

# Test Report

July 2004

For:  
**Samsung Electronics  
America**

## *Executive Summary*

### Testing of Toner Cartridge Life

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NSTL, Inc. conducted an independent cost per page analysis for Samsung Electronics America. The goal of this test was to determine the cost per page, based on toner usage, a user can expect from a Samsung CLP-500 color laser printer. The testing was performed on one model of Samsung laser printer and compared to the cost per page of two leading competitors' printers.

This class of color printer is primarily for users needing occasional color output.

NSTL found that the Samsung CLP-500 had a lower cost of ownership when considering the cost of consumables for both color and monochrome output than two other printers tested: the HP LaserJet 1500L and the Minolta MagicColor 2300W.

For color printing, the Samsung CLP-500 had a lower cost per page than the HP LaserJet 1500L. The Samsung CLP – 500 had a slightly higher cost per page (color) when compared to the Minolta MagicColor 2300W, a difference of “\$.0069”.

The Minolta cost per page for monochrome printing was roughly double that of Samsung and HP was roughly triple that of Samsung.

This difference in the total cost per page based on consumables could save the end user a significant amount over the life of the printer.

## *Test Methodology*

NSTL assembled a test bed which included 2 of each of the printers to be compared:

Samsung CLP – 500; Minolta MagicColor 2300W, HP LaserJet 1500L

### **Color Methodology**

The testing consisted of continuously printing pages of an Adobe Photoshop document designed to cover twenty percent of each printed page. Each color (Cyan, Yellow, Magenta, and Black), represented five percent of the document.

### **Monochrome Methodology**

The testing consisted of continuously printing pages of an Adobe Photoshop document designed to cover five percent of each printed page. The only color printed in this document was black. This page represents an “average” monochrome document.

### **Printing Methodology**

A Microsoft VB.Net application was developed that opened Photoshop, put a page number on the document and then printed the page. This process was repeated until the text print quality began to fade. When the quality began to fade, NSTL stopped the printing. The test engineer reviewed output tray to determine the “last good sheet,” and recorded this number. Then the test cartridge was removed, and shaken. This page number was recorded, and then the printing was resumed. NSTL checked the output approximately every 150 pages. Those printers utilizing a ‘smart-chip’ stopped printing when the printer read 0% toner. In this case, the last page was recorded as the last good sheet.

This cycle of determining and recording a “last good sheet,” and shaking the cartridge, was repeated three times. The very last good sheet value was obtained when the last color faded to an unacceptable level or reached 0%. As a result, NSTL had four “last good sheet” values, and three “cartridge shaken” values (where applicable). When a printer stopped printing if one color reached 0% and would not print without the replacement of a new toner cartridge, a spare toner cartridge was used to continue until the final color toner cartridge read 0%

After the final “last good sheet,” the printing was allowed to continue until print quality was unacceptable. When this point was reached, the cartridge was deemed to be finished, and this page count was recorded.

The default quality modes for all printers were used.

- Samsung 600
- Minolta 1200 x 600

- HP 600

NSTL tested a minimum of 6 cartridges on each brand of printer type with monochrome output and 6 cartridges of each color with the color document.

NSTL purchased all printers and toner products on the retail market. This made sure testing was conducted on “off the shelf” products.

If during the testing, a major print error (heavy streaking, total page speckling, etc.) occurred, the cartridge was given 100 sheets in which to right itself. If this did not occur, assorted repair measures (cleaning, adjusting the print darkness knob, etc.) were attempted and another 100 sheets printed. If these combined actions failed to correct the error, the cartridge was declared a failure. If the cartridge was declared a failure after printing one half of its rated output, it was classified as failed with full usage, in which case it was treated in a fashion similar to that of a finished cartridge.

After each cartridge’s run was completed, NSTL performed routine maintenance procedures before starting a run with a new cartridge. The maintenance routine included cleaning the general area inside the device, wiping up any excess toner dust, and following the directions in the printer manual. In addition, NSTL verified that the device was set to the default printer settings.

## **Yield Output**

### **Toner**

Toner yield output is defined as the total of all printed sheets, for the six cartridges, that did not contain a major permanent print error (e.g., print quality deemed unacceptable).

### **Drum**

Drum yield output is defined as the total of all printed sheets used while printing with a specific drum regardless of the print quality.

