

Genuine Lexmark C534 Brand Laser Cartridges vs. Six Brands of Remanufactured Cartridges

MAY 2012

Buyers Laboratory LLC (BLI) was commissioned by Lexmark International Inc. to conduct an independent comparative lab evaluation of the performance of new Lexmark brand high-yield toner cartridges against that of remanufactured brand cartridges in the Lexmark C534 color laser printer. Test cartridges for the following six representative remanufactured brands were obtained on the open market: ACM Technologies, Emstar, Freecolor (K&U), NewproNet, Pelikan and Silver Reed/TRS.

The test was designed to objectively compare the performance of genuine Lexmark cartridges to that of the remanufactured brands, and their claim of having equal performance to that of new Lexmark cartridges. All testing was conducted between October 2011 and March 2012 in BLI's 10,000-square-foot test lab located in Hackensack, NJ (USA; www.buyerslab.com).

Approximately 410,000 pages were printed during the test. Nine cartridges of each color from each brand were evaluated across three printers, so that three cartridges per color were tested in each printer. The cartridges were run to end of life utilizing the five-page ISO 24712 color test file intended to be representative of typical customer usage (see Exhibit A below), during which time page yield, image quality and reliability performance were evaluated. Following the completion of testing for each brand, the printers were cleaned and serviced with new photoconductor units, transfer belts and fusers. Toner waste containers were changed when prompted.

PERFORMANCE SUMMARY

Throughout BLI's test, the Lexmark OEM cartridges provided performance that was consistently superior overall in each of the three test categories (page yield, image quality and reliability) to that of the remanufactured brand cartridges tested.

While no problems were encountered with the original Lexmark cartridges, the test results for the 216 remanufactured cartridges revealed a number of significant issues in all three performance categories as follows:

- **Reliability:** 80 (37%) of the 216 remanufactured cartridges overall experienced reliability failures (52% black, 36% cyan, 33% magenta, 22% yellow), with 50 (23%) of those being out-of-box failures (28% black, 22% cyan, 15% magenta, 19% yellow) and 30 (14%) expiring prematurely for a variety of reasons, including toner streaking, toner leakage, cartridges not being identified by printers, error messages and heavy background on pages.

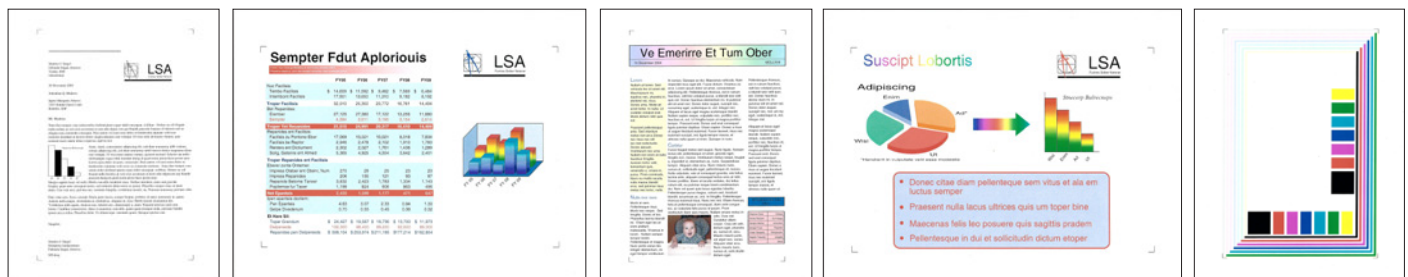


Exhibit A: ISO 24712 Test Suite

- **Page yield:** Though each of the remanufactured brands' claimed black page yields equal Lexmark's 8,000-page claim, the average tested yield achieved with the black third-party cartridges was just 5,754 pages, which is 2,860 pages short of Lexmark's 8,614-page tested average and just 67% of the yield achieved by the black Lexmark cartridges.

