

## COMPARATIVE PERFORMANCE EVALUATION

March 2010

### Xerox OEM Printer Cartridges vs. Remanufactured Cartridges

#### PERFORMANCE SUMMARY

In a comparative cartridge test conducted by Buyers Laboratory on 15 Phaser 4510 printer cartridges from Xerox Corporation vs. 15 from each of three third-party vendors (4InkJets, NewProNet and TonerPrice), for a total of 60 cartridges, the Xerox OEM cartridges delivered overall page yield, image quality and reliability performance that was superior to the overall performance of the three remanufactured third-party cartridge brands.

#### Page yield

Overall, the Xerox OEM cartridges gave an ISO average page yield performance that exceeded that of the remanufactured cartridges by as much as 26.5%.

#### Image quality

The overall image quality produced by the Xerox OEM cartridges exceeded that of the three remanufactured cartridges, with the Xerox cartridges producing superior text, line art and solids, and displaying superior overall image quality consistency.

#### Reliability

The Xerox OEM cartridges experienced no reliability issues of any kind and proved to be more reliable than the three remanufactured brands, each of which experienced one failure.

#### OVERALL PERFORMANCE RATINGS

	Xerox	Brand A	Brand B	Brand C
ISO Page Yield	4	2	2	2
Image Quality	3.6	2.6	2.6	2.6
Reliability	4	3	3	3
COMPOSITE	3.9	2.5	2.5	2.5

Scale of 1 to 4, with 4 being the best.

### TEST RESULTS BY CATEGORY

#### PAGE YIELD

Based on ISO yields obtained in testing, the 15 Xerox OEM cartridges gave an overall page yield performance that was superior to each of the three competitive brands. In fact, the yield performance of the Xerox cartridges exceeded that of the Brand A cartridges by 26.0%, while exceeding that of the Brand B cartridges by 12.5% and exceeding the page yield performance of the Brand C cartridges by 26.5%. This can be attributed to the fact that all 15 of the Xerox cartridges gave a consistent performance and exceeded their claimed page yield of 19,000 pages, while several of the competitive cartridges did not. In fact, one cartridge each for Brand B and Brand C fell short of the 19,000-page claimed yield by 55.4% and 18.6%, respectively. Both were classified as premature expires, meaning they netted less than 75% of the claimed 19,000-page target. In addition, one of the Brand A cartridges was an out-of-box failure, so it had no page yield.

#### IMAGE QUALITY

Image quality was evaluated using the ISO 19752 test target (see page 5) and was based on five criteria: text, line art, halftones, solids and consistency of performance, with test samples taken at the start of testing, then after the test was 25%, 50% and 75% completed. 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 circles for Line Art; halftone levels, graininess and banding for Halftones; visible darkness/boldness and consistency of coverage for Solids; as well as consistency of performance in each of the four test categories.

	Xerox	Brand A	Brand B	Brand C
<b>Text</b>	4	2	2	2
<b>Line Art</b>	4	2	2	2
<b>Halftones</b>	3	3	3	4
<b>Solids</b>	3	3	3	2
<b>Consistency</b>	4	3	3	3
<b>OVERALL</b>	3.6	2.6	2.6	2.6

Scale of 1 to 4, with 4 being the best.

As noted in the table above, the overall image quality performance of the Xerox cartridges proved to be superior to that of the three remanufactured brands. In addition to being bold and fully formed, text produced from the Xerox cartridges was very detailed, sharp and clean. As noted in the graphs on page 3, BLI's test technicians also observed that the Xerox image quality actually improved from start to about 25% into testing and remained that way until end of life, whereas the text and line art performance of the competitive brands started out either on par with or slightly better than the Xerox cartridges but quickly dropped below the Xerox quality and remained that way until end of life. The Xerox cartridges also produced lines that were clean and consistent horizontally and vertically, and circles that displayed minimal jaggedness around curves that could only be observed under magnification.

In contrast, the text and line art produced from the remanufactured cartridges was inconsistent from start to end, with image breakup and toner splatter observed around characters, resulting in characters that were not as sharp as those produced with the Xerox cartridges and density that was inconsistent. BLI's lab technicians also observed that pages from the remanufactured cartridges sporadically contained toner speckles throughout testing, while this only briefly occurred at the very start of testing with the Xerox cartridges. Though there was slight over-toning at the start of testing with the Xerox cartridges that resulted in some overspray and a marginal downgrading of the initial quality of text and lines, this quickly dissipated.