## **Cost-Per Page Analysis**

The cost per page analysis is a comparison of the indices that could be used to forecast possible printing costs after the purchase of the printers. Each printer's index is arrived at by summing the individual consumable's cost per page. The individual consumable cost per page is calculated by dividing the accumulated consumable yield from all test runs into the total cost of the consumable utilized by those runs.

## *Test Environment*

All printers were tested in a standalone environment using a USB connection. Each printer was connected to a dedicated desktop. All paper used was 20lb weight and letter size.

### Computers

- HP D530 CMT - Pentium 4 2.6 GHz
- 512 MB RAM, 80 GB hard drive
- Windows XP on each client station
- The printer driver supplied (on CD) and included with each printer was used for testing

### Manufacturer Printer Specifications

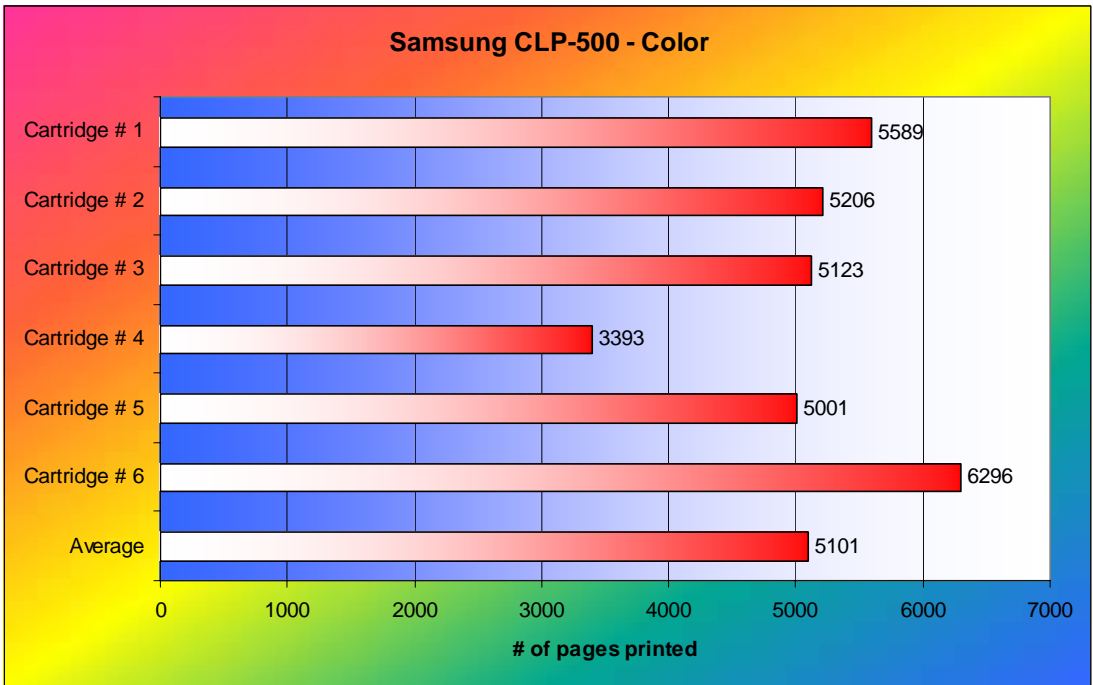
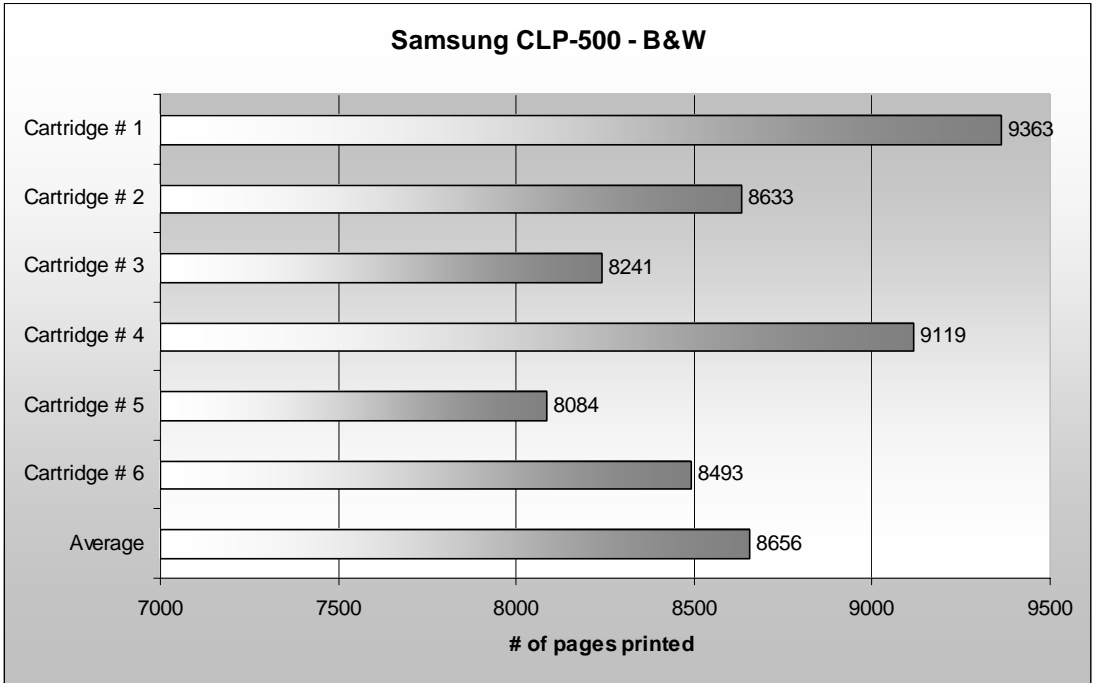
All printer specifications below were taken from each manufacturer's individual website.

