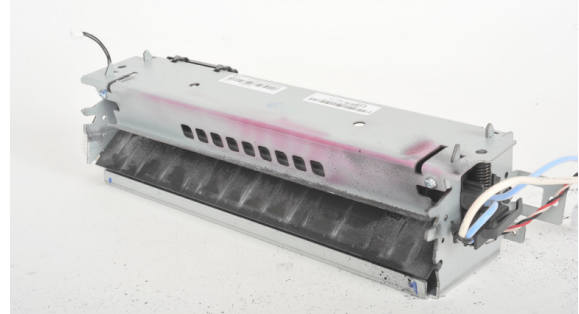
The printer using Brand #4 cartridges shows heavy toner leakage inside the paper drawer.

## Fuser Comparison

The fuser that was removed from the Brand #4 test printer exhibited a pinkish/reddish tint not normally seen on a fuser. Because of its location within the printer, the fuser is not visible to end users or service technicians without removal. Because the Lexmark MS610dn uses only black toner, it is unclear what caused the color change, and BLI analysts were unable to find material data safety sheets for any of the third-party cartridge brands tested.



The fuser from the printer dedicated to only genuine Lexmark Unison Toner cartridges shows only paper dust, as would be expected, with no toner contamination on the unit.



The fuser from the printer dedicated to Brand #4 cartridges, on the other hand, showed not only toner contamination but evidence of some type of pinkish/reddish contamination, too.

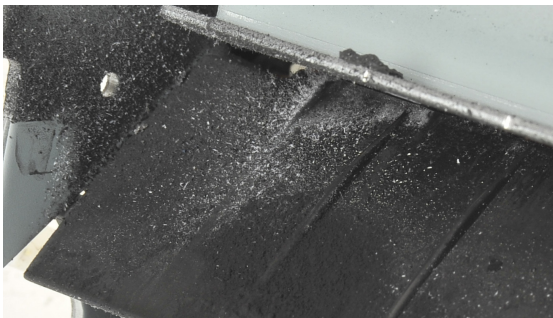


## Fuser Entry Guide Comparison

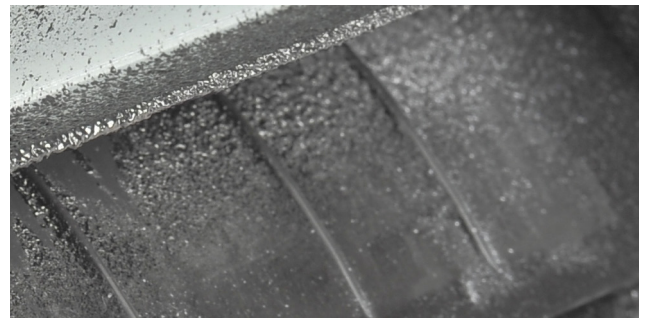
BLI observed an increase in wrinkled/damaged paper output during testing. Upon inspection, fuser entry guides of each test printer using third-party brand cartridges showed significant toner contamination. Toner on the entry guides melted, causing a rough uneven surface that likely skewed paper as it entered the fuser.



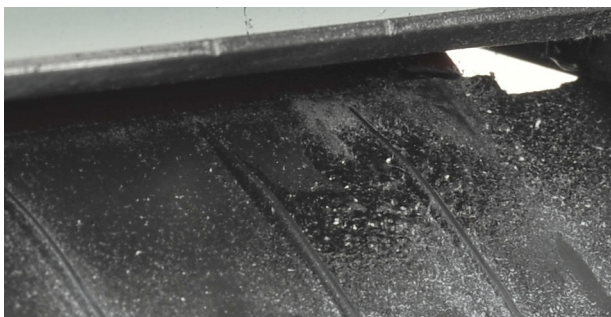
The Fuser Paper Entry Guides found on the MS610 fuser unit that used only genuine Lexmark Unison Toner cartridges show only normal paper dusting (visible as white specs) is evident on the fuser paper entry guide. The fuser using only genuine Lexmark Unison toner entry guides are free of visible toner residue.



The printer using Brand #1 cartridges shows moderate toner contamination on the fuser entry guide.



The printer using Brand #2 cartridges shows heavy toner contamination on the fuser entry guide, with large areas of melted toner across multiple surfaces of the guide.



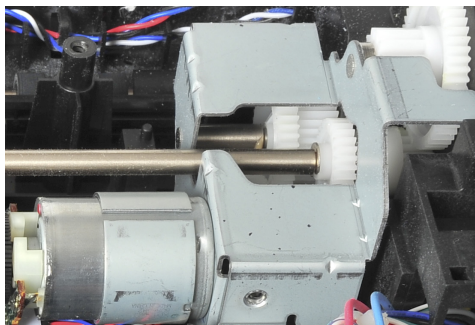
The printer using Brand #3 cartridges shows moderate toner contamination on the fuser entry guide, with areas of melted toner on some areas of the guide.