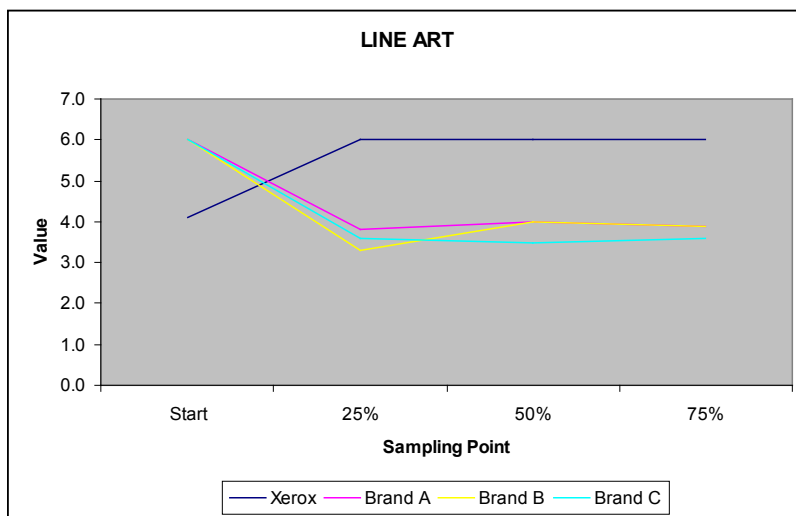
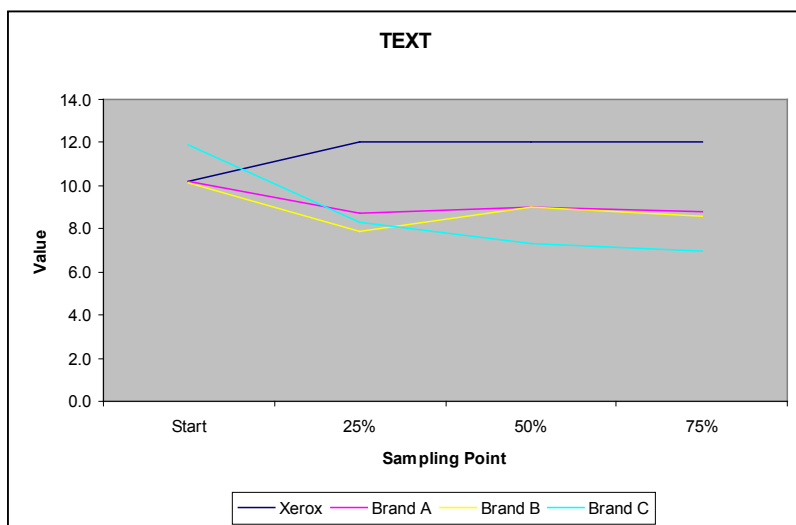
With regard to halftones, which is critical for the creation of shaded areas (as with bar graphs and pie charts), those produced with the Brand C cartridges were slightly grainy but provided clean transition between levels with little or no banding or streaks within the halftone pattern. Consequently, the halftone performance of the Brand C cartridges was slightly superior to the Xerox,

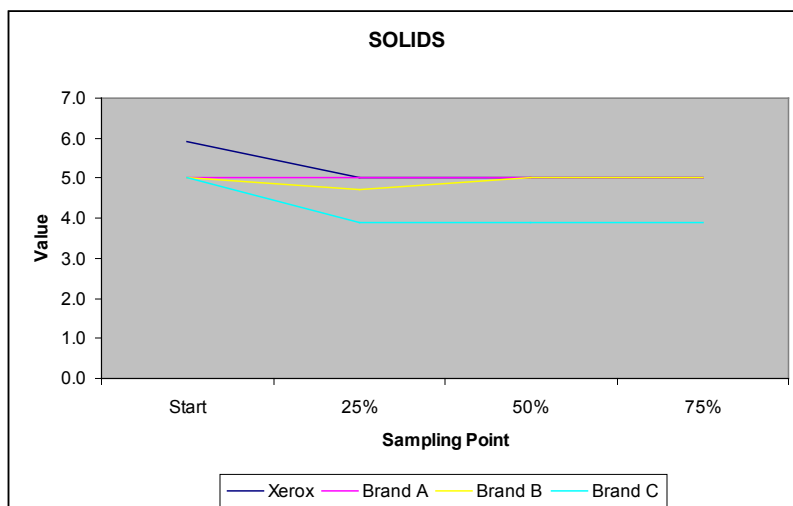
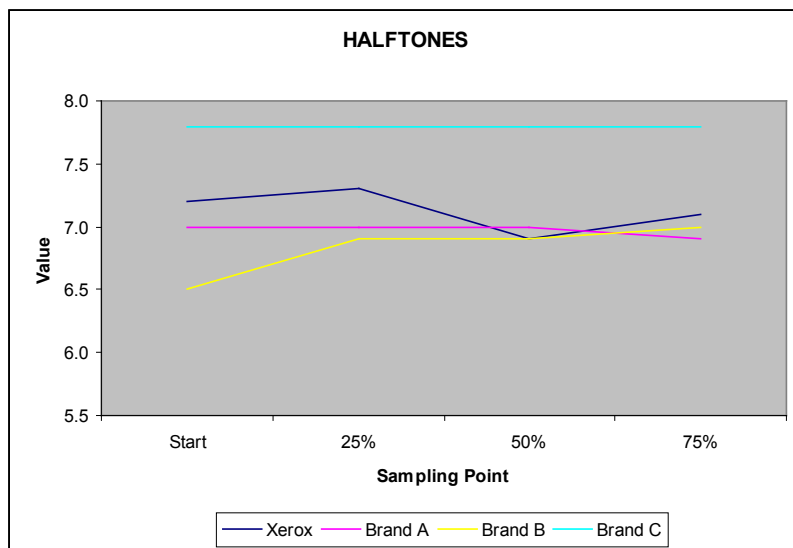
Brand A and B cartridges, which had a slightly grainy pattern and clean transitions between halftone levels but had more banding than was found with Brand C. It should also be noted that Brand B had the worst banding and that Xerox had slightly better early halftones than Brands A and B.

