

HP LaserJet Cartridge Reliability Comparison Study – 2025

HP LaserJet Toner Cartridges vs. Asia-Pacific Remanufactured Brands

The *spencerLAB* DIGITAL COLOR LABORATORY conducted a cartridge reliability comparison testing of original HP Inc. (HP) LaserJet monochrome toner cartridges and two brands of remanufactured cartridges sold in the Asia-Pacific region. The test included CF276A (76A)/CF258A (58A) cartridge models for the HP LaserJet Pro M404dn printer. Ten cartridges of each brand were tested to ensure statistically meaningful results.

The analysis evaluated both Reliability and overall Print Quality across the lifespan of each brand of tested toner cartridge model. Reliability factors—such as Dead-on-Arrival (DOA), Low Quality (LQ), and Premature Failure (PF) cartridges [see definitions in Appendix 4]—were assessed to determine the total number of Problem Cartridges per brand. Print samples were collected at consistent intervals throughout each cartridge's life and evaluated using a Print Quality Acceptance scale developed through a psychometric research study. The four PQ acceptance levels were: External Use (suitable for all uses, including external distribution), Internal Use (within the organization), Individual Use, and Unusable.

KEY FINDINGS

- Testing of the Original HP toner cartridges revealed no Problem Cartridges, while all remanufactured cartridges showed some form of reliability issue, including DOA, Premature Failures, and Low Quality.
- None of the Original HP toner cartridges were classified as Low Quality, while 40% of the remanufactured cartridges fell into the Low Quality category.
- Original HP toner cartridges had no DOAs or Premature Failures, whereas 5% of the remanufactured cartridges were DOA and 55% experienced Premature Failures.
- HP cartridges produced a higher percentage of External Use Print Quality samples at 96%, whereas the tested remanufactured brands exhibited only 8% External Use Print Quality samples and 92% Limited Use pages.
- Remanufactured brands tested exhibited Print Quality Samples with defects, such as Dots, Ghosting, Fade, Banding, Smudge, Light Print, and Streaks.

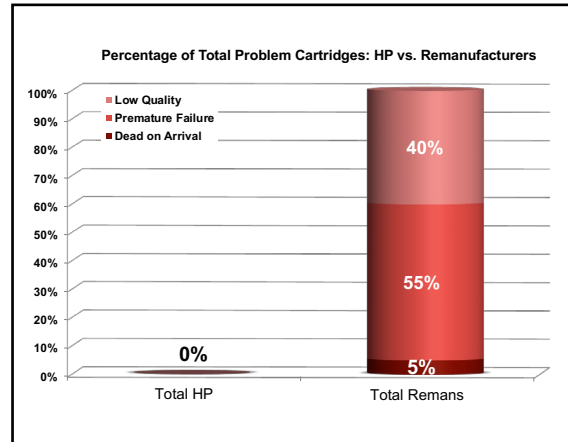
The *spencerLAB* DIGITAL COLOR LABORATORY, a division of Spencer & Associates Publishing, Ltd., is an independent test laboratory with a broad base of industry clients. Although this independent comparative study was commissioned by HP Inc., *spencerLAB* believes these results maintain its reputation for the integrity of its procedures and analyses. Results stated herein are based upon direct testing by *spencerLAB* of actual products believed to be representative.

TEST RESULTS

CARTRIDGE RELIABILITY: DEAD-ON-ARRIVAL, PREMATURE FAILURE, AND LOW QUALITY

HP cartridges demonstrated greater Reliability compared to the tested remanufactured brands; no HP units were classified as Problem Cartridges or identified as Low Quality (LQ).