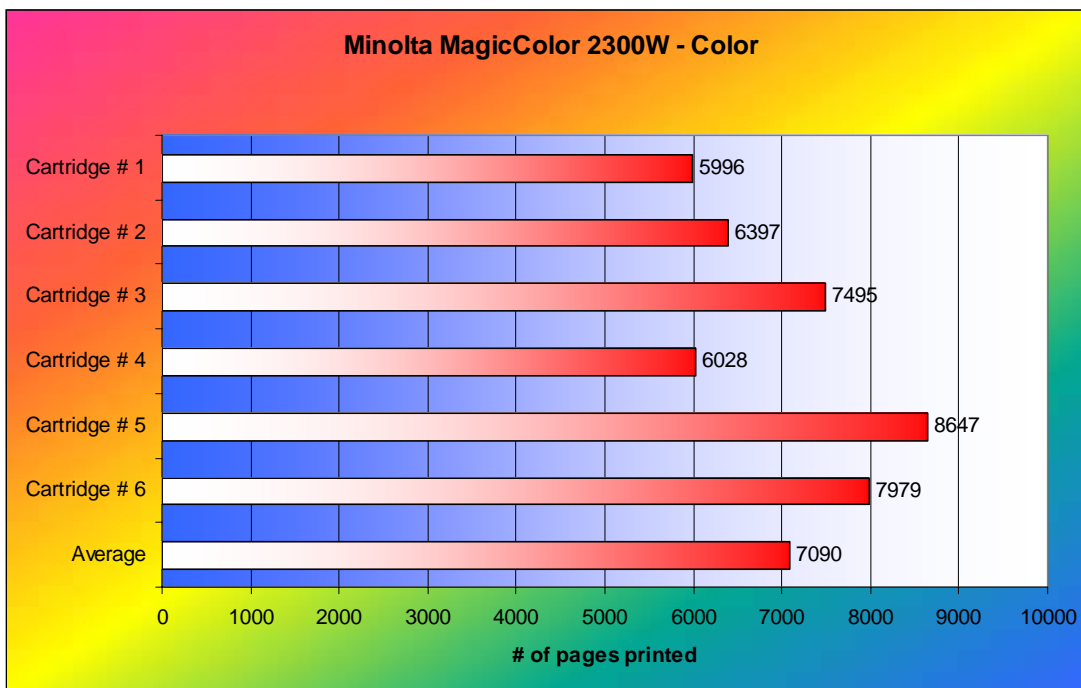
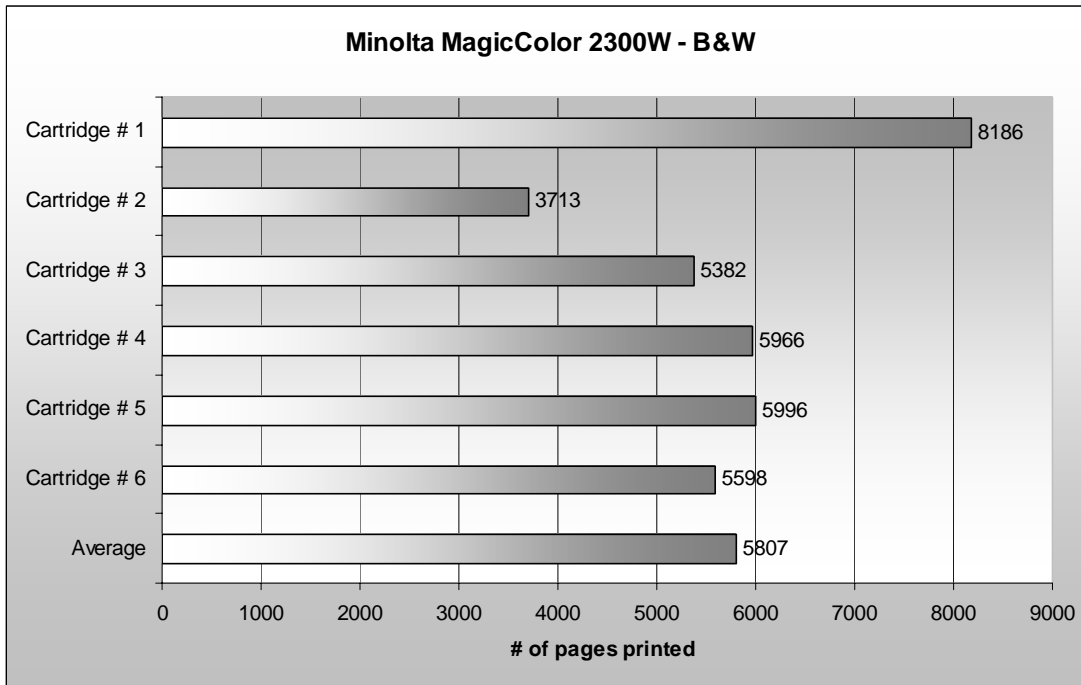
- Samsung CLP – 500
  - Print speed, black (pages per minute)
    - Up to 21PPM (Letter)
  - Print speed, color (pages per minute)
    - Up to 5PPM (Letter)
  - Max Monthly Duty
    - 35,000 Pages Max (Black)
  - Ram (Std / Max)
    - 64 MB /192 MB
  - Toner Black
    - (7000 sheets @ 5% coverage)
  - Toner Color
    - (5000 sheets @ 5% coverage)