Though the Brand C cartridges displayed better halftone performance, the solids produced by the Xerox, Brand A and Brand B cartridges were comparable and superior to those produced with the Brand C cartridges. BLI's lab technicians observed that Xerox OEM, Brand A and Brand B had darker and more consistent results from various locations on the page and printed with little or no mottled appearance, whereas Brand C's solids were lighter, inconsistent and had some mottling. It should also be noted that with a few of the remanufactured cartridges from each brand occasional toner flaking off pages was observed. In addition, extraneous repetitive imaging was occasionally seen with the Brand B and Brand C cartridges.

The Xerox cartridges also excelled in overall image quality consistency over the course of the test, as can be seen in the graphs below. This is especially apparent with text and line art, whereas the other brands all begin to show some deterioration shortly after the start of testing.

(See Exhibits on pages 5 and 6 for examples of the image quality problems encountered.)





## RELIABILITY

In the reliability test category, the Xerox OEM cartridges gave a flawless performance, with not a single reliability problem occurring. In contrast, each of the three remanufactured brands had one cartridge failure. Brand A experienced an out-of-box failure (OOBF) that was due to a plastic “plug” dislodging from the cartridge when the sealing tape was removed, while one cartridge from Brand B and one from Brand C seized up during testing and emitted a loud noise, after which neither cartridge could print any acceptable pages.

### CARTRIDGE FAILURES

	Out-of-Box Failures	Premature Expires
Xerox	0	0
Brand A	1	0
Brand B	0	1
Brand C	0	1

While the remaining 14 cartridges for each of the remanufactured brands performed without reliability issues, it should also be noted that “physical” imperfections were observed with 11 of the 15 cartridges from Brand B. Nine cartridges had toner smeared on the drums and four were missing springs; however, these issues did not have a negative impact on performance. In addition, the packing tape was very difficult to remove from the toner compartment of most Brand B cartridges; in one case a small piece of tape remained, but this did not influence performance. One Brand C cartridge had a significant amount of toner on the case when unpackaged, but this also did not affect performance. Though these issues did not have a negative impact on cartridge performance, they did lead test operators to question the QA procedures of the remanufactured cartridge vendors.

In contrast, no defects of any kind were observed with the Xerox cartridges.