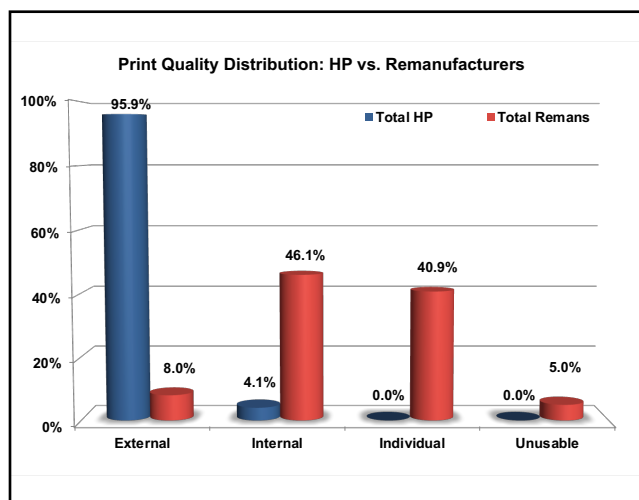
The remanufactured brand toner cartridges exhibited Reliability issues, including DOA, PF, and LQ, resulting in 100% of the 20 cartridges tested being classified as Problem Cartridges. Of these, 40% were LQ cartridges—defined as those with 50% or more of their pages categorized as Limited Use, but not classified as DOA or PF. PF cartridges—those with page yields less than 80% of the average for all HP toner cartridges of the same model, excluding DOA units—made up 55% of the tested cartridges. Additionally, 5% of the remanufactured cartridges were classified as DOA.



For the average user, problem cartridges can be highly disruptive, leading to unreliable performance, poor-quality output that is unsuitable for distribution, the need to reprint materials, or even repurchase the toner cartridge. These issues increase time and labor demands, waste supplies, and ultimately raise the overall cost of printing.