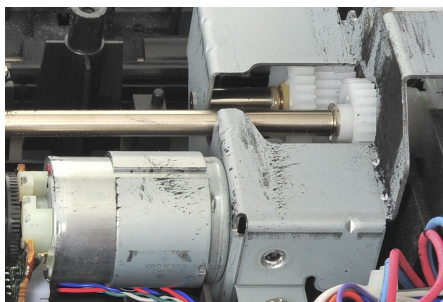
The printer using Brand #4 cartridges shows heavy toner contamination on the fuser entry guide, with large areas of melted toner across multiple surfaces of the guide.

### Mechanical/Electrical Component Comparison

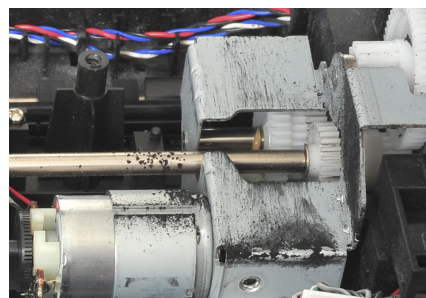
Toner contamination within the device gear train, in and around electrical housings and components, was evident in all devices using third-party toners. Stray toner appears to stress mechanical/electrical systems of the physical device and is a likely factor causing inconsistent print quality and could cause malfunctions within the printer.



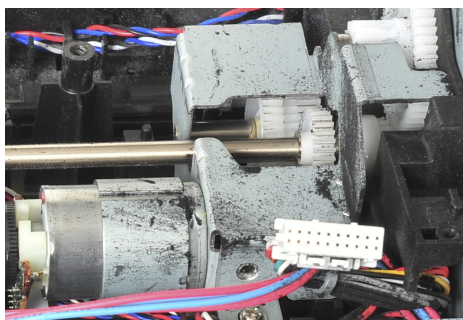
After printing 244,325 pages, the electrical/mechanical components from the printer using only genuine Lexmark Unison Toner was clean, with little to no toner contamination visible.



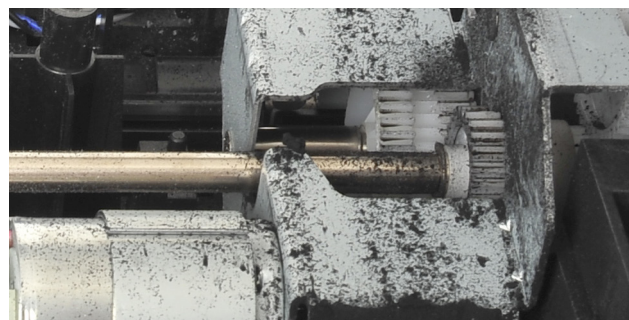
The printer using Brand #1 cartridges shows moderate toner leakage within the mechanical/electrical system.



The printer using Brand #2 cartridges shows moderate to heavy toner leakage within the mechanical/electrical components, including in the gear system, which could lead to performance issues.



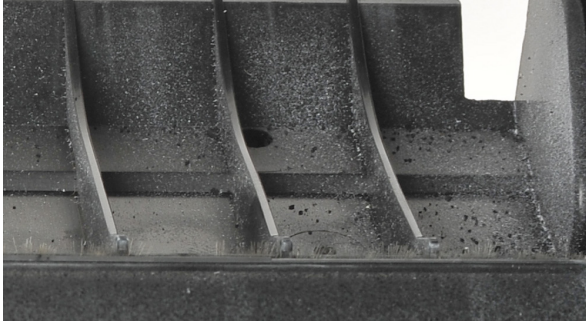
The printer using Brand #3 cartridges shows moderate to heavy toner leakage within the mechanical/electrical components, including in the gear system, which could lead to performance issues.



The printer using Brand #4 cartridges shows heavy toner contamination throughout the mechanical/electrical components, including in the gear system, which could lead to performance issues.

### Internal Paper Feed Guide Comparison

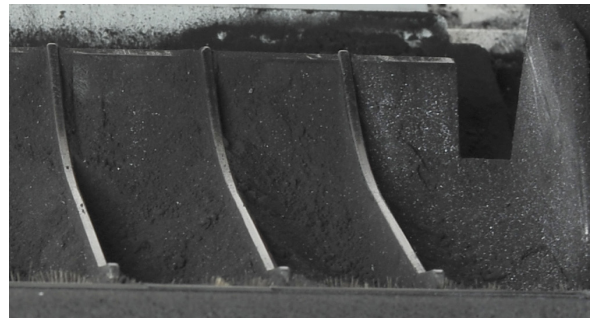
Significant toner was found collecting within paper guides of all devices using third-party toner. Toner concentrations among the third-party manufacturers tested ranged from light to heavy, varied with heavier concentrations on either the left or right side of the device. It is likely that the large amount of toner deposited in the internal paper feed guide area could contribute to both print quality failures and paper feed errors found when using third-party toner.