### EXHIBITS

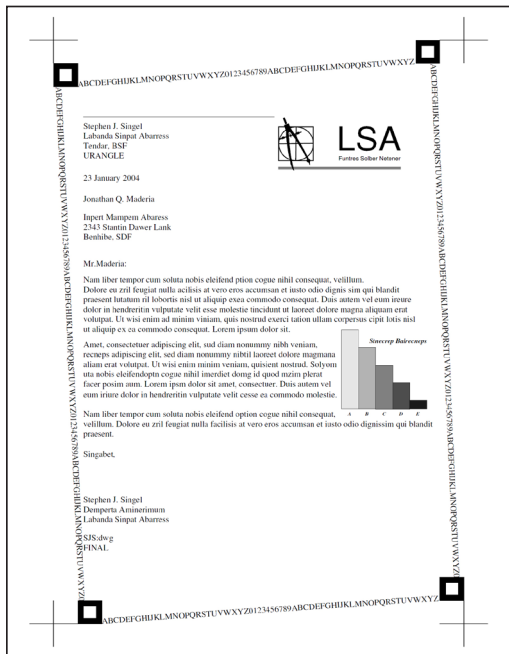


EXHIBIT A: ISO 19752 TEST TARGET

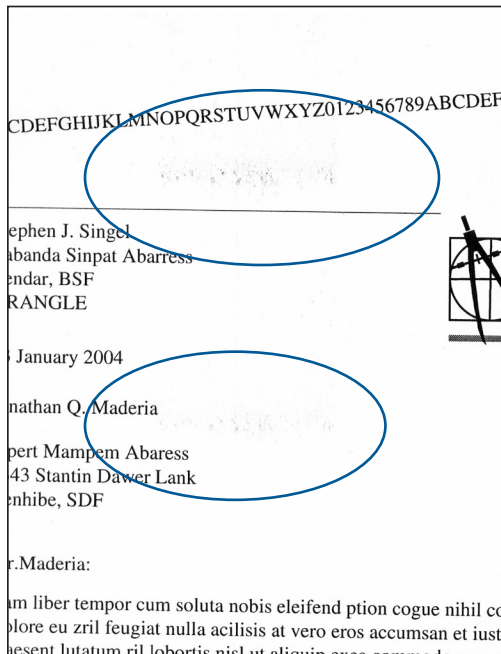
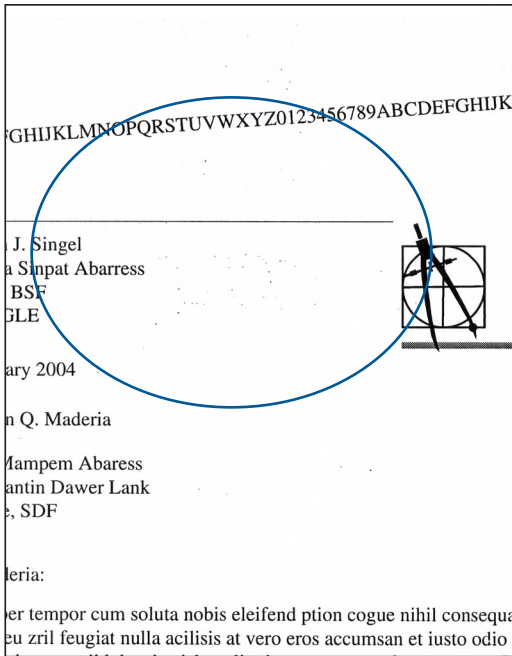
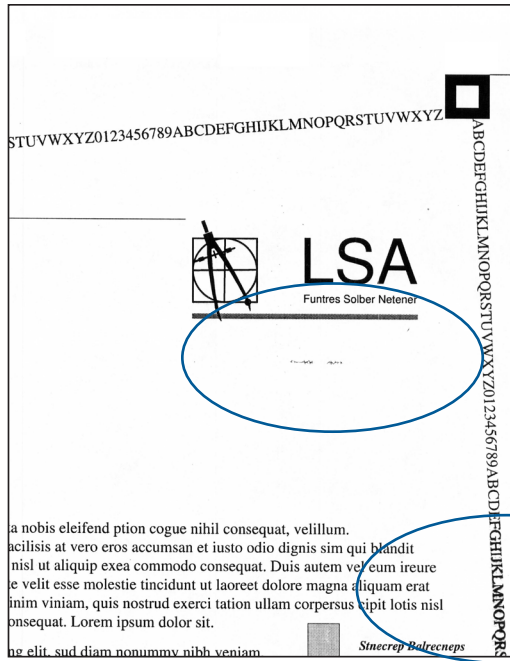


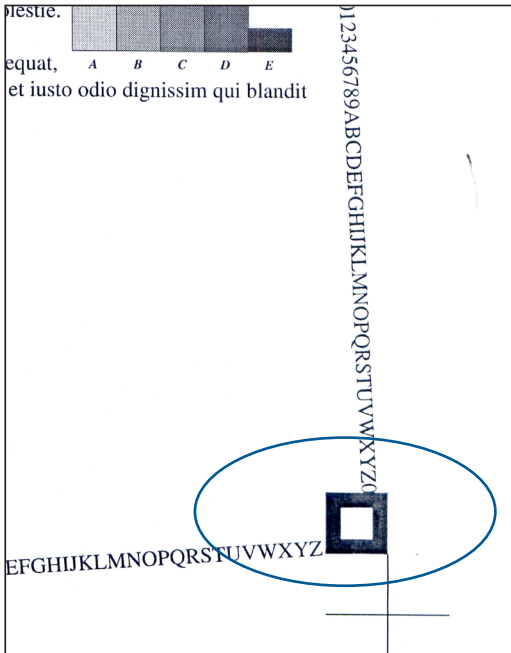
EXHIBIT B: EXTRANEOUS REPETITIVE IMAGING