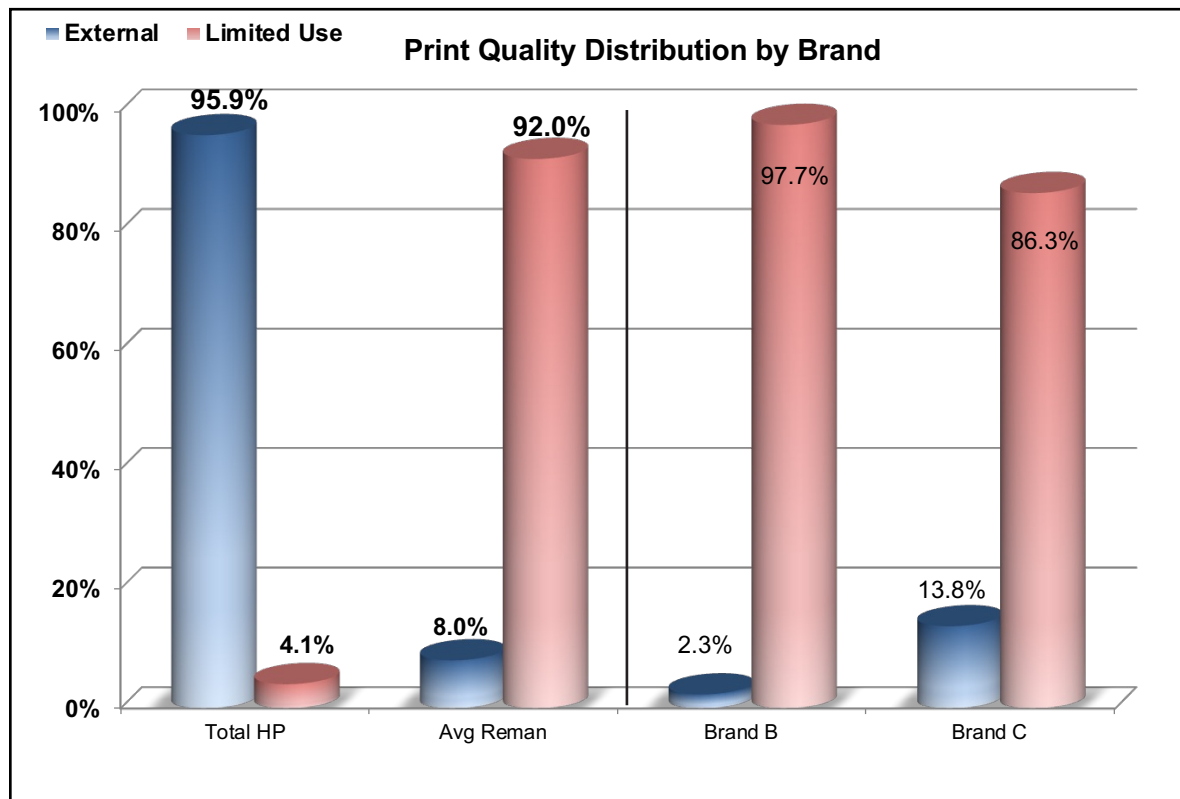
PRINT QUALITY DISTRIBUTION

HP cartridges produced significantly higher page yields and superior Print Quality (PQ) compared to the tested remanufactured cartridges. Of the pages printed using



HP cartridges, 95.9% were rated suitable for External Use, while only 8.0% of pages from remanufactured cartridges met that standard. Just 4.1% of HP pages were rated for Internal Use, and none classified as Unusable or Individual Use. In contrast, 92% of pages from remanufactured cartridges fell into Limited Use categories—Internal, Individual, or Unusable—exhibiting defects such as

dots (28%), ghosting (22%), fade (14%), banding (12%), smudging (10%), light print (5%), and streaking (1%).



THE *spencerLAB* DIGITAL COLOR LABORATORY

With over thirty-five years of industry service, SPENCER & ASSOCIATES PUBLISHING, LTD. has earned a premier reputation for its expertise in evaluating digital color imaging and printing. Its independent test division, the *spencerLAB* DIGITAL COLOR LABORATORY, is internationally recognized as a leader in unbiased, third-party research and comparative analysis of digital imaging and printing system performance; the laboratory strictly adheres to the integrity of its methodology, even in commissioned studies. *SpencerLAB* provides leadership in quantitative and qualitative comparisons, benchmarking key performance metrics of digital printing systems in all technology classes, from desktop printers to digital color presses – providing research and evaluation services, compliance certifications, benchmark test software/hardware, and focus group management.

Leading vendors and firms for whom printing is mission-critical rely upon *spencerLAB* to provide strategic support and benchmarking of Print Quality, Ink/Toner Yield and Cost-per-Print, Throughput, Availability, Reliability and Usability for ink- and toner-based as well as other printing technologies. Corporate clients turn to *spencerLAB* for expert guidance in print system acquisition and optimizing print operations.

For more information, please visit www.spencerlab.com.

