

Xerox & Third-Party Toners – Reliability Test Report

Xerox Phaser 6360 Color Laser Printer

When Xerox commissioned *spencerLAB* to perform an independent Reliability Test of a range of Third-Party compatible and OEM Xerox Phaser 6360 toner cartridges, we incorporated relevant methodology from the ISO/IEC 19798 color yield standard. This ensured running the test over multiple machines as well as cartridges – quasi-continuously printing ISO 24712 standard documents with at least three sets of cartridges on each of three printers for each cartridge manufacturer. While focussed on monitoring reliability issues throughout that standardized procedure, this could additionally provide ISO Yield data for each cartridge supplier.

The *spencerLAB* DIGITAL COLOR LABORATORY division of Spencer & Associates Publishing, Ltd. has been performing third-party toner cartridge tests for nearly a decade, and we anticipated similar findings – perhaps higher yield, a few print quality issues, and possible reliability issues – all varying by vendor. However, other than with OEM Xerox cartridges, it was not possible to complete the ISO-based methodology – on *any* of the third-party cartridge sets – before reliability became the overriding issue. We tested compatible toner cartridges from Cartridge World, Media Sciences, and Rhinotek. Although no cartridges were dead-on-arrival, every one of the tested third-party brands experienced cartridge leakage that caused at least one of its three new, dedicated printers to fail before a third cartridge set could be completed.

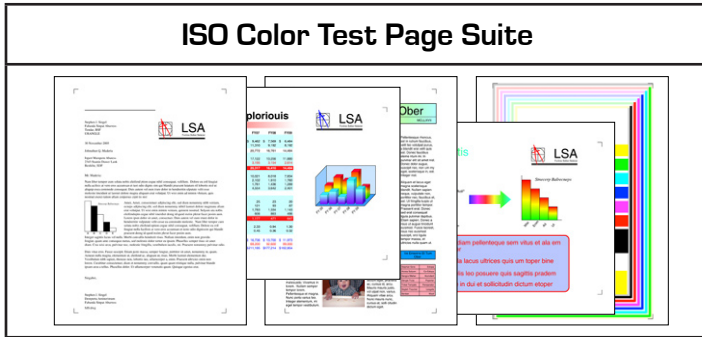
The primary mode of failure was leaking cartridges that allowed toner to permeate the printers, depleting the cartridges much too rapidly, causing print quality defects, contaminating fusers, transfer rollers, and imaging units – making quite a mess, and building up on drive train gears, thereby grinding down gear teeth – even rendering some printers unusable.* The detailed results of our test are reported herein as we found them.

Our summary finding was that ***the Xerox 6360 Color Laser Printer OEM Toner Cartridges were more Reliable than Any of the tested Third-Party Compatible Cartridges.*** Cartridges from all third-party compatible suppliers experienced toner leakage, print quality defects, user issues, and related printer failures. Prints from Xerox OEM toner cartridges did not exhibit any significant print quality defects throughout the reliability testing.

* This was the first time we experienced toner cartridge-related printer damage, and it was quite unexpected – finding these similar product quality issues with three different vendors is unprecedented in our experience. We note mention in one of the vendor's most recent quarterly report, "...a year-over-year increase in our warranty expense related to one of our products. A latent issue was determined to have been caused by a change in manufacturing processes by one of our vendors. While the issue is now resolved, we expect a higher than normal rate of warranty claims in the near future..." While this does not specify the product, we may speculate about a common basic defect in cartridge construction that potentially distorts our results, and anticipate corrective action on the part of the vendors. These are not the subtle issues we normally encounter, and we are unable to extrapolate these test results to other products from these suppliers; we hope to have the opportunity to repeat this testing.

METHODOLOGY

This Reliability Test was performed with methodology adopted from the ISO|IEC 19798:2007 “Method for the determination of toner cartridge yield for colour printers and multi-function devices that contain printer components”, including use of the ISO|IEC 24712:2007 “Colour test pages for measurement of office equipment consumable yield”.



Reliability testing included monitoring for print quality defects, toner cartridge and printer issues, paper jams and other user issues.

Printing was performed using Adobe Reader 9.1.0 running under Windows XP Professional with Service Pack 3. The print driver was at default for Plain Paper with “Let Printer Determine Colors” checked for Yield Testing results. Testing was performed on Staples Copy Paper, 92 Brightness, 20 lb. A full printed suite was saved every 500th page.

Twelve new Phaser 6360DN printers were actively employed in the testing. Imaging units, transfer rollers, and fusers were replaced per usage requirements. In addition, some imaging units required more frequent replacements in response to print quality issues and drive system failures, and some fusers were replaced more frequently in an effort to diminish paper jam occurrences. Three printers each were dedicated to Xerox OEM cartridges, three to each third-party brand’s cartridges.

Phaser 6360 Xerox OEM Cyan, Magenta, Yellow, and Black High Capacity Toner Cartridges (106R01218-21) were used for this test. Corresponding cartridges were acquired directly from Cartridge World USA and Rhinotek Computer Products, Inc.; Media Sciences International cartridges were acquired via TheNerds.net, Neximaging.com, and Provantage.com. Multiple shipments were received over a six-week period during March-April 2009.

DETAILED FINDINGS

In the following discussion, detailed findings are organized into the categories of Print Quality, Cartridge and Printer Failure, User Issues, and Yield results. Within this report the specific test results will not be identified with a named brand.