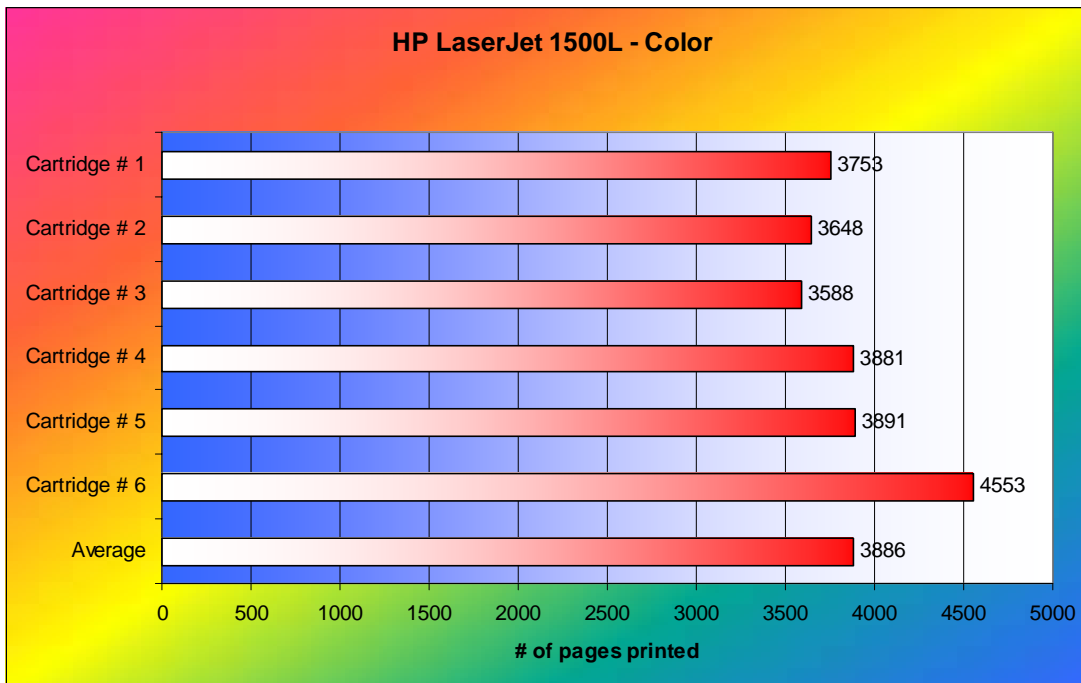
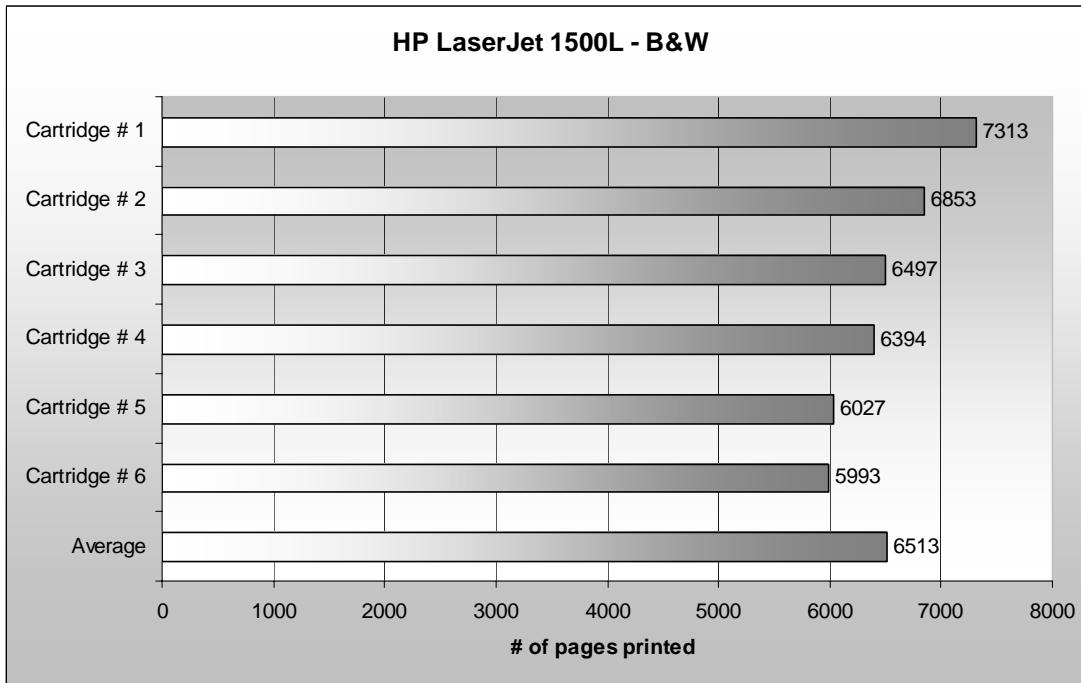
## Minolta MagicColor 2300W

