

## Comparison Study

# HP LaserJet Print Cartridges vs. Non-HP Toner Cartridges

## Optical Density/Toner Adhesion

October 2010

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## Executive Summary

In October 2010, QualityLogic completed a study for Hewlett-Packard (HP) comparing the optical density and toner adhesion of HP LaserJet print cartridges for the HP LaserJet P1505 and P4015 printers, HP 36A and 64A, compared to a sample of non-HP toner cartridges sold as substitutes for them. All cartridges tested were sold in North America.

Printing was performed in a controlled environment using a test page jointly developed by HP and QualityLogic. The results of the study show that the HP print cartridges tested outperformed the non-HP toner cartridges tested in all areas of the study.

### Optical Density



The optical density metric for this study was a measurement of how light or dark a printed test patch was as determined by an Xrite 939 Spectrodensitometer. This metric highlights, on average, how much lighter or darker the non-HP test patches were compared to the average HP test patch measurements. Three test patches on each sample page printed in the study were measured for this metric, the light grey patch, the dark grey patch and the black patch. The resulting data showed that the optical density measurements for the non-HP toner cartridges tested were an average of 15.1% lighter for the light grey patch, 13.4% lighter for the dark grey patch, and 8.0% lighter for the black patch compared to the average of the HP print cartridges tested.

### Toner Adhesion



The toner adhesion metric for this study was a measurement of how well the toner adhered to the printed pages in the study. This was accomplished by determining how much lighter the black test patch became after performing a tape test. Adhesive tape was applied to and removed from the black test patch in a controlled manner, with optical density measurements taken before and after the tape test. The resulting data showed that the optical density measurements for the non-HP toner cartridges tested were an average of 11.0% lighter (4.3X the HP result) after the toner adhesion test, compared to an average of 2.5% lighter for the HP print cartridges tested.

(See Appendix 2 for additional information)

#### Remanufactured toner cartridges tested from the following non-HP brands:

- OfficeMax
- Staples Sustainable Earth
- Quill

#### Clone and/or remanufactured toner cartridges tested from the following non-HP brands:

- Dataproducts
- Elite Image
- Rhinotek
- Xerox

## Test Overview

### Optical Density

Optical density was determined by taking optical density measurements from three separate patches (light grey, dark grey and black) on each sample page in the study. Optical density measurements from each sample page were compared to the average HP measurements for the same patch to calculate the percentage of difference between the two patches. The percentage of difference for all sample pages printed by the non-HP toner cartridges tested were combined to create the three study results for the light grey, dark grey and black test patches.

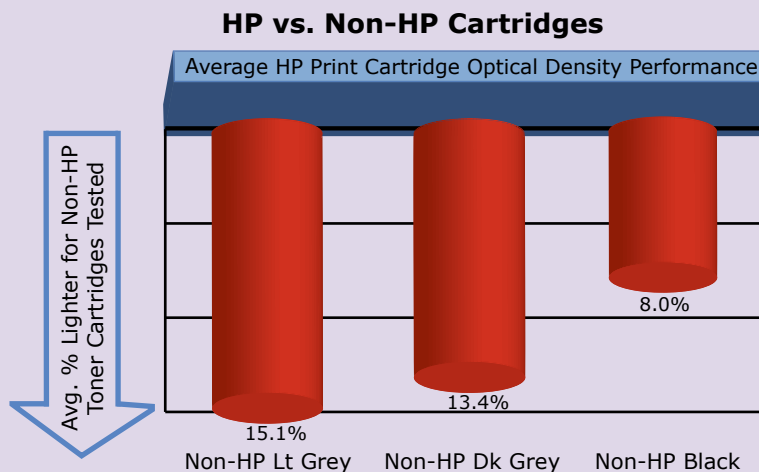
### Toner Adhesion

Toner adhesion was determined by performing optical density measurements, before and after the toner adhesion test, using the black test patch for each sample page in the study. The change in optical density before and after the test was calculated as the percentage of difference for each sample. The percentage of difference from each sample was then combined into an average result for HP and for the non-HP toner cartridges tested.

## Detailed Results

### Optical Density

The optical density measurements for the non-HP toner cartridges tested were an average of 15.1% lighter for the light grey patch, 13.4% lighter for the dark grey patch, and 8.0% lighter for the black patch compared to the average of the HP print cartridges tested.

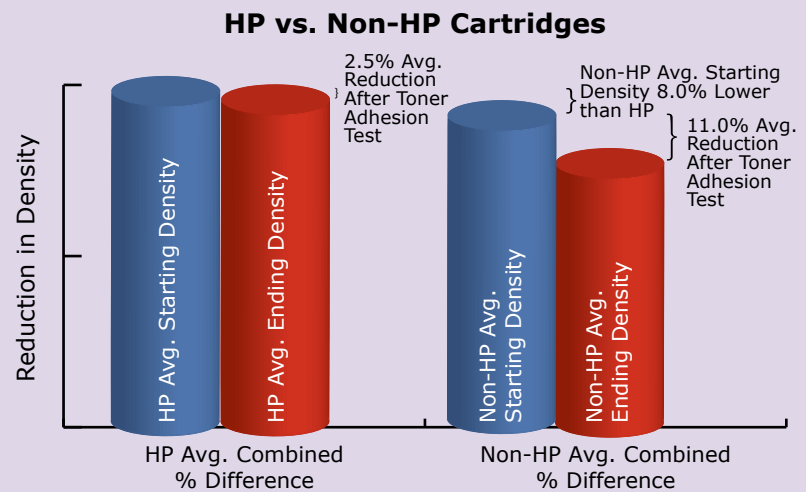


### Optical Density - Results by brand tested:

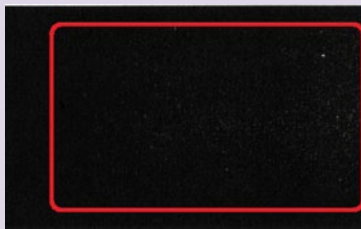
Brand	Light Grey Avg. % Lighter than HP	Dark Grey Avg. % Lighter than HP	Black Avg. % Lighter than HP
Brand A	12.1%	9.1%	9.9%
Brand B	12.0%	4.3%	6.8%
Brand C	5.6%	2.7%	2.5%
Brand D	11.6%	9.1%	3.9%
Brand E	-5.5%	-1.6%	1.1%
Brand F	31.6%	30.9%	11.4%
Brand G	32.9%	36.8%	17.6%