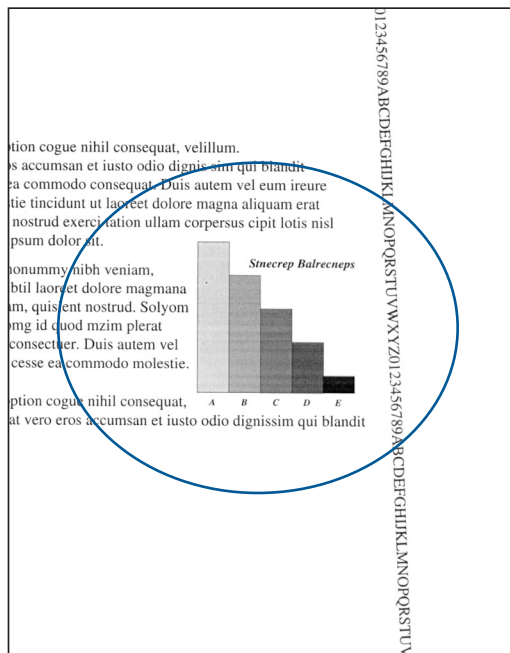
**EXHIBIT C: TONER SPECKLING**



**EXHIBIT D: TONER SPLATTER AND EXTRANEIOUS IMAGING**



**EXHIBIT E: LIGHT AND MOTTLED SOLIDS**



**EXHIBIT F: HALFTONE BANDING**

## TEST METHODOLOGY

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### Test Objective

Buyers Laboratory Inc. (BLI) was commissioned by Xerox Corporation to conduct an independent comparative lab evaluation of the page yield, image quality and reliability performance of 4InkJets, NewProNet and TonerPrice remanufactured cartridges for the Xerox Phaser 4510 monochrome printer against that of Xerox OEM cartridges. Though the remanufactured cartridges are referred to as Brands A, B and C in this report, it should not be assumed that the order in which the remanufactured brands are identified above directly correlates to A, B and C. All testing was done in accordance with ISO/IEC 19752. A total of 60 cartridges were tested across 12 printers, with three printers dedicated to each cartridge brand. Five cartridges were run in each printer so that a total of 15 cartridges for each brand were tested.

All testing was performed in BLI's 10,000-square-foot test lab located in Hackensack, NJ (USA; [www.buyerslab.com](http://www.buyerslab.com)).

### 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. Per ISO/IEC 19752 test specifications, at least nine of each cartridge type was tested over three of each printer model. In this test 15 cartridges for each brand were tested and three printers were dedicated to each brand of cartridge with five of each cartridge tested in each printer. The printers were all run in default (normal) mode.

### Page Yield

To evaluate page yield, BLI used the ISO 19752 one-page monochrome test target. End of life for each cartridge occurred either when the printer prompted the operator to replace a cartridge, when excessive fading following the second "shake" or image quality degradation occurred, or if unacceptable image quality failures were encountered.

The total page count per cartridge was defined as the number of acceptable pages printed (that is, pages without unacceptable image quality defects, such as excessive streaking, textual imperfections, toner flaking, speckling or fading). The overall average page yield per brand was defined as the combined total number of acceptable pages printed by all of the cartridges, divided by 15.

### Image Quality

In assessing image quality, BLI's lab test technicians assigned a grade of 1, 2, 3 or 4 to each cartridge, with 4 being the very best. Averages of the individual cartridge grades were calculated in order to assign a value and overall grade to each brand of cartridge. BLI's test analysts based their assessments on a set of specific criteria, including imperfections in lettering, solids and lines, density, halftones and the appearance of streaks, consistency and uniformity of images. Visual assessments were made in a Graphiclite D5000 Standard Viewer, and density was measured with an X-Rite 508 Series Densitometer and imageXpert PQ Analyzer.

### Reliability

Throughout testing, any cartridge malfunctions observed, such as operational/mechanical failures, 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.

**Premature expire:** Cartridges that produced less than 75% of the stated page yield were considered to be premature expires.