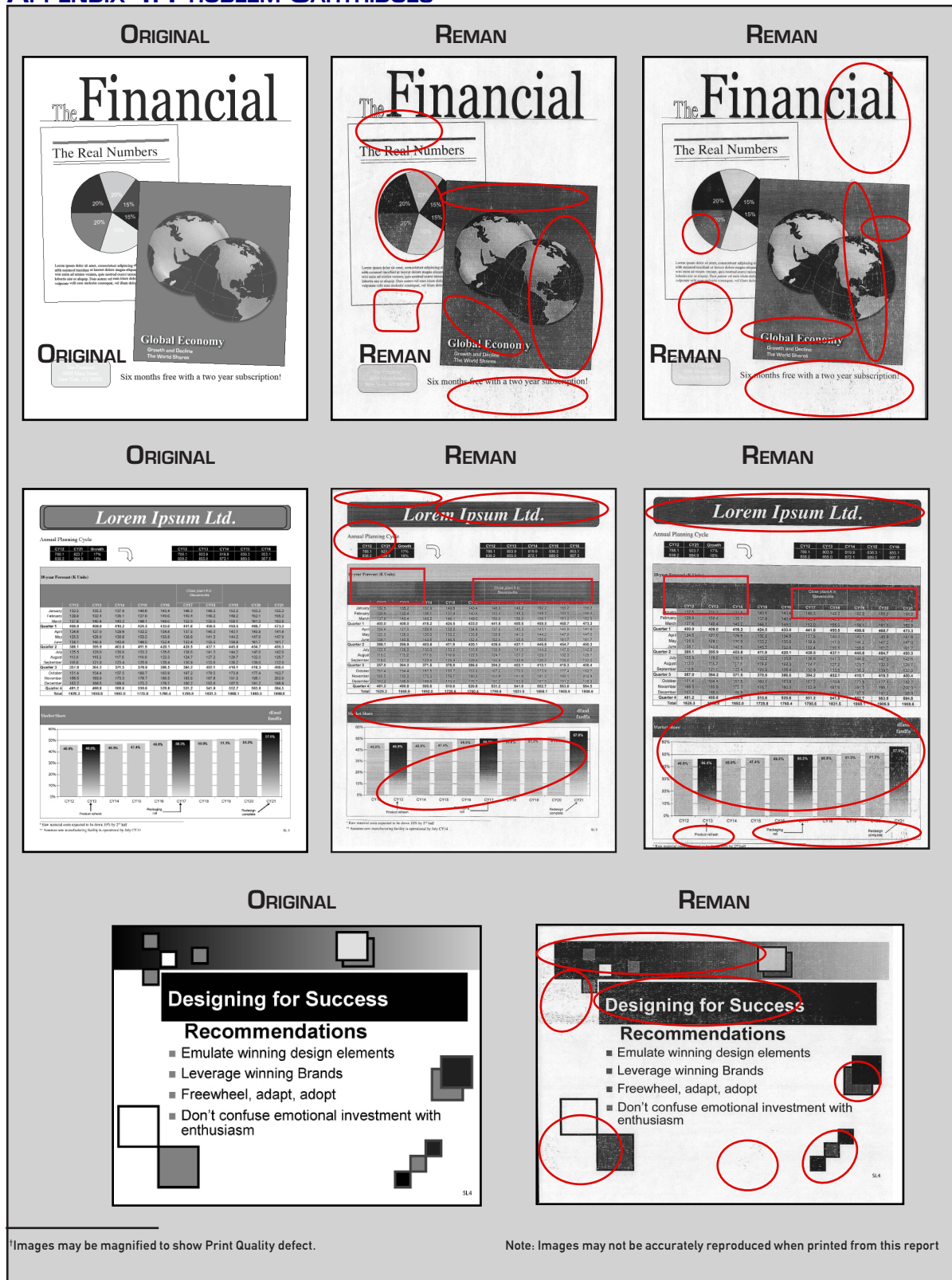
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APPENDIX 1: PROBLEM CARTRIDGES



*Images may be magnified to show Print Quality defect.

Note: Images may not be accurately reproduced when printed from this report

APPENDIX 2: METHODOLOGY

TEST PARAMETERS

The test focused on the 76A/58A cartridge model used in the HP LaserJet Pro M404n printer. Remanufactured brands were selected by HP and sourced from the Asia-Pacific region by *spencerLAB* for testing. Ten cartridges of each of the remanufactured brands and HP branded cartridges were tested to get significant overall results.

A four-page PDF test suite was printed from a Windows 11 system using Acrobat Reader version 2024.005.20421. Files were printed in default plain paper mode with the latest printer drivers downloaded from HP's website, using Hammermill Fore Multi-Purpose 20 lb., 96 brightness office paper. All test printing was conducted by *spencerLAB*.

All test materials—including printers, toner cartridges, and paper—were acclimated to typical office temperature and humidity conditions for a minimum of 12 hours. Printing was carried out in a semi-continuous process, with pauses for tasks such as paper refills and overnight breaks, and continued until each toner cartridge reached End-of-Life (EOL). EOL is defined as the point at which the Print Quality of any single page from the four-page suite degraded to the Unusable category, based on a grading scale established by a psychometric study [see Appendix 3]. Two shake procedures were performed prior to a cartridge being deemed EOL.