While the overall average page yield for the third-party color cartridges was similar in performance to Lexmark's, it should be noted that the actual average third-party color yields varied greatly by brand, ranging from as low as 2,472 pages to as high as 9,857 pages. In contrast, the Lexmark color cartridges displayed very consistent and reliable performance, with average color yields ranging from a low of 7,158 pages to a high of 7,654 pages (vs. Lexmark's claimed yield of 7,000 pages).

- **Image quality:** 88% of the image quality samples taken from the remanufactured brands had some sort of defect such as recurrent extraneous marks in the background, toner streaking, banding in solids, and toner overspray—and in many cases, more than one issue. In contrast, the Lexmark cartridges gave a strong and consistent image quality performance with all cartridges, with no image quality defects of any kind observed.

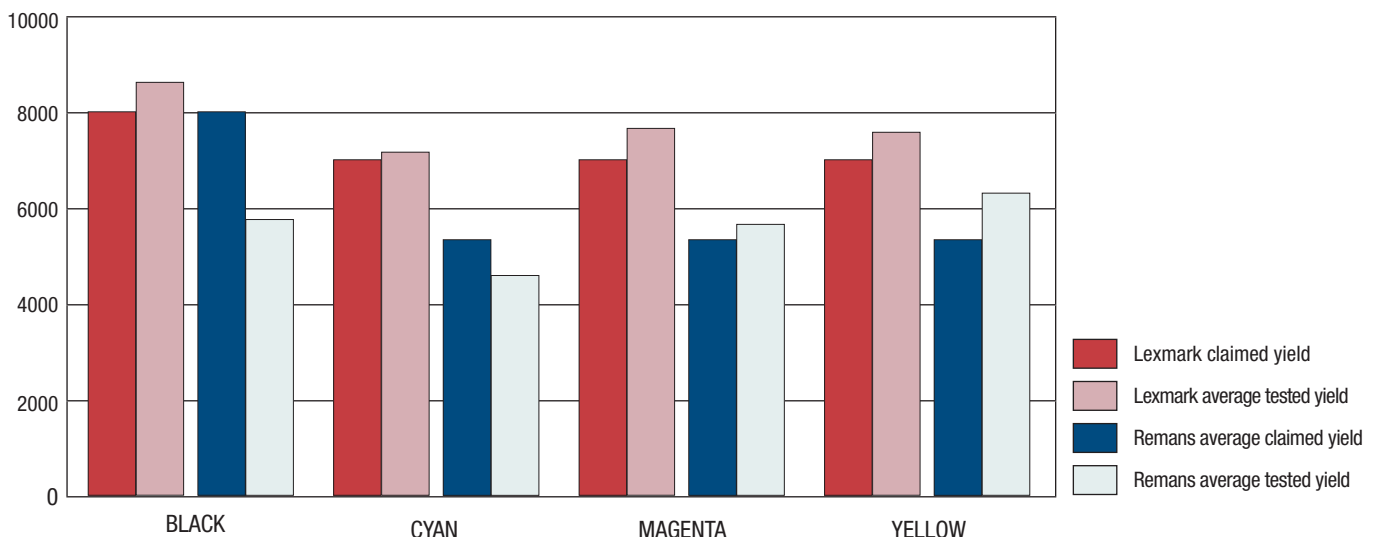
In commenting on the overall performance of the Lexmark cartridges, Anthony Polifrone, BLI's Managing Director, noted: *"The Lexmark brand C534 cartridges clearly outperformed the remanufactured brands overall, delivering superior page yields, image quality and reliability, with no failures of any kind. In contrast, the remanufactured cartridges had an overall average reliability failure rate of 37% and image quality defects in 88% of the evaluation samples."*

OVERALL PERFORMANCE

Average Page Yield Performance

While all of the brands have a claimed black cartridge yield of 8,000 pages, only the average yield for the original Lexmark black cartridges exceeded this claim, while the average yield of the black remanufactured brands fell well short. In fact, the black original Lexmark cartridges, with an average yield of 8,614 pages, clearly outperformed the black remanufactured cartridges, which had an average yield of just 5,754 pages and fell short of the Lexmark cartridges by 2,860 pages or 33%.