PRINT QUALITY

Prints from Xerox OEM toner cartridges did not exhibit any print quality defects throughout the reliability testing. Prints from the third-party toner cartridges had print quality defects that would render the prints unusable – defects such as ghosting, streaking, banding, text distortion, excess toner, excessively dark color and very low Black density.

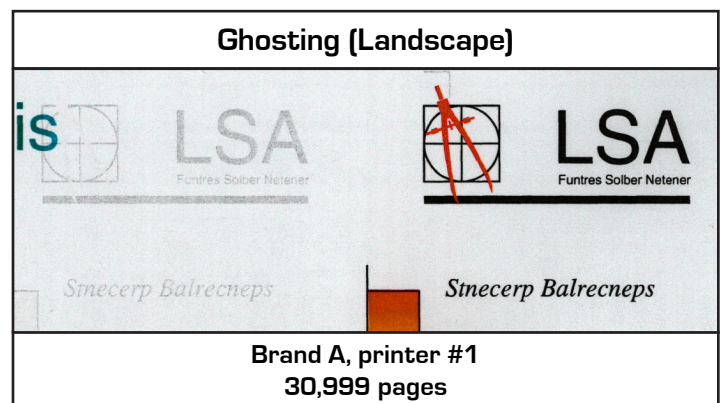
Xerox OEM

As noted above, prints from Xerox OEM toner cartridges did not exhibit print quality defects throughout the reliability testing. Xerox Phaser 6360 printers with OEM toner cartridges printed a total of over 240,000 pages: 81,458, 84,290, and 78,899 pages for each of the three printers, respectively.

Brand A

There were no DOAs, and (with all three new, dedicated printers) initial print quality was generally comparable* to that of the Xerox OEM toner cartridges. However, within 1500 pages toner particles were visible adhering to the back of the prints from two of the printers, to be followed by those from the third printer at about 5500 prints.

A second print quality issue – ghosting, the faint copying of parts of the print image on additional areas of the page – began to be barely discernible on one of the printers using Brand A toner at 10,000 prints, and by 16,000 prints, ghosting could clearly be seen on output from all three printers.



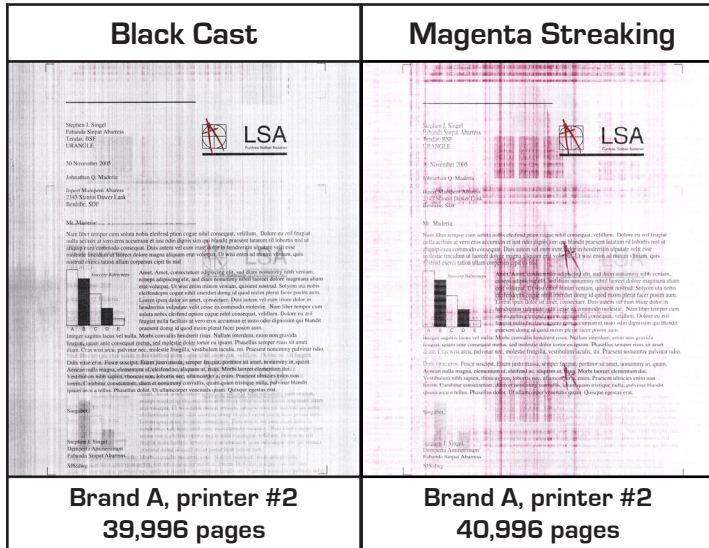
Brand A Black toner increasingly leaked throughout the test and caused an overall cast on the printouts, a print quality defect generating unusable prints. The Black

* An informal *spencerLAB* print quality comparison was performed.

cast on prints occurred at 33,000 pages for printer #1 and at about 27,000 pages for both printers #2 and #3. Vacuuming the excess toner out of the printers, replacing the Imaging Unit and the Transfer Roller improved this print defect briefly, but within 2000-7000 pages the Black cast returned.

Banding – strips of density differences – was first discernible at about 14,500 pages for one printer and by 22,500 pages banding was evident on output from all three printers. Banding, first detected in the pie chart image, was quickly present throughout the test suite.

Text distortion – shrinking and stretching of letters – occurred as well at 36,500, 31,500, and 38,500 pages for printers #1, #2, and #3, respectively. This print defect disappeared when the Imaging Unit was replaced, but would return when the Imaging Unit approached its premature end-of-life.

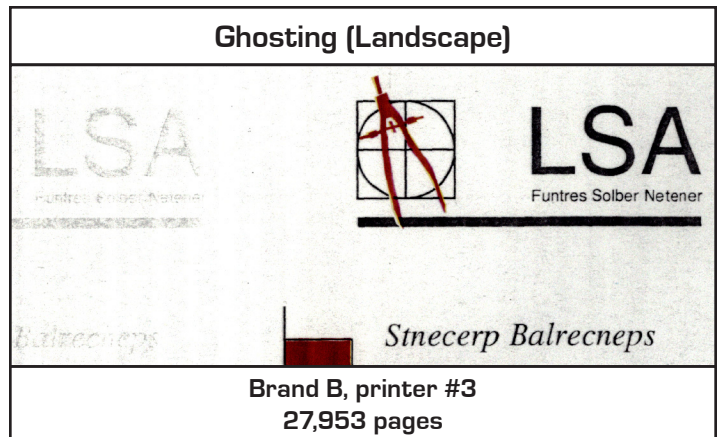


Brand B

There were no DOAs, and (with all three new, dedicated printers) initial print quality was comparable to that of the Xerox OEM cartridges. Defects were soon noticeable; by 4000 pages Cyan and Magenta toner particles began adhering to the back of the prints from all three printers.