CARTRIDGE RELIABILITY TESTING

Prior to printing, all cartridges were carefully unpacked and inspected for any toner leakage and/or damaged components.

PRINT QUALITY ASSESSMENT

Overall Print Quality was assessed using sixty-four print samples per toner cartridge, consisting of sixteen four-page suites collected at evenly spaced intervals throughout each cartridge's lifespan.

Using the psychometric Print Quality acceptance scale, *spencerLAB* evaluators assessed and rated each print sample, assigning it to one of four categories: External Use, Internal Use, Individual Use, or Unusable. The final Print Quality level for each sample was based on the average of the evaluators' scores, with any observed defects also documented.

APPENDIX 3: PSYCHOMETRIC STUDY – PRINT QUALITY SCALE

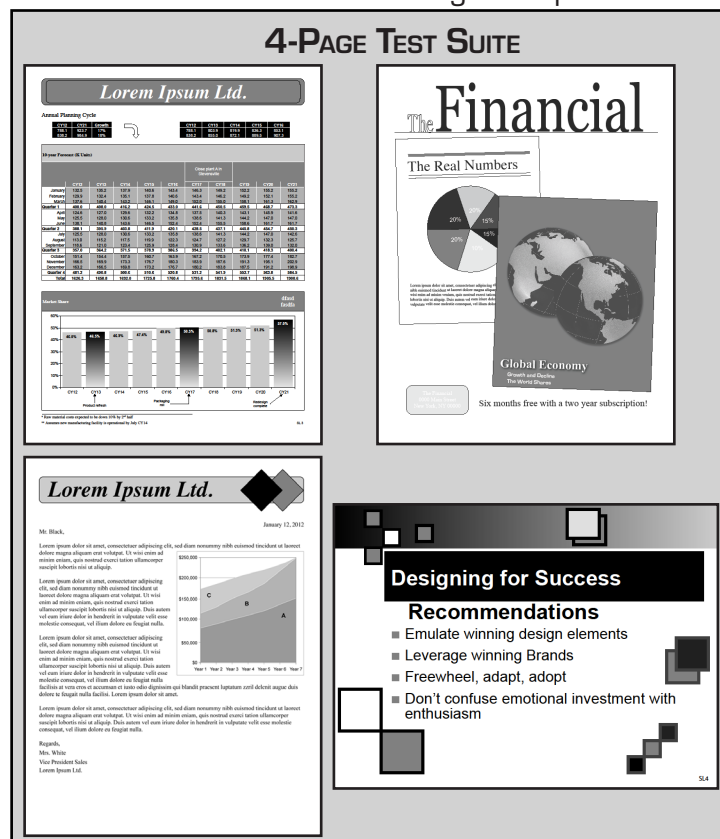
A psychometric study of monochrome office printing users was conducted by *spencerLAB* in the greater New York City area (Hicksville, New York) in March of 2012, to establish a Print Quality acceptance scale. Participants who printed monochrome documents for personal, internal, and external use, were recruited from a range of professions and business sizes, from micro business (1-49 employees) to enterprise business (>500 employees). A total of thirty-eight business printing users participated in the exercise.

TEST SUITE

SpencerLAB collaborated with HP to design a representative business-user test suite. *SpencerLAB* then utilized the test suite pages to simulate common Print Quality defects such as banding, streaks, dark and light density, ghosting, etc. A total of fifteen test sets were created and each test set had a range of up to twelve variations (based on severity of defect) for a single defect type.

Test sets were printed on a HP LaserJet P3015 using Windows 7 and Acrobat Reader 10.1.2. Test samples were printed in default mode for plain paper, using the latest print driver available from HP's web site at the time of printing on Hammermill Fore MP 20lb., 96 Brightness, plain office paper. All printing

was performed by *spencerLAB* and test sets were reviewed to ensure that the test samples were rendered as intended.