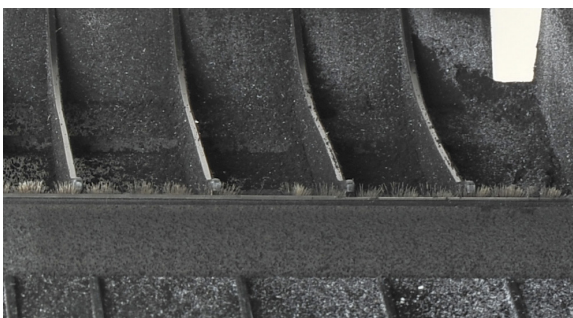
At the end of testing, the internal paper feed guide from the printer using only genuine Lexmark Unison Toner was relatively clean, with very little toner spillage visible.



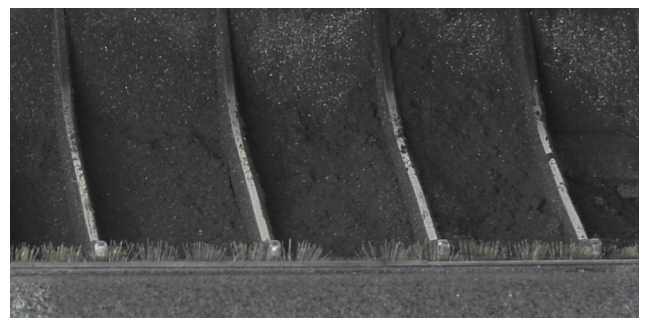
The printer using Brand #1 cartridges shows moderate to heavy toner build-up across the paper feed guide.



The printer using Brand #2 cartridges shows significant/heavy toner build-up across the paper feed guide.



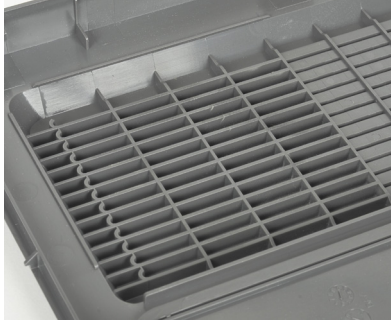
The printer using Brand #3 cartridges shows light to moderate toner build-up across the paper feed guide.



The printer using Brand #4 cartridges shows moderate to heavy toner build-up across the paper feed guide.

### Printer Cover Vent Comparison

Residual toner buildup was evident on the cooling fan vents of all third-party toner cartridge test machines. Loose toner within the device was expelled out into the test environment. Toner residue on the inside of the printer cover vent was not visible from outside of the printer.



The test printer using genuine Lexmark Unison Toner cartridges showed no toner residue, indicating proper toner containment throughout the 244,373 page test cycle.



The printer using Brand #1 cartridges shows showed light toner residue after printing 96,895 pages.



The printer using Brand #2 cartridges shows light to moderate toner residue on the vent cover.



The printer using Brand #3 cartridges shows light to moderate toner residue on the vent cover.

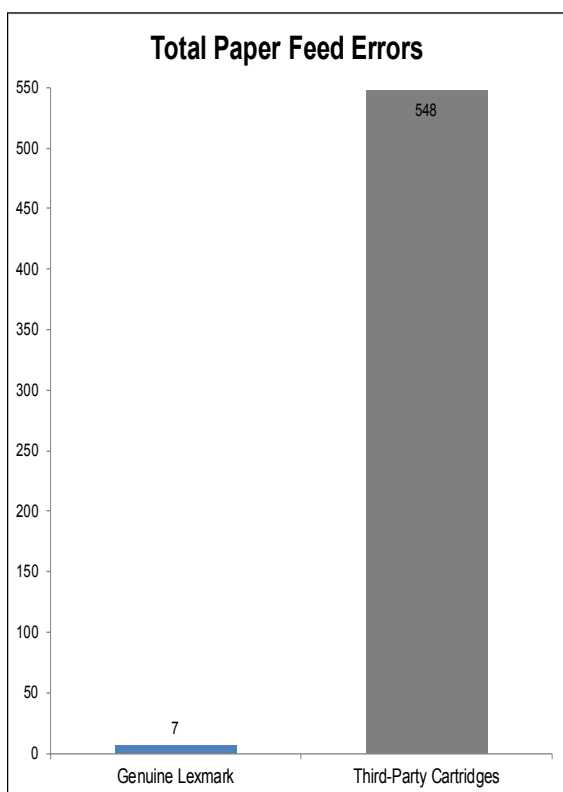


The printer using Brand #4 cartridges shows moderate to heavy toner residue on the vent cover.