GRAPH 1: Page Yield Performance—Average Page Yield

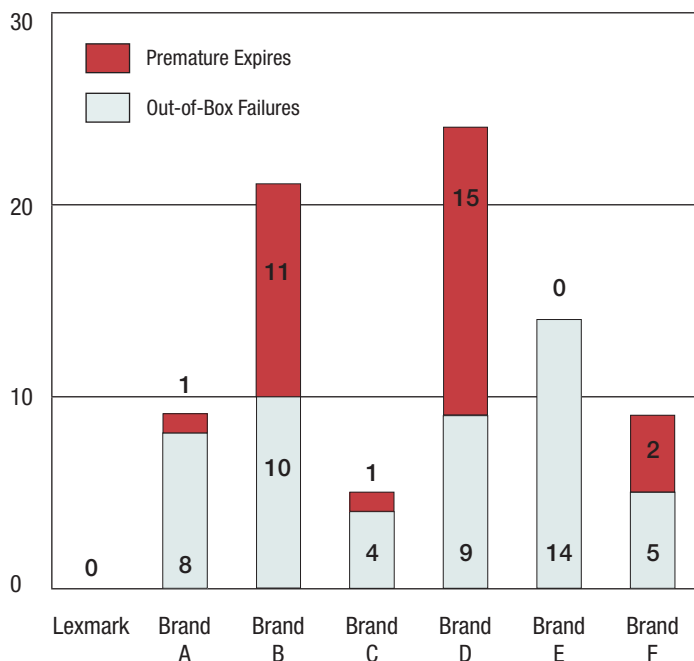


The claimed yield for each color cartridge is 5,000 pages with five of the remanufactured brands and 7,000 pages with one, for a normalized average of 5,333 pages, and the average tested yield for the color remanufactured cartridges was 4,587 pages for cyan, 5,653 pages for magenta, and 6,304 pages for yellow. Lexmark's claimed yield for its color cartridges is 7,000 pages and the tested average yields for each of the color Lexmark cartridges is as follows: 7,158 pages for cyan, 7,654 pages for magenta and 7,573 pages for yellow.

Reliability

As previously noted, the Lexmark cartridges had no premature expires or out-of-box failures. However, of the 216 remanufactured cartridges tested, 80 failed (30 premature expires, 50 out-of-box failures), resulting in a collective failure rate of 37%. Brand A had eight out-of-box failures and one premature expire for a failure rate of 25%; Brand B, with 10 out-of-box failures and 11 premature expires, had a failure rate of 58%; Brand C had a failure rate of 14%, with four out-of-box failures and one premature expire; Brand D's failure rate was a 67%, with nine out-of-box failures and 15 premature expires; Brand E had no premature expires, but had 14 out-of-box failures for a failure rate of 39%; and Brand F had five out-of-box failures and two premature expires for a failure rate of 19%.

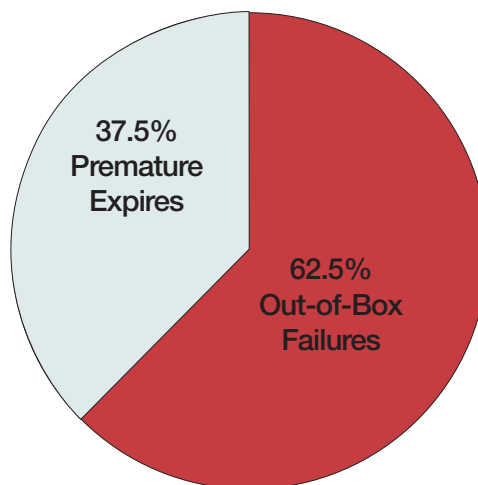
GRAPH 2: Failures per Brand



Cartridge Failures

	Out-of-Box Failure	Premature Expire	TOTAL
Lexmark	0	0	0 (0%)
Brand A	8	1	9 (25%)
Brand B	10	11	21 (58%)
Brand C	4	1	5 (14%)
Brand D	9	15	24 (67%)
Brand E	14	0	14 (39%)
Brand F	5	2	7 (19%)
TOTAL REMAN FAILURES	50	30	80 (37%)