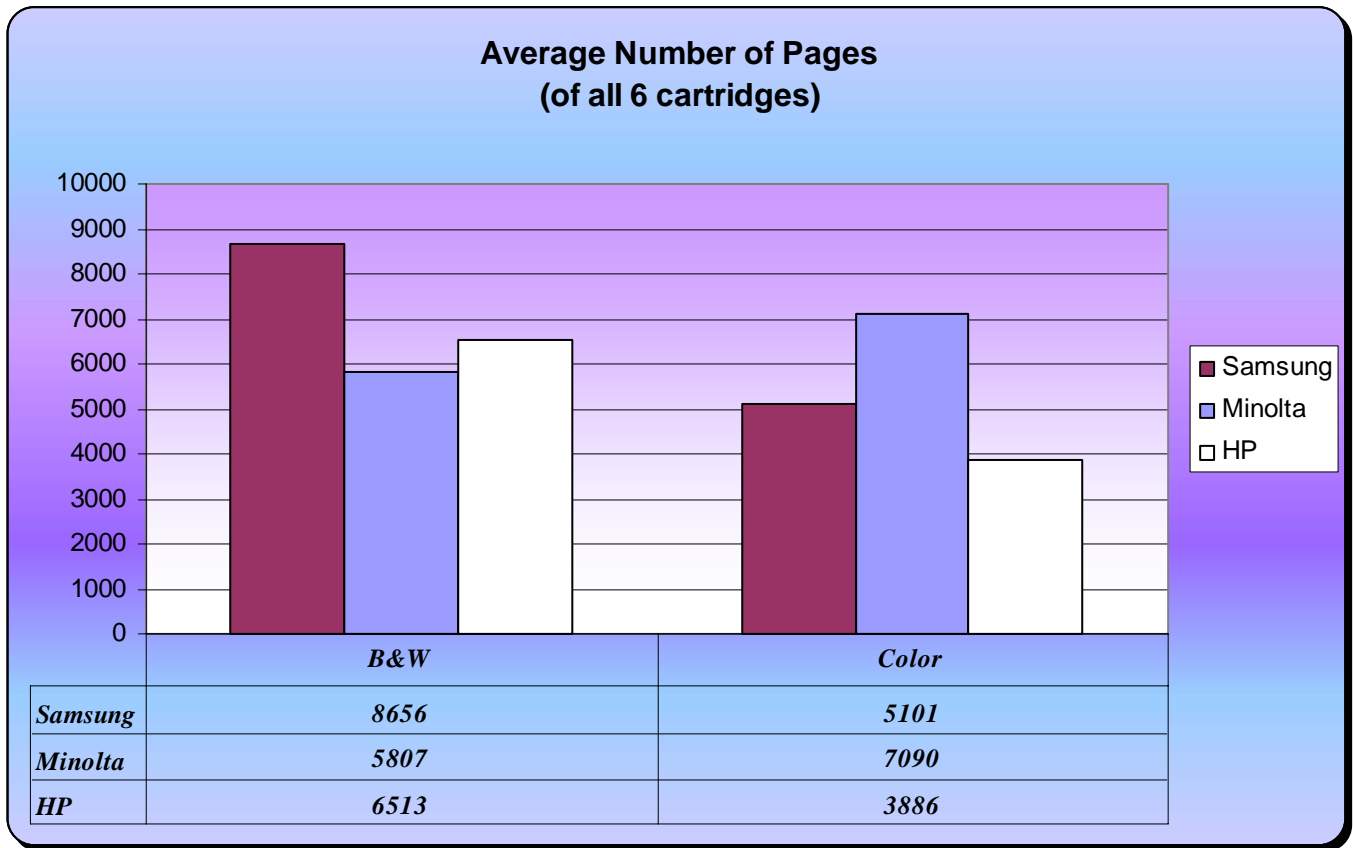
- Print speed, black (pages per minute)
    - up to 16 ppm
  - Print speed, color (pages per minute)
    - up to 4 ppm
  - Maximum Duty Cycle:
    - Up to 35,000 prints/month (25/75 mix of color and monochrome)
  - Memory, std.
    - 32 MB SDRAM on board
  - Toner Black - High Capacity
    - (approx. 4,500 prints at 5% coverage)
  - Toner Color - High Capacity
    - (approx. 4,500 prints at 5% coverage)
  - OPC Drum Cartridge
    - (approx. 45,000 mono / 11,250 color prints- continuous mode)
- HP LaserJet 1500L
    - Print speed, black (pages per minute)
      - Up to 16 ppm
    - Print speed, color (pages per minute)
      - Up to 4 ppm
    - Recommended monthly volume, maximum
      - 30,000 pages
    - Memory, std/max.
      - 16 MB
    - approximate page yield (letter)- drum
      - 20,000 mono / 5,000 color \*Based on 5% average coverage
    - approximate page yield (letter) - black
      - 5,000 \*Based on 5% average coverage
    - approximate page yield (letter) - color
      - 4,000 \*Based on 5% average