Prints displayed ghosting over the entire page. Barely discernible ghosting began at 3900, 3300, and 4100 pages for each of the three printers, respectively; this would begin lightly, then increase in density as printing continued. The printers performed automatic cleaning cycles, but they did not remove this print defect. The Imaging Unit, Fuser, and Transfer Roller were all replaced; print quality improved slightly, but ghosting was still apparent.

Another print defect, streaking of Magenta toner, began to appear at 38,000 pages for printer #1 and at 27,500 pages for printer #2. Magenta toner streaking density increased as the test continued. As with the Black toner cast, vacuuming and replacing the Imaging Unit and Transfer Roller stopped the print defect, but only temporarily.



Magenta toner cartridges began to leak; it was noticed at 23,570, 32,850, and 23,953 pages for printers #1, #2, and #3, respectively. Excess Magenta toner appeared as a light over-all cast on prints and continued to increase until Magenta toner covered the page. Magenta toner streaking was found on printer #2 output, starting at 38,300 pages. The printers' automatic cleaning could not resolve these issues. Magenta toner continued to leak into the printers; the printers were

vacuumed out and Imaging Units were replaced. Although this improved the print quality, excess toner was still visible on prints, and the density increased rather quickly.

Magenta Cast and Streaking

Brand B, printer #2
(Imaging Unit replaced at 33,718 pages)

32,145 pages 32,850 pages 38,337 pages

Banding, similar to that experienced with Brand A cartridges, initially was noticed in the pie chart image, but then became more obvious on other pages in the test suite. Banding was observed at 16,000 pages for printer #1, 16,600 pages for printer #2, and 16,500 pages for printer #3.

Banding

Brand B, printer #1
24,999 pages

Text distortion, similar to that experienced with Brand A cartridges, started at 22,800, 32,645, and 21,409 pages for each of the three printers, respectively. As noted previously, when the Imaging Unit was replaced this print defect was removed, but as the Imaging Unit approached premature end-of-life, the text distortion would return.

Brand C

As with the other third-party vendors' cartridges, there were no DOAs, and (with its three new, dedicated print-

ers) initial print quality was comparable to that of the Xerox OEM cartridges, but defects were soon noticeable. Toner particles were visible adhering to the back of the prints as early as 5436, 4231, and 3167 pages for each of the three printers, respectively.

Similar to testing results with Brand A and Brand B cartridges, ghosting, banding, and text distortion were observed.

Barely discernible ghosting was noticed at 5000, 11,000, and 8300 pages for each of these printers, respectively. Initially difficult to see, it became more pronounced along with a density increase during the print run. Print quality improved slightly when the Imaging Unit, Transfer Roller, and Fuser were changed, but ghosting remained apparent.

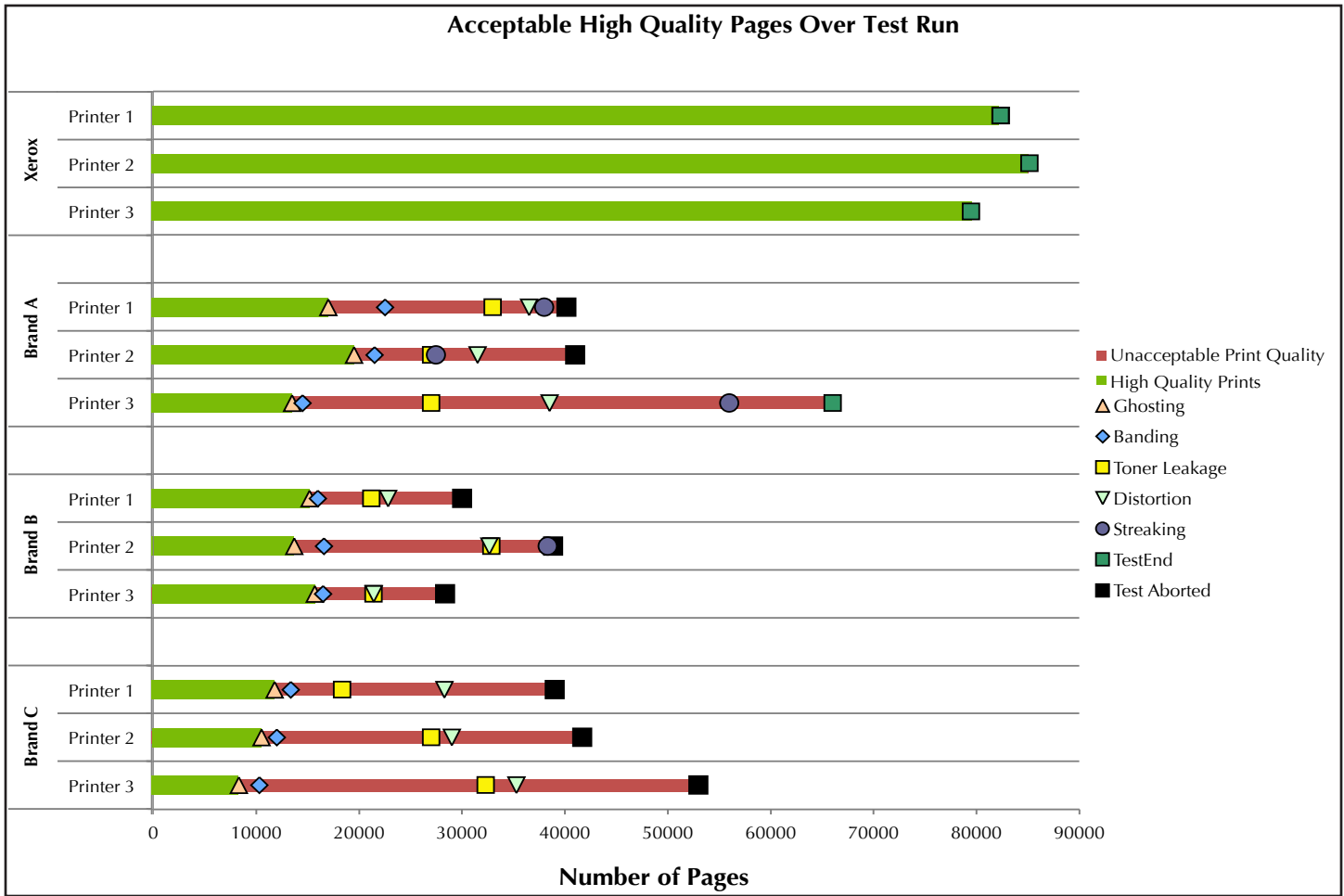
Banding was observed at 13,350, 12,000, and 10,300 pages for each of the three printers, respectively.