GRAPH 3: Total Reliability Failures of Remanufactured Brands



The reliability failures were classified as:

- Out-of-Box Failures – a cartridge that was inoperable upon installation or produced 20 or fewer acceptable pages

- Premature Expires – a cartridge that produced below 75% of the average expected comparative page yield
- Image Quality Failures – a cartridge that developed unacceptable image quality during life

Out-of-Box Failures

The reasons that 50 of the remanufactured cartridges were classified as out-of-box failures include:

- Extraneous marks on pages (7)
- Toner streaking (38)
- Spots/dots on side of pages (2)
- Excessive toner dumping out of box (2)
- Defective cartridge (error message on display before printing any pages) (1)

Exhibits B–D to the right are representative of the type of failure encountered with the remanufactured cartridges that resulted in them being classified as an out-of-box failure.

Premature Expires

Of the 30 remanufactured cartridges that expired prematurely, 11 expires were due to early fading of images, two were due to the cartridges being defective, and 17 were because of severe streaking that rendered output clearly unacceptable. In both cases with the defective cartridge, the device had an error message on the display and would not print until that cartridge was replaced; this occurred just after 100 pages on one printer and just after 2,250 pages on the other.

Exhibit E to the right is representative of the type of streaking encountered with the remanufactured cartridges that resulted in them being classified as premature expires.

Print Quality

In addition to evaluating functional performance, print samples for each test cartridge were evaluated for consistency and quality throughout life. Images were evaluated using tests for six criteria (text, line art, solids, color business graphics, color photographic images, and density), as well as visually for acceptability for cus-