## Print Feed Reliability

Paper jams can result in significant printer down time, frustration and lost productivity for users, and even a service call. In BLI's test, printers running third-party toner cartridges were 25 times more likely to experience a paper jam, with test printers for all third-party brand cartridges exhibited significantly more print feed errors than the printer using genuine Lexmark Unison Toner cartridges. The loose third-party toner covering paper path/travel surfaces likely contributed to increased paper jams. The graph and table below show the frequency of error codes related to paper feed issues during testing. Feed errors required access to both the front and rear of the device to clear paper jams.

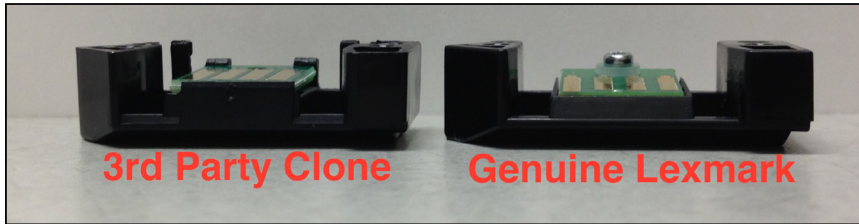
### Overall Reliability Summary for 80-Day Test Duration



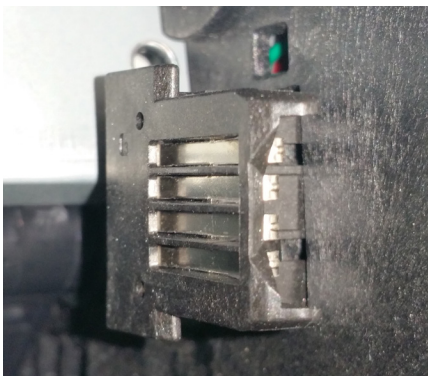
| GENUINE LEXMARK UNISON TONER  |                |                       |
|---|----------------|-----------------------|
| DESCRIPTION   | ERROR CODE     | NUMBER OF OCCURRENCES |
| Fuser Exit Sensor   | 202.xx         | 7                     |
| <b>Total Paper Feed Errors</b>  |                | <b>7</b>              |
| THIRD-PARTY BRANDS TESTED   |                |                       |
| DESCRIPTION   | ERROR CODE     | NUMBER OF OCCURRENCES |
| Electrical Interference Toner Density Sensing System                                | 132.xx         | 3                     |
| Input Sensor, Exit Sensor Page Error - Paper failed to move through system normally | 200.xx, 202.xx | 50                    |
| Auto Duplex Feed Errors   | 230.xx, 232.xx | 494                   |
| Paper Tray Feed Errors  | 241.xx         | 1                     |
| <b>Total Third-Party Feed Errors</b>  |                | <b>548</b>            |

## Toner Cartridge Installation/Communication

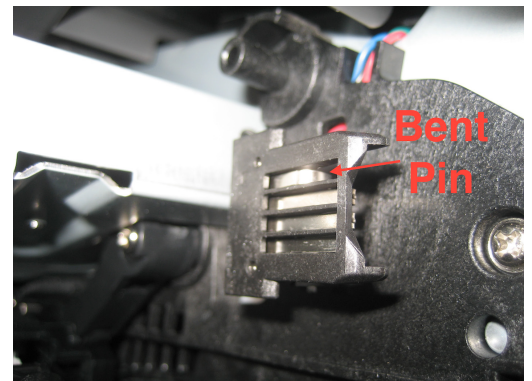
At installation, all of the genuine Lexmark Unison Toner cartridges tested installed properly in the printer and operated without any communication errors. By contrast, half of the third-party brands tested experienced some installation errors, either out of the box (i.e., cartridges failed to be recognized by the printer), or mid-life, which precluded cartridge test completion. Poor cartridge design, coupled with incorrect installation instructions, damaged one test printer, which required repair from a Lexmark service technician in order to continue testing.



Because the chip interconnect on the clone cartridge (left) is angled differently than the original Lexmark chip interconnect (right), the clone cartridge caused damage to the printer.



Before installation of the clone cartridge, the pins on the chip sensor are visible and intact.