Text distortion started at 28,300, 29,000, and 35,300 for each of the three printers, respectively.

Black & Color Density

Brand C, printer #3

	<p>8797 pages (Black installed at 8300 pages)</p>
	<p>9297 pages</p>
	<p>10,297 pages</p>



Similar to Brand A Black toner cartridges, Brand C Black toner cartridge leaked during the test and caused an overall cast on the printouts. Black cast on prints occurred at 18,350 pages for printer #1, 27,000 pages for printer #2, and at 32,300 pages for printer #3. Vacuuming the excess toner out of the printers and replacing the Imaging Unit and Transfer Roller improved this print defect briefly, but the Black cast would return.

With a new Black toner cartridge installed and Cyan, Magenta, and Yellow toner cartridges approaching their end-of-life, prints significantly lost Black density, while the color densities increased and were rendered too dark. Black density increased as printing continued and was followed by improvement in color density. This defect dissipated within 1500-2000 pages.

CARTRIDGE & PRINTER FAILURE†

Xerox OEM

Xerox printers with OEM toner cartridges had no failures. Three printers and nine sets of toners were able to finish the full reliability testing, including ISO yield.

† Two Imaging Units were defective on arrival, and were not used during testing.

Brand A

Brand A toner cartridges experienced excessive toner leakage. Black and Magenta toner were the most frequent to leak, for unknown reasons. Black Toner was leaking so excessively that toner emerged from the Manual Tray on printer #1 causing it to be unusable – clean paper would become covered with Black toner before printing. Toner leaked into the printers themselves causing print quality issues, paper jams, and even printer failures. An exception was printer #3 in which only Black toner leaked so much as to infiltrate the Imaging Units; no Magenta toner was found as noticed in printer #1 and #2 Imaging Units. While printing continued, Black and Magenta toner usage increased rapidly. Yellow and Cyan had visible leakage, but it was not as drastic as with Magenta and Black Toners. Toner cartridge leakage also caused the Imaging Units and Transfer Rollers used with Brand A to be damaged well before their rated life of up to 35,000 pages.

Toner permeated these printers – clogging the gears of the Imaging Unit, thereby causing one of the gears to grind down and interfere with Imaging Unit rotation. This, in addition to print quality issues, caused continu-

Transfer Roller Failure



Xerox printer #2
84,290 pages

Functioning Transfer Roller #2
at 34,351 pages



Brand A printer #3
66,039 pages

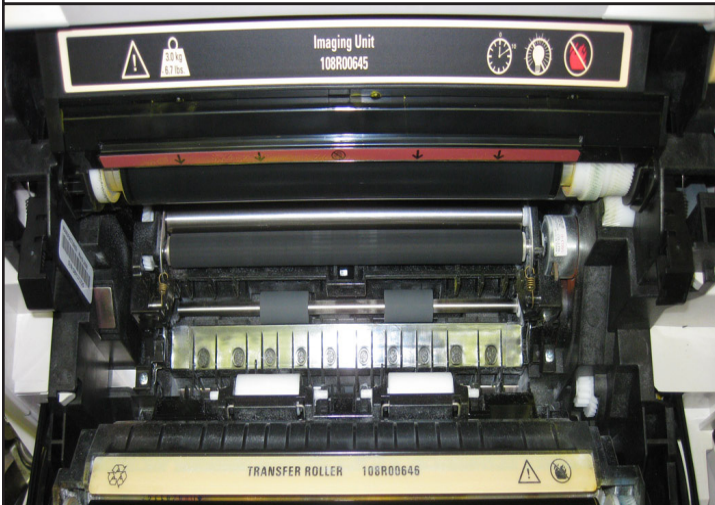
Failed Transfer Roller #3
at 2648 pages

ous paper jams whose recurrence could not be eliminated. While Brand A printer #1's first Imaging Unit end-of-life was at 34,500 printed pages and gears were not stripped, the second Imaging Unit reached only 5644 pages before

its gear had worn down. Gears in both Imaging Units used in printer #2 wore down, the first managing 33,500 pages while only 7500 pages for the second. Printer #3 did not have a failed Imaging Unit; perhaps significantly, only Black toner leaked as noted above. Since printer #1 and #2 Imaging Units' gears were permanently damaged by the toner, vacuuming the loose toner out of the printer was to no avail.

