BLI Custom Test Report

November 2019

Ink Consumption Efficiency Evaluation: Epson's Individual Ink Cartridges Versus Competitors' Tri-Colour Ink Cartridges

Buyers Laboratory LLC (BLI) was commissioned by Seiko Epson Corporation to conduct confidential testing of Epson 502/502XL, 29/29XL and 603/603XL single-colour standard and high-yield ink cartridges to evaluate the efficiency of their total ink consumption performance compared with that of the tri-colour ink cartridges for competitive HP and Canon models. The tests were conducted with two different printing workflows—photo printing and text- and graphics-based document printing. Printing was performed in a continuous mode in a controlled environment, using print conditions in line with ISO 24734 test methodology but with a custom document suite. Cartridges were run to end of life.

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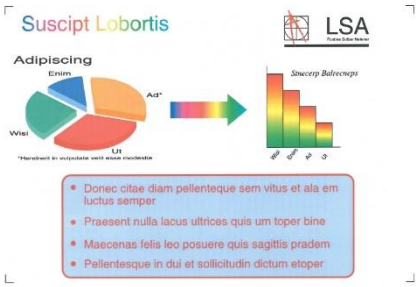
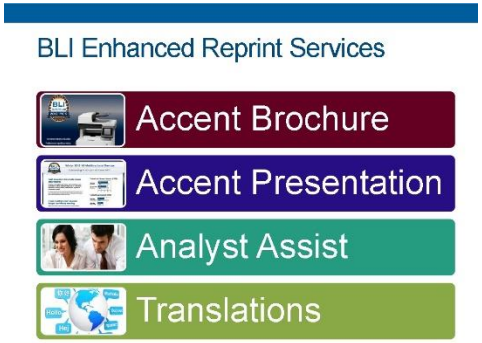
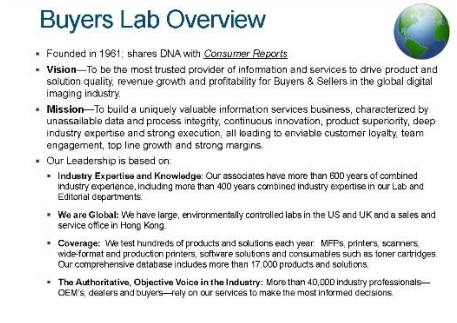
Workflow Test Materials

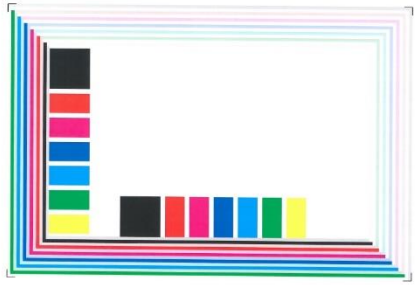
A generic text and graphics-based document intended to be typical of documents printed in small or home office environments was used in the document workflow test run. This type of printing which covers all home and office requirements can typically show a bias towards corporate brand colours. The text and graphics-based documents were printed on UPM New Future Laser 80gsm A4 media, with print conditions in line with ISO 24734 test procedures.

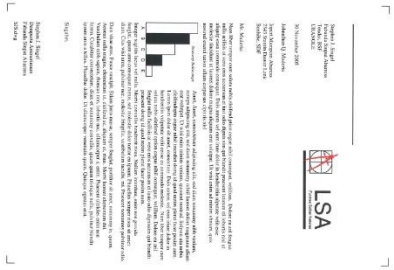
Sample pages from the Document workflow test file