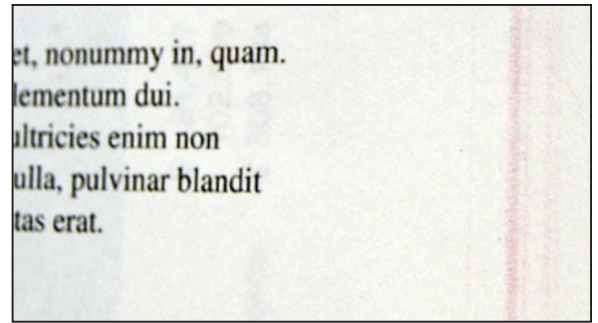


EXHIBIT B: Toner Streaking



EXHIBIT C: Excessive Toner Dumping

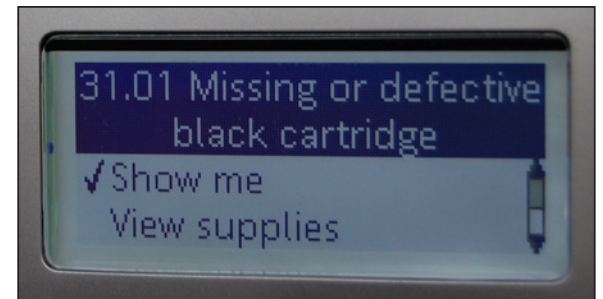


EXHIBIT D: Error message on display detailing a defective cartridge

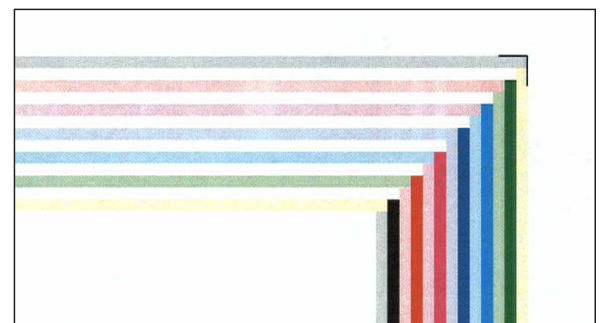


EXHIBIT E: Toner Streaking

tomers use. Samples were taken at the start of testing, at the approximate midpoint, and just prior to image fade/cartridge end of life. Each sample was evaluated for clarity and definition of text and line art, crispness of characters, production of solids, color business graphics and color photographic images, as well as for image quality defects such as oversaturation of color output; improper color production; toner flaking, streaking, scattering or overspray; background in white areas; banding in solids; jittering; and halo effect.

While there were no image quality defects observed with the Lexmark print samples, 88% of the image quality samples evaluated for the remanufactured cartridges had defects. Toner speckling and extraneous marks in the background of pages were the most prevalent print quality defect with the remanufactured cartridges, which was evident in a large majority of the evaluation sets (Brands A–D and F). Banding in solids was noticed with Brands B and D; image quality samples from Brand E added defects such as horizontal lines or backgrounds being tinted gray (like a newspaper), while minor to severe toner streaking or overspray also contributed to most of the remanufactured cartridges’ image quality being inferior to that of Lexmark.

The following exhibits are representative of the types of image quality defects encountered with the remanufactured cartridges:

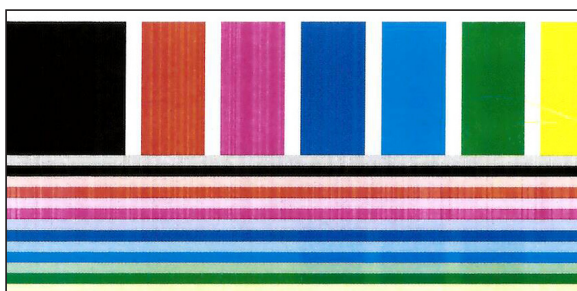


EXHIBIT F: Banding in Solids

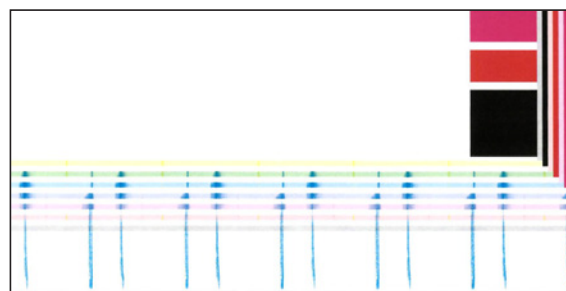


EXHIBIT G: Extraneous Horizontal and Vertical Lines

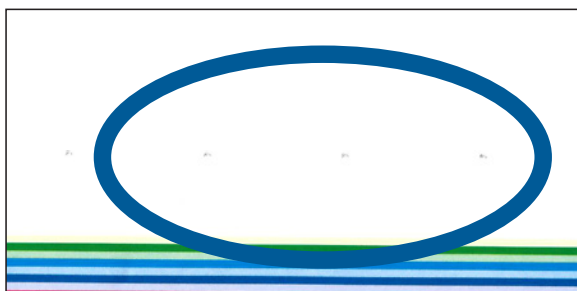


EXHIBIT H: Extraneous Background Patterns

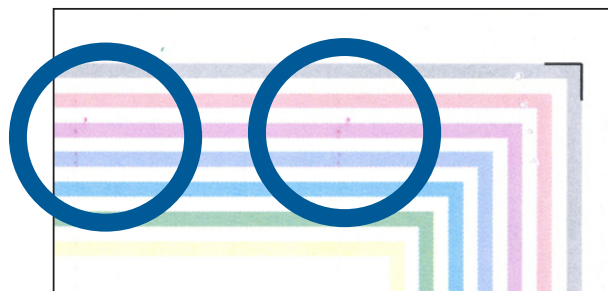


EXHIBIT I: Toner Speckling

SUMMARY

This extensive test, which included approximately 410,000 pages printed, demonstrates the superiority of the page yield, reliability and print quality performance of genuine Lexmark C534 cartridges. It also provides independent test verification that overall the remanufactured brands fall short of their claim of equal to new Lexmark performance. These results are consistent with an earlier BLI comparative test of Lexmark genuine cartridges vs. remanufactured brands. In commenting on the results, Polifrone noted: *“BLI believes that the superior performance of the Lexmark C534 OEM cartridges in these tests clearly demonstrates that lower priced remanufactured cartridges may actually provide very little value and end up costing more because of inferior yield, reliability and print quality performance.”*

LAB TEST DATA

Data Table 1: Overall Tested Page Yields—Black

Brands	Number of Cartridges Tested	Yield Claim (Pages)	Mean
Lexmark New	9	8,000	8,614
Brand A	9	Equals OEM	5,648
Brand B	9	Equals OEM	4,417
Brand C	9	Equals OEM	6,611
Brand D	9	Equals OEM	150
Brand E	9	Equals OEM	6,106
Brand F	9	Equals OEM	11,589
Remanufactured Brands	54		5,754

Lexmark's claimed yield is based on testing using the ISO 24712 document.

Data Table 2: Overall Tested Page Yields—Cyan

Brands	Number of Cartridges Tested	Yield Claim (Pages)	Mean
Lexmark New	9	7,000	7,158
Brand A	9	5,000	5,007
Brand B	9	5,000	2,472
Brand C	9	5,000	7,361
Brand D	9	Equals OEM	3,247
Brand E	9	5,000	3,394
Brand F	9	5,000	6,039
Remanufactured Brands	54		4,587

Lexmark's claimed yield is based on testing using the ISO 24712 document.

Data Table 3: Overall Tested Page Yields—Magenta

Brands	Number of Cartridges Tested	Yield Claim (Pages)	Mean
Lexmark New	9	7,000	7,654
Brand A	9	5,000	3,996
Brand B	9	5,000	3,056
Brand C	9	5,000	9,278
Brand D	9	Equals OEM	3,122
Brand E	9	5,000	9,633
Brand F	9	5,000	4,833
Remanufactured Brands	54		5,653

Lexmark's claimed yield is based on testing using the ISO 24712 document.

Data Table 4: Overall Tested Page Yields—Yellow

Brands	Number of Cartridges Tested	Yield Claim (Pages)	Mean
Lexmark New	9	7,000	7,573
Brand A	9	5,000	5,577
Brand B	9	5,000	2,833
Brand C	9	5,000	9,556
Brand D	9	Equals OEM	9,857
Brand E	9	5,000	4,936
Brand F	9	5,000	5,067
Remanufactured Brands	54		6,304

Lexmark’s claimed yield is based on testing using the ISO 24712 document.

Data Table 5: Cartridge Reliability Failures

Brands	Number of Cartridges Tested	Out of Box Failure	Premature Expiration	Total Failures
Lexmark New	36	0	0	0
Black	9	0	0	0
Cyan	9	0	0	0
Magenta	9	0	0	0
Yellow	9	0	0	0
Remanufactured Brands	216	50	30*	80
Black	54	18	10	28
Cyan	54	13	9	22
Magenta	54	8	10	18
Yellow	54	11	1	12

* Of the premature expires, 11 were due to early fading of images, 17 were due to image quality failure, and two were because of the cartridges being defective.

TEST METHODOLOGY

Test Conditions

BLI performed all testing in its 10,000-square-foot U.S. lab located in Hackensack, 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. Nine of each cartridge brand was tested over three printers, and printers were replaced whenever an individual unit showed signs of diminished performance. The printers were rebuilt after running all cartridges from one brand; this involved vacuuming the inside of the printer and changing the photoconductor units, transfer belts and fusers. Toner waste containers were changed when prompted. The printers were all run in default (normal) mode.