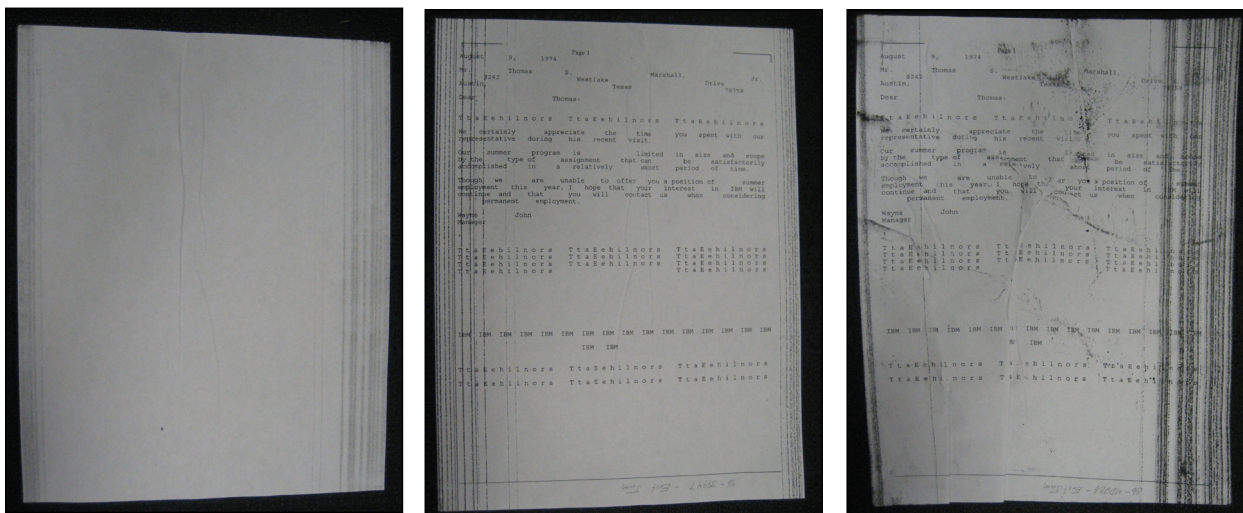
After installation of the clone cartridge, the pins on the sensor have been bent back and damaged.

## Print Quality Analysis

Genuine Lexmark Unison Toner cartridges consistently delivered print quality that was superior to all third-party brands tested. Virtually all test pages printed using genuine Lexmark Unison Toner cartridges were acceptable by BLI standards.

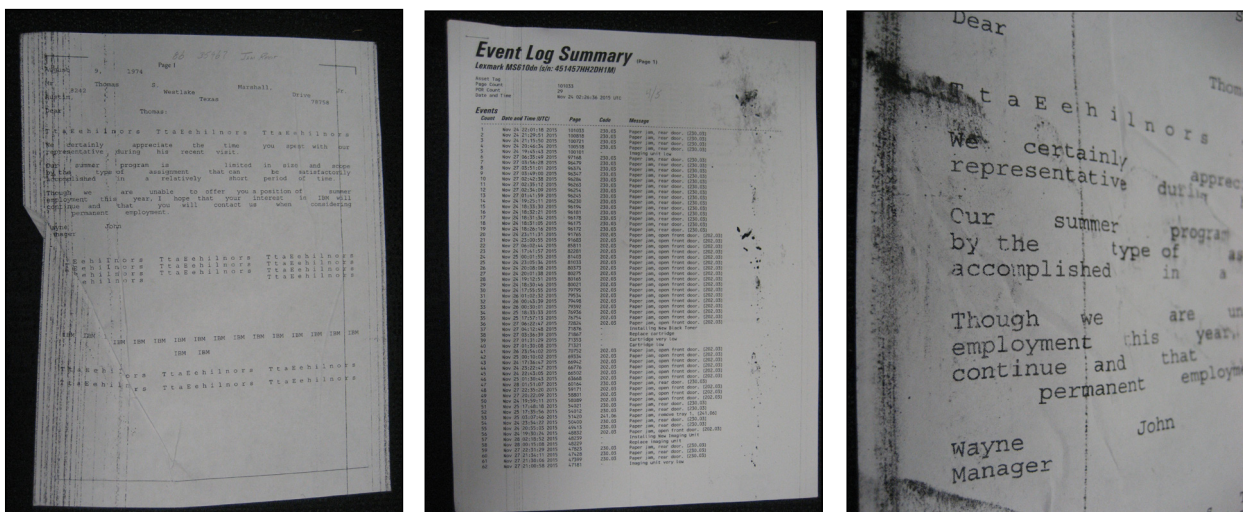
As shown below, all third-party toner cartridge brands exhibited poor print quality. Test pages exhibited significant amounts of stray toner, likely related to both toner quality and the significant amount of loose toner within the Lexmark Unison Print System. Based on BLI standards, most test pages printed with these third-party brand cartridges lacked character definition, and overall print quality would be considered deficient.