Transfer Rollers became covered with toner from leaking cartridges, shortening their life. First Transfer Rollers printed 27,292, 27,715, and 27,295 pages for each of the three printers, respectively, while the second Transfer Rollers only printed 10,203, 10,637, and 9621 pages for each of the three printers, respectively; toner leakage cut Transfer Roller life by about half.

Toner Cartridge Leakage



Xerox OEM Cartridges - Minor Accumulation
78,899 pages, printer #3



Brand A - Significant Toner Leakage
66,039 pages, printer #3



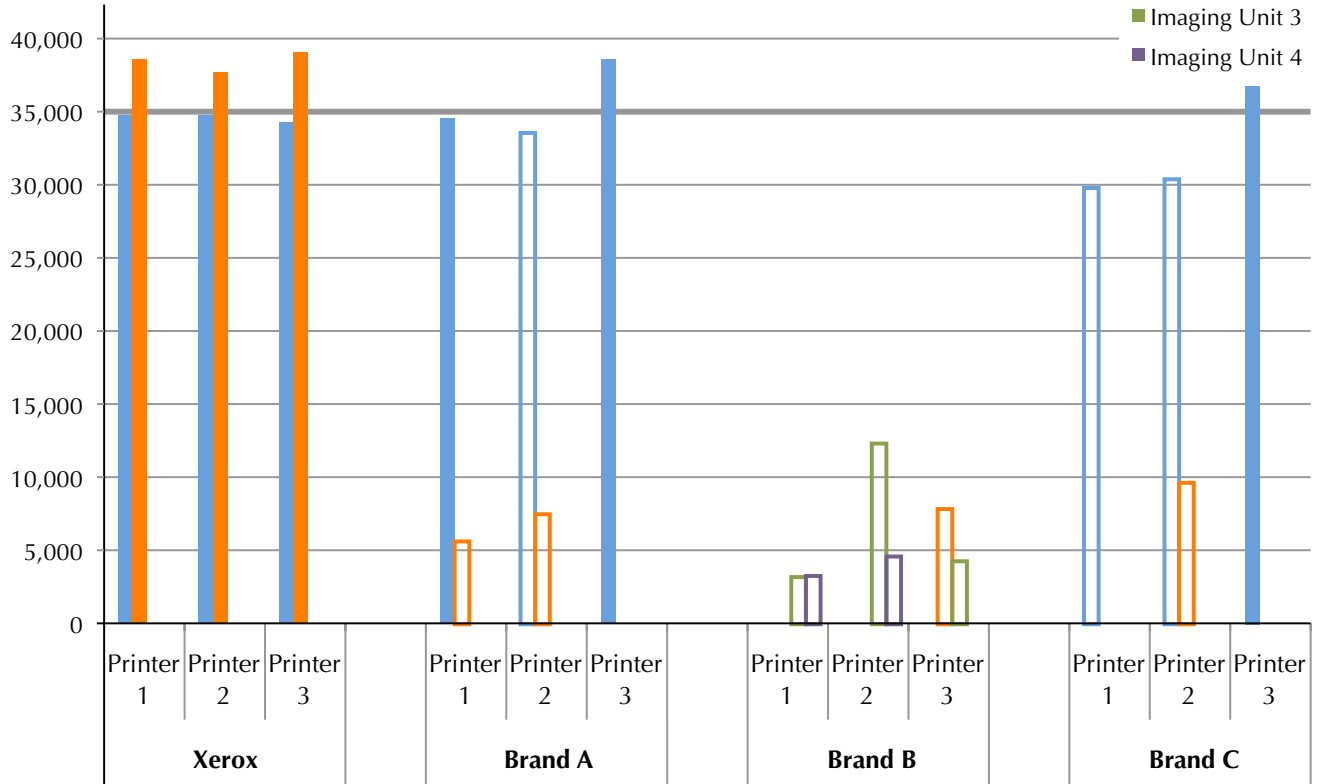
Brand B - Significant Toner Leakage
38,337 pages, printer #2