Though the remanufactured brands are referred to as Brands A through F in this report, it should not be assumed that the order in which the remanufactured brands are identified on page 1 of this report directly corresponds to A through F throughout this report.

Page Yield

To evaluate page yield, BLI used the five-page ISO 24712 color test target. A cartridge was considered to be at the end of its life when a fade occurred following two cartridge shake procedures. The cartridges were shaken either at the appearance of a “Toner Low” message from the printer or if a fade occurred before the cartridge had been shaken twice. Premature image quality deterioration also denoted the end of cartridge life.

The total page count per cartridge was defined as the number of acceptable pages printed (that is, pages without image quality defects such as excessive streaking, textual imperfections or fading). The overall average page yield per color per brand was defined as the combined total number of acceptable pages printed by all of the cartridges, divided by nine. The average pages per gram of toner was defined as the page count divided by the grams of toner consumed, which was determined by weighing the cartridge before and after the test.

Print Quality

In assessing image quality, BLI’s lab test technicians assigned a rating of poor, fair, good, very good or excellent to each performance category. Averages of the individual cartridge grades were calculated in order to assign a value and overall grade to each brand of cartridge. Visual assessments were made in a Graphiclite D5000 Standard Viewer and with an Edmund Scientific PL-B776U PixeLINK Camera. Black density was measured with an X-Rite 508 Series Spectrodensitometer, and color density was measured with an X-Rite i-One/iO Color Spectrophotometer.

Print quality was evaluated based on the following criteria: text, line art, halftone range, halftone coverage, solids, color business graphics, color photographic images, and density, with test samples taken at the start of testing, approximate midpoint and just prior to fade/end of life. Based on the test target, each criterion was rated according to a cartridge’s performance in the following related sub-categories: boldness, sharpness, fullness of formation, and smoothness for Text; line consistency and formation of circles for Line Art; visible darkness/boldness and consistency of coverage for Solids; sharpness of fine detail, as well as banding, for Color Business Graphics; and smoothness of output for Color Photographic Images. Two density measurements were taken for each print quality sample, one each on the right- and left-side of the page. Each sub-category was rated as being poor, fair, good, very good or excellent. The scores were totaled across each category and averaged to obtain a grade for each cartridge brand for the first four criteria; density was graded according to an improvised scale, again on a four-point scale. All criteria were then averaged and constitute the overall grade for each brand.

Reliability

Throughout testing, any cartridge malfunctions observed, such as operational/mechanical failure, physical defects, toner leakage and image quality failures, were recorded. Out-of-box failures: A cartridge that was inoperable upon installation, or produced 20 or fewer acceptable pages, was considered to be an “out-of-box” failure. Image quality failures: A cartridge that developed unacceptable image quality during life. Premature expire: Cartridges that produced below 75% of the average stated page yield were considered to be premature expires.

ABOUT BUYERS LABORATORY

Since 1961, Buyers Laboratory LLC (BLI) has been the leading global independent office-equipment test lab and business consumer advocate. In addition to publishing the industry's most comprehensive and accurate test reports on office document imaging devices, each representing months of exhaustive hands-on testing in BLI's US and UK laboratories, the company has been the leading source for extensive runnability testing on imaging media and consumables, as well as extensive specifications/pricing databases on MFPs, printers, scanners and fax machines. BLI also has a long-standing reputation for being the industry's most trustworthy and complete source for quality testing services and global competitive intelligence.

In addition to testing over 200 office machines and related consumables annually for its subscribers, BLI provides consulting services to buyers and a range of private testing services that include document imaging device beta and pre-launch testing, performance certification testing, consumables testing (including toner, ink and photoconductors), solutions evaluations, and imaging media runnability testing.

For more information on BLI, call (201) 488-0404, visit www.buyerslab.com, or e-mail info@buyerslab.com.