### PRINT QUALITY SAMPLES: Brand #1



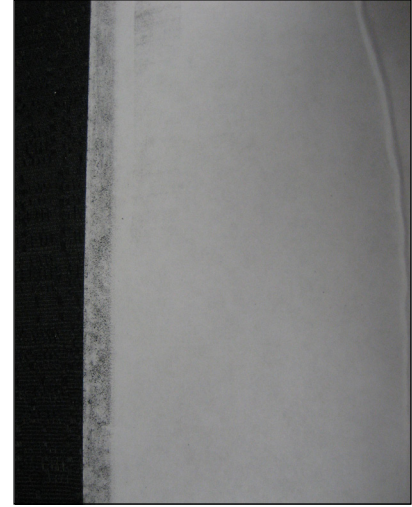
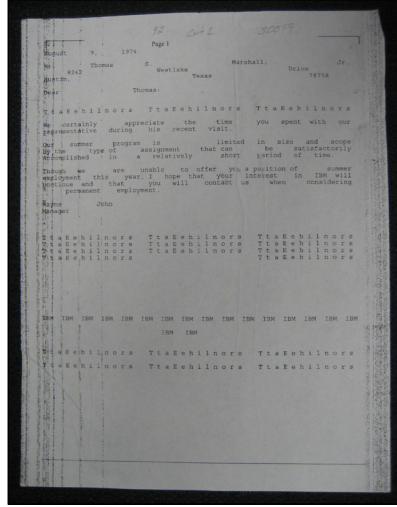
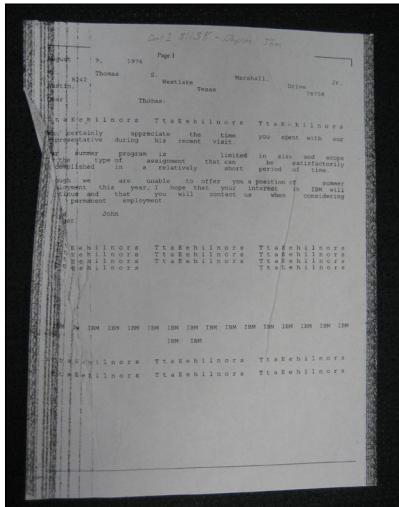
Pages produced using Brand #1 cartridges exhibited wrinkling and moderate to heavy toner streaking at the edges of pages (on both the front and back of pages).

### PRINT QUALITY SAMPLES: Brand #2



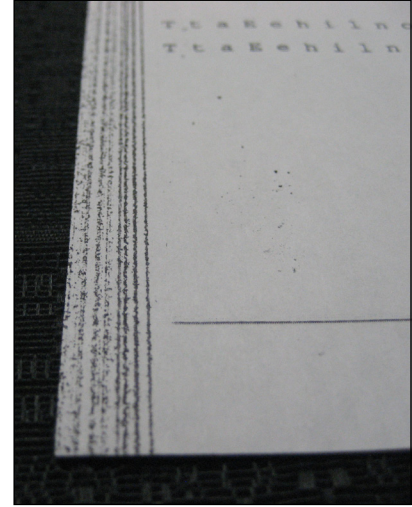
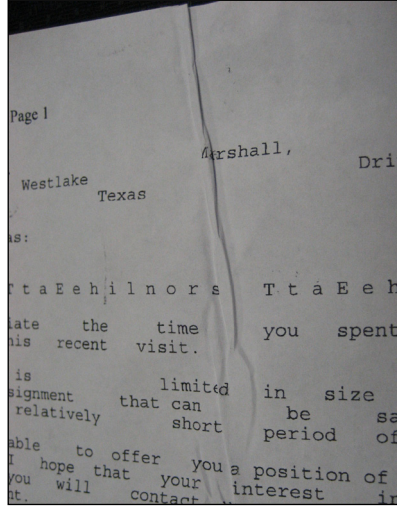
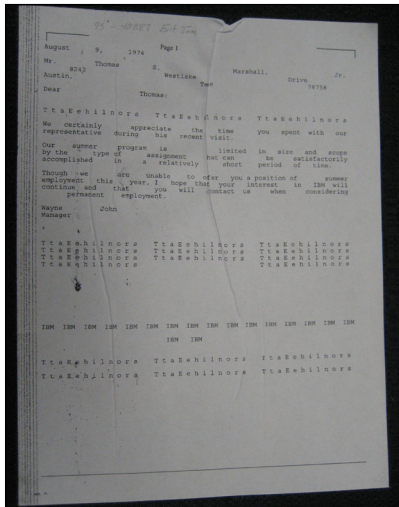
Pages produced using Brand #2 cartridges exhibited wrinkling, toner flaking, spotting and light to moderate streaking throughout testing.