Brand C - Significant Toner Leakage
41,503 pages, printer #2

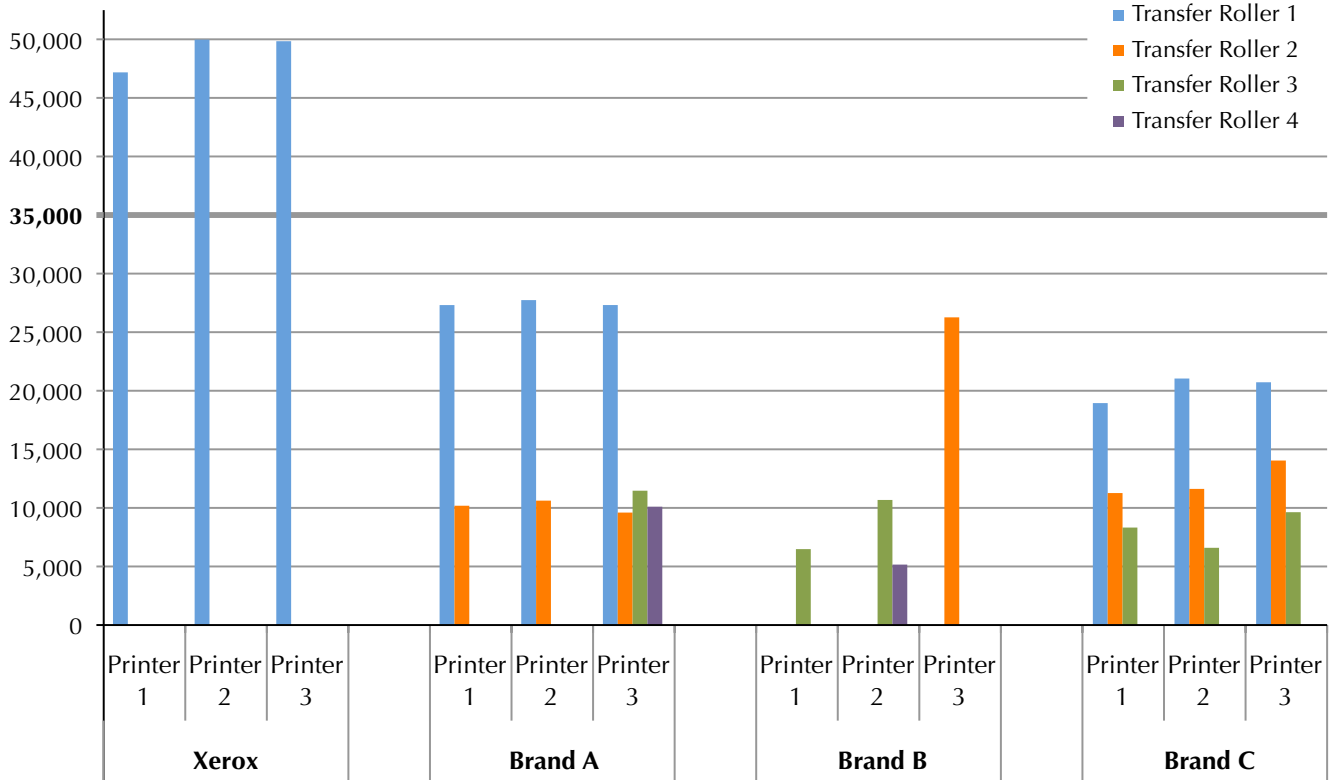
Imaging Unit Life

- Gear Failure
- Imaging Unit 1
- Imaging Unit 2
- Imaging Unit 3
- Imaging Unit 4