# Test Results









**Toner Cost per Page**

Samsung Black Toner				Samsung Color Toner			
Item	Cost	Qty	Total	Item	Cost	Qty	Total
Printer	\$600.14	1	\$600.14	Printer	\$600.14	1	\$600.14
Black toner	\$91.91	6	\$551.46	Color toner*	\$318.45	6	\$1,910.70
<b>Total pages printed</b>			<b>51933</b>	<b>Total pages printed</b>			<b>30608</b>
<b>Toner Cost Per Page</b>			<b>\$0.0106</b>	<b>Toner Cost Per Page</b>			<b>\$0.0624</b>

Minolta Black Toner				Minolta Color Toner			
Item	Cost	Qty	Total	Item	Cost	Qty	Total
Printer	\$663.53	1	\$663.53	Printer	\$663.53	1	\$663.53
Black toner	\$73.21	6	\$439.26	Color toner*	\$318.21	6	\$1,909.26
<b>Total pages printed</b>			<b>34841</b>	<b>Total pages printed</b>			<b>42542</b>
<b>Toner Cost Per Page</b>			<b>\$0.0126</b>	<b>Toner Cost Per Page</b>			<b>\$0.0449</b>

HP Black Toner				HP Color Toner			
Item	Cost	Qty	Total	Item	Cost	Qty	Total
Printer	\$670.10	1	\$670.10	Printer	\$670.10	1	\$670.10
Black toner	\$76.94	6	\$461.64	Color toner*	\$277.44	6	\$1,664.64
<b>Total pages printed</b>			<b>39077</b>	<b>Total pages printed</b>			<b>23314</b>
<b>Toner Cost Per Page</b>			<b>\$0.0118</b>	<b>Toner Cost Per Page</b>			<b>\$0.0714</b>

\*This price includes 1 cartridge of each color (Cyan, Magenta, Yellow).

**Drum Cost per Page \***

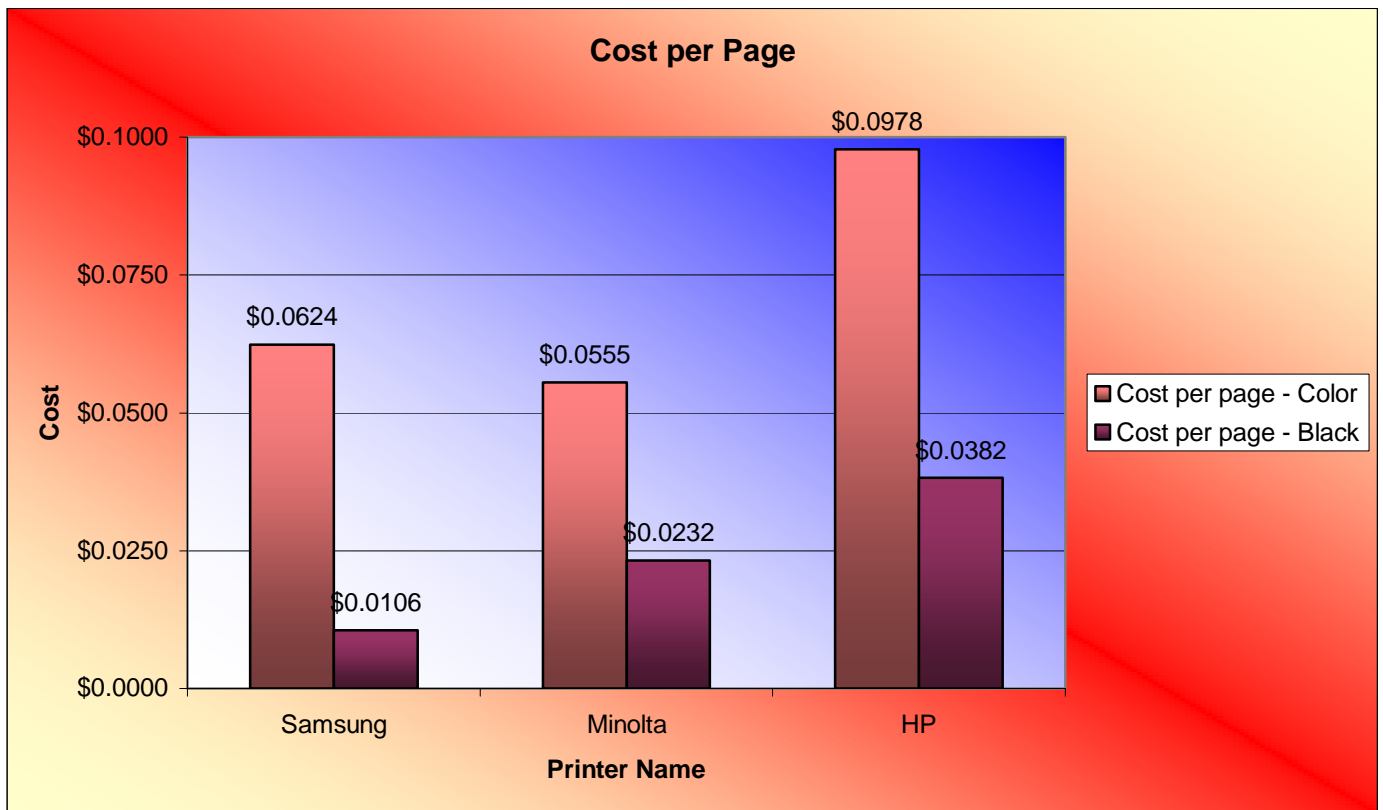
Avg. Pages / Drum	Printer 1	Printer 2	Pages/Drum	Cost/Drum	Drum Cost / Page
Minolta	13313.67	12482.67	12898.1667	\$137.06	<b>\$0.0106</b>
HP	6597.6	5881	6239.3	\$164.44	<b>\$0.0264</b>