BUSINESS USER FOCUS GROUPS

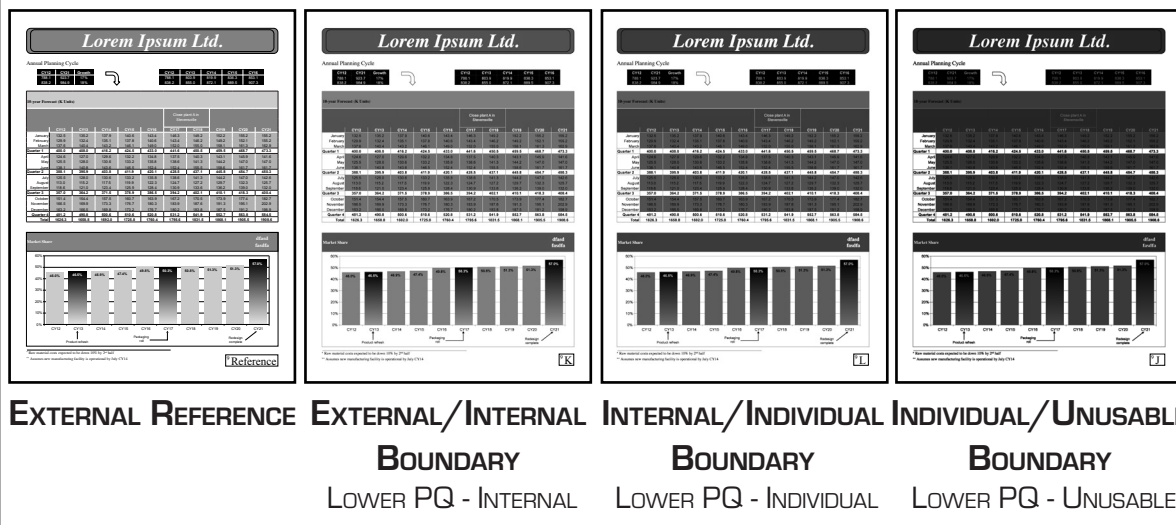
The focus group participants judged fifteen sets of print samples and sorted the samples into four Print Quality levels based on their acceptance level of Print Quality. The test samples were rated in a neutral environment, with no external lights, and uniform lighting.

Participants sorted all the test samples into four Print Quality acceptance levels:

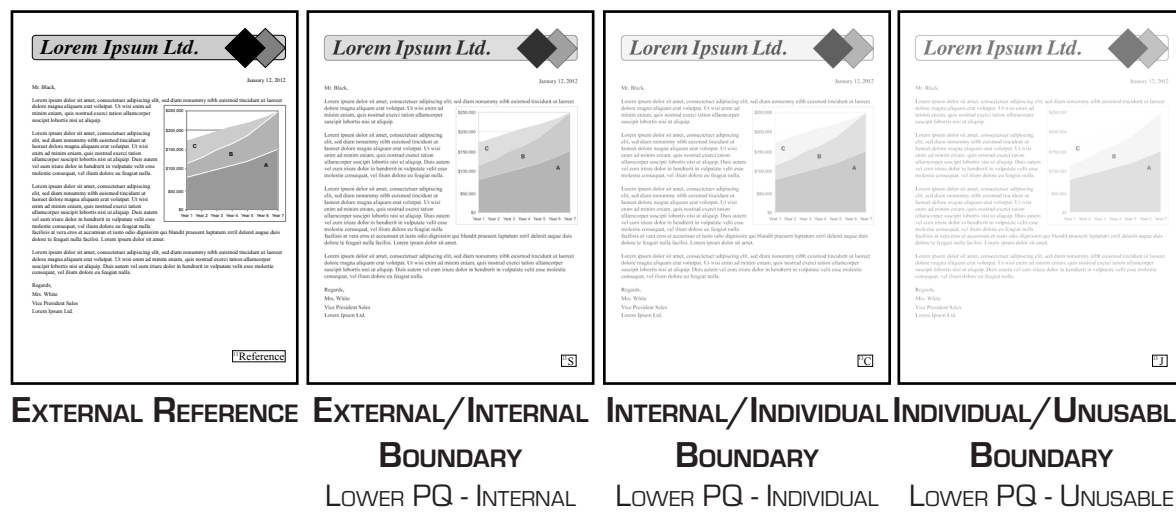
- External Use – acceptable for all purposes, including distribution outside the organization to clients, vendors, and other external parties
- Internal Use – acceptable for internal company distribution, but not acceptable for sharing outside a company
- Individual Use – usable as a copy to read, file, or mark-up in the office, but not acceptable for distribution either internally or externally
- Unusable – not acceptable for any business purpose