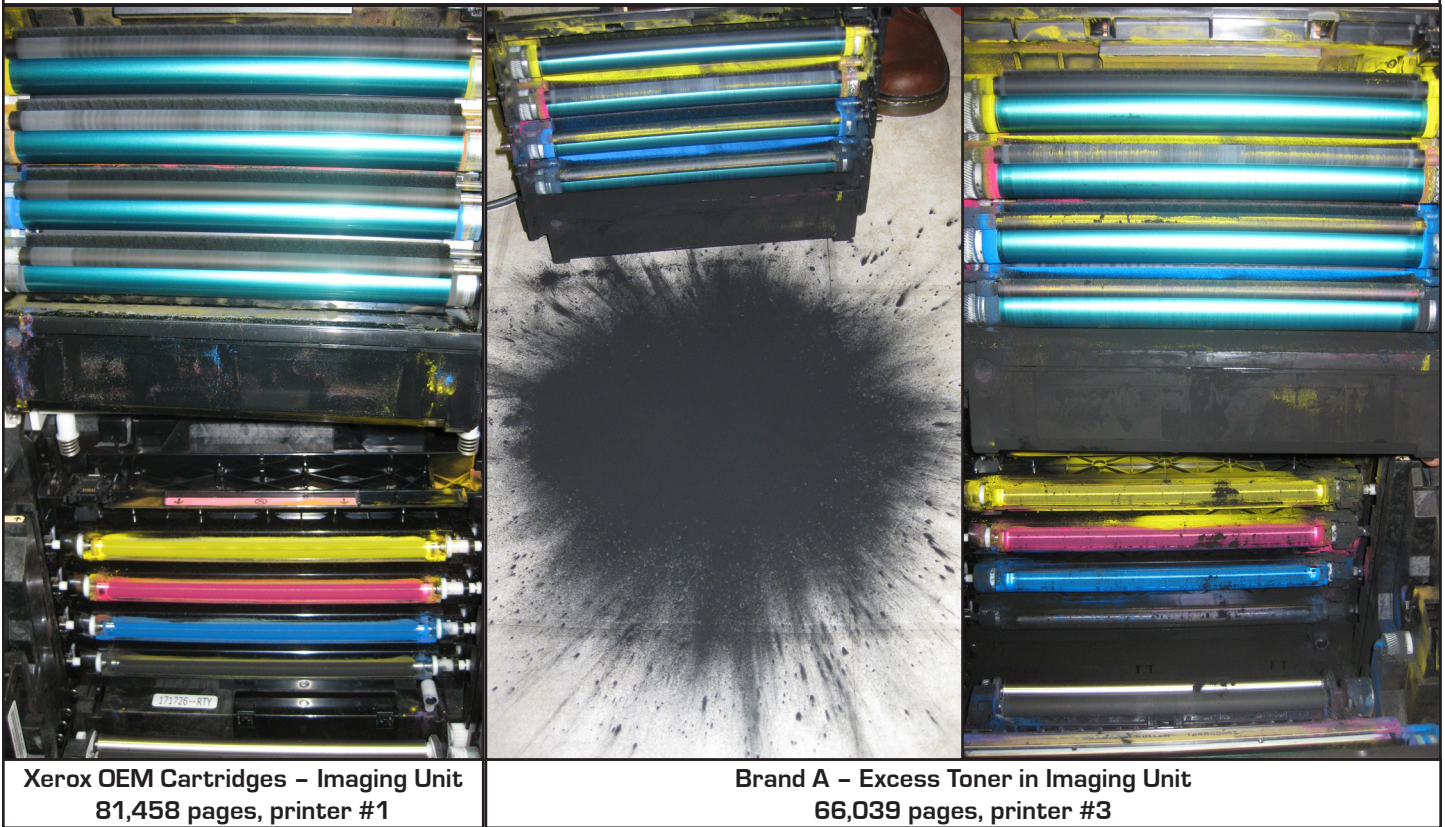


Transfer Roller Life

- Transfer Roller 1
- Transfer Roller 2
- Transfer Roller 3
- Transfer Roller 4



Replacing Imaging Unit



Xerox OEM Cartridges - Imaging Unit
81,458 pages, printer #1

Brand A - Excess Toner in Imaging Unit
66,039 pages, printer #3

Brand B

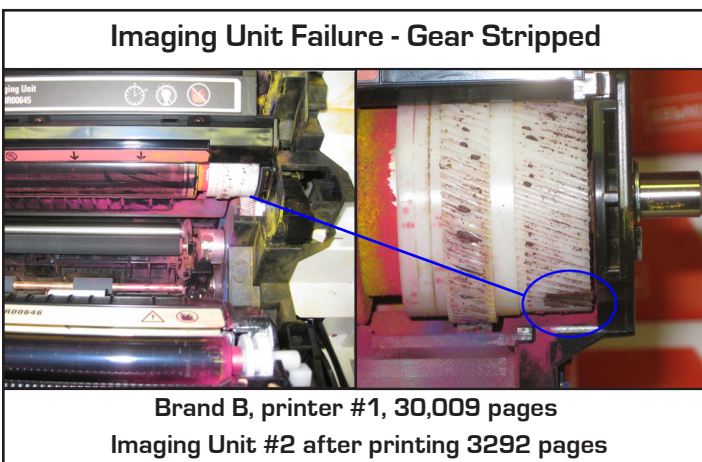
Brand B toner cartridges also experienced excessive toner leakage. All three printers dedicated to Brand B testing had Magenta toner cartridge leakage; printer #1 also had Yellow toner leakage. Again on all three printers, loose toner was observed on Manual Tray 1, Imaging Unit gears were stripped, and Transfer Roller life declined by about half.

100,000 pages. All printers had Fusers that were covered with loose toner, which caused incessant paper jams. These jams may have been caused by toner clogging the Fuser gears, as with the Imaging Units.

Brand C

Brand C toner cartridges had excessive toner leakage in their dedicated printers, resembling those of Brand A and Brand B. Toner leakage was primarily from Black cartridges, but printer #2 also had loose Magenta Toner. All three printers had toner appear in Manual Tray 1 and Imaging Unit gears were stripped.

Transfer Roller life declined rapidly, as with Brand A and Brand B toner cartridges. Printer #1 used three Transfer Rollers which reached 18,942 pages, then 11,283 pages, and finally 8345 pages. Transfer Rollers from printer #2 had descending yields as well; 21,035, 11,637, and 6621 pages. Printer #3 also used three Transfer Rollers; 20,716, 14,052, and the last with 9653 pages.



Brand B, printer #1, 30,009 pages
Imaging Unit #2 after printing 3292 pages

Furthermore, there was a Fuser failure with Brand B toner cartridges; a Fuser in printer #2 reached end-of-life after only 16,010 pages, well before its rated life of up to

Paper jams, comparable to those with Brand B cartridges, occurred constantly at the Fuser, which was coated in toner. A Fuser in printer #2 had to be replaced at 39,144

Toner Leakage on Manual Tray 1



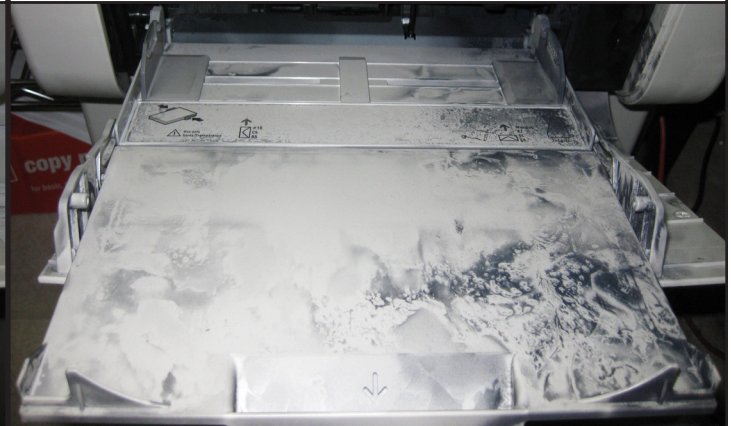
Xerox OEM Cartridges, printer #2
84,290 pages



Brand A, printer #2
41,000 pages



Brand B, printer #3
28,385 pages



Brand C, printer #1
38,848 pages

pages because of the continuous paper jams, earlier than its up to 100,000-page rated life.