**PRINT QUALITY SAMPLES: Brand #3**



Pages produced using Brand #3 cartridges exhibited wrinkling and moderate to heavy toner streaking on the edges of pages (on both the front and back of pages).

**PRINT QUALITY SAMPLES: Brand #4**



Pages produced using Brand #4 cartridges exhibited severe wrinkling and light to moderate toner spotting and streaking on the left edge of pages.



## Supporting Test Data

### Toner Yield Data (Fully exhausted cartridges)

#### Device A:

| Genuine Lexmark Unison Toner cartridges |                     |                      |                    |                        |                      |                   |                      |
|---|---------------------|----------------------|--------------------|------------------------|----------------------|-------------------|----------------------|
| Cartridge                               | Full Weight (grams) | Empty Weight (grams) | Net Weight (grams) | Total Counter at Start | Total Counter at End | Total Impressions | Impressions per gram |
| A                                       | 834.70              | 378.90               | 455.80             | 46                     | 49,096               | 49,050            | 107.61               |
| B                                       | 841.70              | 377.00               | 464.70             | 49,096                 | 100,938              | 51,842            | 111.56               |
| C                                       | 842.00              | 380.80               | 461.20             | 100,938                | 154,906              | 53,968            | 117.02               |
| D                                       | 840.80              | 376.80               | 464.00             | 154,906                | 209,223              | 54,317            | 117.06               |
| Averages                                | 839.80              | 378.38               | 461.43             |                        |                      | 52,294            | 113.31               |

#### Device B:

| Brand #1 toner cartridges |                     |                      |                    |                        |                      |                   |                      |
|---------------------------|---------------------|----------------------|--------------------|------------------------|----------------------|-------------------|----------------------|
| Cartridge                 | Full Weight (grams) | Empty Weight (grams) | Net Weight (grams) | Total Counter at Start | Total Counter at End | Total Impressions | Impressions per gram |
| A                         | 921.70              | 700.10               | 221.60             | 29                     | 14,777               | 14,748            | 66.55                |
| B                         | 933.80              | 883.50               | 50.30              | 14,777                 | 17,117               | 2,340             | 46.52                |
| C                         | 929.50              | 399.90               | 529.60             | 17,117                 | 55,261               | 38,144            | 72.02                |
| D                         | 931.00              | 760.40               | 170.60             | 55,261                 | 70,625               | 15,364            | 90.06                |
| E                         | 931.00              | 931.00               | -                  | 70,625                 | 70,625               | 0                 | N/A                  |
| F                         | 931.00              | 593.80               | 337.20             | 70,625                 | 96,924               | 26,299            | 77.99                |
| G                         | 933.10              | 933.10               | -                  | 96,924                 | 96,924               | 0                 | N/A                  |
| Averages                  | 929.40              | 667.54               | 261.86             |                        |                      | 19,379            | 70.63                |

Three Brand #1 cartridges expired prematurely during testing and two cartridges were not recognized upon installation, with the final cartridge inserted rendering the printer dedicated to this brand inoperable (the printer would no longer recognize any cartridges, including genuine Lexmark cartridges at this point in testing). The out-of-box failures/zero-yield cartridges are not included in the averages.

#### Device C:

| Brand #2 toner cartridges |                     |                      |                    |                        |                      |                   |                      |
|---------------------------|---------------------|----------------------|--------------------|------------------------|----------------------|-------------------|----------------------|
| Cartridge                 | Full Weight (grams) | Empty Weight (grams) | Net Weight (grams) | Total Counter at Start | Total Counter at End | Total Impressions | Impressions per gram |
| A                         | 875.60              | 384.80               | 490.80             | 16                     | 34,567               | 34,551            | 70.40                |
| B                         | 884.30              | 382.50               | 501.80             | 34,567                 | 71,798               | 37,231            | 74.19                |
| C                         | 873.00              | 389.40               | 483.60             | 71,798                 | 111,479              | 39,681            | 82.05                |
| D                         | 883.90              | 387.20               | 496.70             | 111,479                | 155,525              | 44,046            | 88.68                |
| E                         | 889.50              | 382.90               | 506.60             | 155,525                | 199,988              | 44,463            | 87.77                |
| Averages                  | 881.26              | 385.36               | 495.90             |                        |                      | 39,994            | 80.62                |