SpencerLAB applied proprietary sorting and analysis algorithms to compute the average Print Quality rating for each sample within each test set. These scores were then used to establish the rank order of the samples in each test set.

DARK DENSITY TEST SET SAMPLE



LIGHT DENSITY TEST SET SAMPLE



Examples above are the boundary samples from two of the fifteen test sets.

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APPENDIX 4: TEST TERMS AND DEFINITIONS

Terms		Definitions
End-of-Life, (EOL)		A condition determined by one of three mechanisms: 1. Cartridge is Dead on Arrival. 2. Cartridge stops printing and efforts to recover are unsuccessful. 3. Degradation of Print Quality to unacceptable (Unusable) for any one of the Test Suite pages. Any printer documentation recommendations are performed no more than two times to recover PQ. After the second recovery, if PQ does not recover or degrades to Unusable, EOL is reached and marked before pages of unacceptable quality.
Dead-on-Arrival, (DOA)		A condition determined by one of four mechanisms: 1. A cartridge that has at least 50% of the handling surface covered in leaked toner, before or during the installation process and/or toner visibly spilled in the plastic bag containing the cartridge and/or on the exterior of the cartridge. 2. A cartridge that within the first ten pages has at least one page categorized as Unusable and does not improve during the recovery process. <ul style="list-style-type: none"> Recovery process requires following the printer manual instructions for correction of the noted defect, or if the defect is not addressed in the manual, the first attempt to recover shall be to remove the cartridge and perform a shake procedure. Following this recovery process, ten more pages shall be printed and evaluated. If at least one page is categorized as Unusable, a second recovery attempt of printing a cleaning page, if available, shall be performed. Following the second recovery procedure, ten more pages shall be printed and pages evaluated for categorization. If at least one page is categorized as Unusable following this recovery process, the cartridge is DOA. 3. Cartridge is broken or missing parts. 4. Cartridge fails to operate upon installation and does not recover upon removing the cartridge and re-installation.
Premature Failure, (PF)		A cartridge with a page count of less than 80% of the average page count for all HP toner cartridges of that model that were not DOA, unless non-HP cartridge stated yield differs from HP stated yield.
Low Quality, (LQ)		A cartridge with 50% or more pages categorized as Limited Use, but was not DOA or PF.
Problem Cartridges		Cartridges categorized as either DOA, PF, or LQ.
Limited Use		Sample pages with PQ categorized as either Internal Use, Individual Use, or Unusable.
Print Quality Levels	External Use	Acceptable for all purposes, including distribution outside the organization to clients, vendors, and other external parties. Examples: marketing materials to promote the company or products, official company correspondence, invoices.
	Internal Use	Acceptable for internal company distribution, but not acceptable for distribution outside the organization. Examples: documents to distribute to colleagues, immediate superiors or subordinates as business communication.
	Individual Use	Usable as a copy to read, file, or mark-up in the office, but not acceptable for distribution, either within or outside a company.
	Unusable	Not acceptable for any business purpose.
Usable Pages		Pages that were acceptable for any use, and not deemed Unusable.
Remanufactured Toner Cartridge		A reused HP cartridge shell that has been disassembled and had one or more components replaced. The cartridge is then refilled with non-OHP toner and reassembled.

*spencer***LAB**
RELIABILITY TESTED