Printers

Five out of nine printers that were used with the third-party toner cartridges *could not finish* the ISO-style reliability testing because the accumulated buildup of toner through the machines caused premature failures of Imaging Units, Transfer Roller, Fusers. Eventually the printers themselves became unusable, even with replacement parts. Testing of three others was aborted when they evidenced increasing toner usage rates and gear damage that indicated imminent printer failure. None of the three printers that were used to test Xerox OEM cartridges had any major reliability issues.

USER ISSUES

Printers using Xerox OEM toner cartridges had the “Mis-feed at Tray 2” error when the printer did not correctly

grab the paper or had a paper jam. Third-party toner cartridge machines had continuous paper jams and toner leakage. These can significantly impact user productivity.

Paper Jams

The three printers using Xerox OEM toner experienced a modest number of paper jams (eleven during ISO testing). All printers using third-party toner cartridges experienced numerous paper jams. Paper jams occurred primarily in the Imaging Unit, usually caused by the gear not rotating properly (or at all). These paper jams were not difficult to clear, but continued repeatedly until the Imaging Unit was replaced. After some investigation it was determined that the continuous paper jams were caused by the gear teeth wearing down as they were covered with loose toner; annoying, time consuming, and costly to the user as jams increased in frequency.

Brand B and Brand C also had paper jams in the Fuser area. This paper jam was difficult to clear and the paper would typically tear. The user (our test engineer) needed

to be extremely careful when removing the rest of the paper from the Fuser, which would be quite hot and covered with toner – and often required the time-consuming process of removing the Fuser from the printer and reinstalling it. Paper jams might continue a few times before the printer finally printed again. This process was exasperating and frustrating, as well.

Toner Leakage/Replacing Consumable

Third-party toner cartridge leakage led to consumables needing to be changed more frequently and toner on the users' clothing and hands.

Imaging Units and Fusers were damaged by the loose toner. The stripped gear could be seen on the Imaging Units, while clogged Fuser gears may have been the cause of the persistent paper jams. Transfer Roller life declined rapidly during the print runs and the rollers were layered in toner. Two printers using Brand A toners and two printers using Brand C toners displayed "Dusty Density Sensor" errors. Printing ceased until the Transfer Roller Density Sensor was cleaned. Brand A printer #1 had this error at 37,495 pages and printer #2 at 58,278 pages. Brand C printer #1 had this error at 38,988 and 39,144 pages and printer #3 at 44,088 pages.

When changing Imaging Units on printers that had been using third-party cartridges, toner would *pour* out; Transfer Rollers and Fusers were covered with toner and were impossible to replace without getting toner on surface areas, and on the users. Toner was noticeable on the outside of the printers, spewing from Manual Tray 1. While the user loaded the automatic Paper Tray 2 and picked up output, toner would get on his/her hands and clothing. Manual Tray 1 could not be used without getting toner on clean, unused paper, costing productivity while cleaning the tray. The overall test experience with these third-party toner cartridges would require the user to spend more money on additional consumables, to invest more time in maintenance of the machine, and therefore to have less time for productive work.

YIELD

All three printers dedicated to Xerox OEM cartridges were able to complete their part of ISO Yield testing. Brand A printer #3 was the only other printer able to finish its part of yield testing. No Brand B or Brand C dedicated printers were able to finish.

Xerox OEM

Even though the Xerox Phaser 6360 does not quote yield per ISO, we calculated the ISO "Declared Yield". Averaging the nine cartridges on three printers, Black toner cartridge yield was 17,578 standard pages. Cyan average toner cartridge yield was 13,553; Magenta was 12,927; and Yellow was 12,234 standard pages. Declared yield values in accordance with ISO/IEC 19798:2007 are provided as Appendix I to this report.

Brand A

Brand A toner cartridges experienced excessive toner leakage, as noted earlier. Only one of the three printers dedicated to Brand A had three sets of toner cartridges plus an extra Black cartridge that finished the yield testing.

On the single printer, the four Black toner cartridge average yield was only 10,147 standard pages. Cyan toner three cartridge average yield was 16,083; Magenta was 14,478; and Yellow was 15,577 standard pages. This cannot be considered an ISO Yield since at least nine cartridges on at least three printers are required per the ISO Yield standard.

Other Third-Party Cartridges

Brand B and Brand C toner cartridges could not finish ISO Yield testing.

THE *spencerLAB* DIGITAL COLOR LABORATORY

The *spencerLAB* DIGITAL COLOR LABORATORY is an independent printer evaluation laboratory that provides services to vendors and corporations for whom digital color printing is mission-critical. The laboratory follows strict guidelines in the integrity of both methodology and reporting; vendor-sponsored studies do not guarantee favorable results. *spencerLAB* has developed industry-standard test software, and performs print quality, cost-per-page, speed, and ease-of-use analyses in all technology classes, from desktop printers to digital color presses.

spencerLAB is operated by Spencer & Associates Publishing, Ltd., a premier IT consulting boutique specializing in Digital Color Imaging. Since 1989 Spencer & Associates has provided strategic support in product planning, development, and launch to manufacturers, and workflow analysis, usage optimization and print system selection to corporate users.

©2009 Spencer & Associates Publishing, Ltd.
May not be reproduced in part without explicit permission.
June 2009