**Device D:**

| Brand #3 toner cartridges |                     |                      |                    |                        |                      |                   |                      |
|---------------------------|---------------------|----------------------|--------------------|------------------------|----------------------|-------------------|----------------------|
| Cartridge                 | Full Weight (grams) | Empty Weight (grams) | Net Weight (grams) | Total Counter at Start | Total Counter at End | Total Impressions | Impressions per gram |
| A                         | 922.10              | 388.80               | 533.30             | 13                     | 38,070               | 38,057            | 71.36                |
| B                         | 923.40              | 388.00               | 535.40             | 38,070                 | 83,807               | 45,737            | 85.43                |
| C                         | 922.40              | 391.00               | 531.40             | 83,807                 | 129,507              | 45,700            | 86.00                |
| D                         | 923.00              | 389.10               | 533.90             | 129,507                | 172,929              | 43,422            | 81.33                |
| E                         | 913.20              | 390.10               | 523.10             | 172,929                | 216,690              | 43,761            | 83.66                |
| Averages                  | 920.82              | 389.40               | 531.42             |                        |                      | 43,335            | 81.55                |

**Device E:**

| Brand #4 toner cartridges |                     |                      |                    |                        |                      |                   |                      |
|---------------------------|---------------------|----------------------|--------------------|------------------------|----------------------|-------------------|----------------------|
| Cartridge                 | Full Weight (grams) | Empty Weight (grams) | Net Weight (grams) | Total Counter at Start | Total Counter at End | Total Impressions | Impressions per gram |
| A                         | 920.50              | 387.20               | 533.30             | 19                     | 39,522               | 39,503            | 74.07                |
| B                         | 915.40              | 390.30               | 525.10             | 39,522                 | 79,088               | 39,566            | 75.35                |
| C                         | 915.40              | 385.10               | 530.30             | 79,088                 | 128,355              | 49,267            | 92.90                |
| D                         | 919.70              | 386.20               | 533.50             | 128,355                | 178,340              | 49,985            | 93.69                |
| Averages                  | 917.75              | 387.20               | 530.55             |                        |                      | 44,580            | 84.00                |

## Test Methodology

### Test Conditions

BLI performed all testing in its 13,500-square-foot U.S. lab located in Fairfield, NJ. All tests were conducted under controlled conditions of temperature and humidity, with conditions monitored 24/7 by an Extech RH S20 Digital RH/Temperature Recorder and Honeywell Model 61 Seven-Day Temperature/Humidity Chart Recorder. Running average temperature was 68°F to 78°F, and running average humidity range was 35% to 65%. All test devices and materials were conditioned for a minimum of eight hours prior to testing. Five Lexmark MS610dn printers were tested over 80 business days in factory default mode, with each printer dedicated to a single brand of toner. Genuine Lexmark Imaging Units were replaced when the component reached end of life.

### Reliability

Throughout testing, any toner cartridge malfunctions observed, such as operational or mechanical failure, physical defects and image quality failures, were recorded. Out-of-box failure: a cartridge that was inoperable upon installation or produced 20 or fewer acceptable pages. Premature Expire: a cartridge that produced less than 75% of the rated yield.

### Image Quality

Visual assessments were made in a Graphiclite D5000 Standard Viewer and with an Edmund Scientific PL-B776U PixeLINK Camera. Density was measured with an X-Rite 508 Series Spectrodensitometer. Image quality was evaluated based on the following criteria: text, line art, halftones, solids and density, with test samples taken at the start of testing and at the 25%, 50% and 75% points.

### Page Yield

To evaluate page yield, BLI used a monochrome test target with 2.8% page coverage. A cartridge was considered to be at the end of life when it was inoperable after installation or physical damage prevented it from being installed, a malfunction or image quality defects occurred, a service code that could not be cleared was brought up on the display, or a the device prompted the operator to replace the cartridge. The overall average page yield was defined as the combined total number of acceptable pages printed by all of the cartridges per brand, divided by the number of cartridges.

## About Buyers Laboratory LLC

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Buyers Laboratory LLC (BLI) is the world's leading independent provider of analytical information and services for the digital imaging and document management industry. For over 50 years, buyers have relied on BLI to help them differentiate products' strengths and weaknesses and make the best purchasing decisions, while industry sales, marketing and product professionals have turned to BLI for insightful competitive intelligence and valued guidance on product development, competitive positioning and sales channel and marketing support. Using BLI's web-based bliQ and Solutions Center services, over 40,000 professionals worldwide create extensive side-by-side comparisons of hardware and software solutions for over 15,000 products globally, including comprehensive specifications and the performance results and ratings from BLI's unparalleled Lab, Solutions and Environmental Test Reports, the result of months of hands-on evaluation in its US and UK labs. The services, also available via mobile devices, include a comprehensive library of BLI's test reports, an image gallery, hard to find manufacturers' literature and valuable tools for configuring products, calculating total cost of ownership (TCO) and annual power usage. BLI also offers consulting and private, for-hire testing services that help manufacturers develop and market better products and consumables.

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