## Toner Adhesion

The optical density measurements for the non-HP toner cartridges tested were an average of 11.0% lighter (4.3X the HP result) after the toner adhesion test, compared to an average of 2.5% lighter for the HP print cartridges tested.



The following examples illustrate the average reduction in density for HP and the non-HP toner cartridges tested.



HP 2.5%  
average  
reduction



Non-HP  
11.0%  
average  
reduction

\*Note: Scanned images may not be accurately reproduced when printed from this report.

## Toner Adhesion - Results by brand tested:

Brand	Avg. % Difference After the Toner Adhesion Test	Ratio to HP Performance
HP	2.5%	N/A
Brand A	6.6%	2.6X the HP result
Brand B	6.4%	2.5X the HP result
Brand C	7.1%	2.8X the HP result
Brand D	19.5%	7.7X the HP result
Brand E	14.9%	5.9X the HP result
Brand F	8.1%	3.2X the HP result
Brand G	12.0%	4.7X the HP result

## Appendix 1: Test Methodology

The following is a summary of the methodology used for this study:

The printers and print cartridges selected for this study are shown at right.

Printer	Black Cartridge
HP LaserJet P1505 (CB412A)	HP 36A (CB436A)
HP LaserJet P4015 (CB509A)	HP 64A (CC364A)

QualityLogic procured all printers, paper and toner cartridges through standard retail channels, from Internet websites, or directly from the manufacturer in North America. A total of 24 cartridges were tested for each brand in the study.

Printing was performed in a continuous mode in a controlled environment using the test page shown at right.

Two new HP LaserJet P1505 and P4015 printers were used for the testing of each brand to assure uniformity and accuracy of the test data independent of a particular printer. Cartridges were obtained in small lots from multiple vendors when possible, and cartridge markings were examined to ensure lot variation.

Printer and driver settings were left at factory default, with the exception of ensuring that the paper type was set for Plain Paper. All printer/cartridge warnings were noted, and cartridges were printed to end of life.

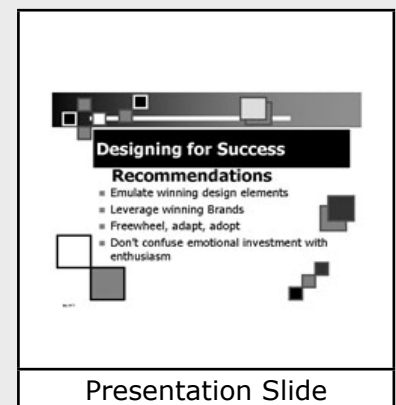
Normal office conditions of temperature (23C ±2C) and relative humidity (50% ±10% RH) were maintained for the duration of the test. All printers, cartridges and paper consumables were stabilized in these conditions for a minimum of 12 hours prior to use, tested in the same environment, and were subject to the same fluctuations.

All test pages were printed using standard 8 ½ x 11 office paper (20 lb, 96 brightness) from Hammermill (Fore MP-White).

Each test page was serialized and identified by printer to provide exact page counts.

Optical density was determined by taking an optical density measurement on three separate patches (light grey, dark grey and black) on each sample page in the study. Optical density measurements from each sample page were compared to the average HP measurements for the same patch to calculate the percentage of difference between the two patches. The percentage of difference for all sample pages printed by the non-HP toner cartridges tested were combined for each of the three patches to create the three study results.

Toner adhesion was determined by taking optical density measurements, before and after the toner adhesion test, using the black test patch for each sample page in the study. Adhesive tape was applied to and removed from the black patch on each sample page in a controlled manner. The change in optical density



before and after the test was calculated as the percentage of difference for each sample. The percentage of difference from each sample was then combined into an average overall result for HP and for the non-HP toner cartridges tested.

The test methodology for this comparison study was developed by Hewlett-Packard and implemented by QualityLogic.

## Appendix 2: Definitions

Test Terminology	Definition
Optical Density	Optical density measurements were taken with an Xrite 939 Spectrodensitometer. Optical density was calculated as the average percent difference for each sample page printed by a non-HP toner cartridge compared to the average HP performance for each of the three test patches (Lt Grey, Dk Grey, Black) for all sampled pages.
Toner Adhesion	A measurement which highlights how much lighter the black patch becomes after performing the toner adhesion test (tape test). The toner adhesion test consisted of taking optical density measurements on the black test patch for all sampled pages before and after the tape test. The tape test consisted of applying and removing 3M 600 adhesive tape to the black patch in a controlled manner. Toner adhesion is calculated as the average reduction in density (percentage of difference) for all sample pages combined into an average for HP and all non-HP toner cartridges tested.
Remanufactured Toner Cartridge	A <u>reused HP cartridge shell</u> that has been disassembled, one or more components replaced, and is filled with non-HP toner.
Clone Toner Cartridge	A <u>new non-HP cartridge shell</u> that has new components and is filled with non-HP toner. They can, however, contain components that have had prior use.