\* Through this project the drums for the Samsung printer did not need to be replaced.

**Cost per Page**

Printer	Cost per Page Black
Samsung	\$0.0106
Minolta	\$0.0232
HP	\$0.0382

Printer	Cost per Page Color
Samsung	\$0.0624
Minolta	\$0.0555
HP	\$0.0978



**Conclusion:**

This class of printer is primarily used in situations where the ratio of color to monochrome output is small. The Samsung CLP – 500 outperformed both the Minolta MagicColor 2300W and the HP LaserJet 1500L on a cost per page basis in the printing of monochrome output. Although the Samsung CLP – 500, had a slightly higher cost per page than the Minolta 2300W when printing only in color, most users of these products will print a combination of monochrome and color pages. As such, Samsung's considerable savings on monochrome printing will make it an overall lower cost printing solution in these situations.

While NSTL was not specifically measuring output speed, it should be noted that the Samsung CLP – 500 completed its usage of all twelve cartridges in approximately half the time it took for both the Minolta MagicColor 2300W and the HP LaserJet 1500L. The difference in speed can be partially accounted for when reviewing the pages per minute of each printer, but it does not explain the total difference of time taken to complete the printing.

The primary purchase of the printers and supplies took place March 10<sup>th</sup>, 2004. Additional supplies took place throughout the testing phase April – May 2004. The cost of all supplies (drums) purchased at the various times remained constant throughout the testing phase.

## **APPENDIX A – Drum replacement**

### **Samsung #1 & #2**

Both printers displayed “replace imaging unit” and “replace transfer belt soon” approximately half way through the testing of each printer. We continued to print without replacing the drum or belt to the end of testing with no discernable loss of quality.

### **Minolta #1 & #2**

After the Minolta printers indicated that the drums were at 0% they continued to print acceptable quality for some time.

#### **Minolta #1**

The first drum showed 0% at page 2000 of cartridge #2, but continued to print to page 1199 of cartridge #3 and then was replaced. The second drum showed 0% at page 5900, cartridge #4, but continued to print to page 2316 of cartridge #5 and was then replaced.

#### **Minolta #2**

The first drum showed 0% at page 1900 of cartridge #2, but continued to print to page 5780 of cartridge #2 and was then replace. The second drum showed 0% at page 4500 of cartridge #3, but continued to print to page 5966 of cartridge #4 and was then replaced.

### **HP #1 & #2**

When the HP printers indicate the drums are at 0% the printer would not print anymore until the drum was replaced. Toner replacement was necessary once the printer indicated 0% toner level for an individual color, even though there is no loss of coverage/quality. Once this color was replaced the printer continued until each color in turn reached 0% and replaced in turn.

#### **HP #1**

The first drum was replaced at page 847 of cartridge #2. The second drum was replaced at page 2323 of cartridge #3. The third drum was replaced at page 2253 of cartridge #4. The fourth drum was replaced at page 3139 of cartridge #5.

#### **HP #2**

The first drum was replaced at page 986 of cartridge #2. The second drum was replaced at page 2146 of cartridge #2. The third drum was replaced at page 5843 of cartridge #4. The fourth drum was replaced at page 1635 of cartridge #6.

## About NSTL™

NSTL is the leading independent information technology testing organization for the computer industry, dedicated to providing high quality services and test tools to hardware developers, software publishers, government agencies and corporations. NSTL has extensive experience developing and conducting objective tests to assess new and existing products for compatibility, performance, comparative performance, usability, and functionality. Our testing services are also used for capacity planning, acquisition support and impact analysis.

NSTL's proficiency and thoroughness provide clients with a high quality, cost-effective means to assess, differentiate and evaluate IT products. Additional information about NSTL is available through the World Wide Web at <http://www.nstl.com/>.

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