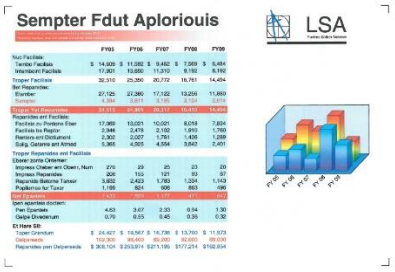




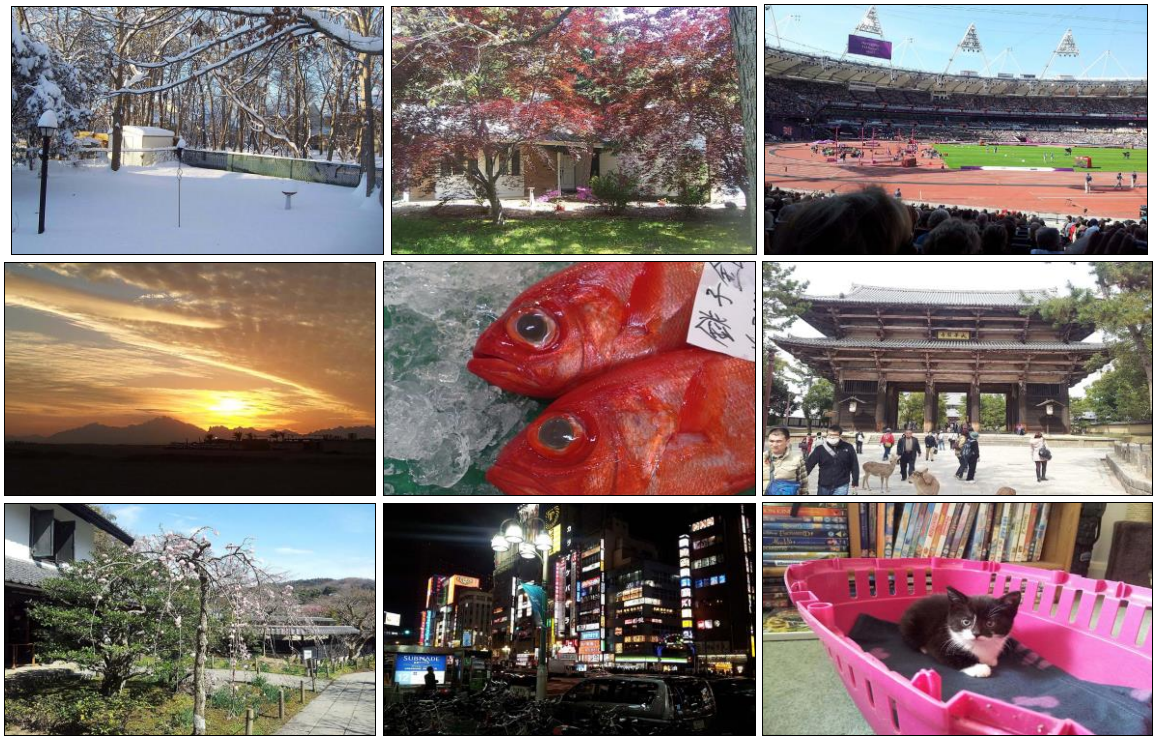








In the photo printing workflow test, Buyers Lab's technicians printed a set of 19 photos that show a broad range of settings and themes as would be found in an average customer's photo album. Print quality mode was set to Borderless Photo mode, and Staples A4 180 gsm glossy photo paper was used for all tested devices.



Sample pages from the Photo workflow test file

Test Devices

Table 1: Device models and tested ink cartridges

Device	Cartridge Type (Standard/High Yield)
Epson WorkForce WF-2830	603/603 XL
Epson Expression Home XP-3100	603/603XL
Epson Expression Home XP-5100	502/502XL
Epson Expression Home XP-255	29/29XL
Epson Expression Home XP-452	29/29XL
HP OfficeJet 5255	63/63XL
HP ENVY 5030	304/304XL
HP ENVY 6230	303/303XL
HP DeskJet 3630	302/302XL
Canon PIXMA TR4550	545 and 546/545XL and 546XL
Canon PIXMA TS3150	545 and 546/545XL and 546XL
Canon PIXMA TS5150	540 and 541/540XL and 541XL
Canon PIXMA MG3650	540 and 541/540XL and 541XL
Canon PIXMA MG4250	540 and 541/540XL and 541XL

Test Methodology

BLI ran two workflows using standard and high-yield single-colour standard cartridges from Epson and standard and high-yield tri-colour cartridges from HP and Canon. With the test printers set in their default mode and having the latest firmware, BLI operated the printers in continuous simplex print mode for up to eight hours per day. Prior to testing each ink cartridge, the devices were charged with starter cartridges, but it must be noted that the starter cartridges were not used for yield analysis.

After charging, new ink cartridges were tested to exhaustion to evaluate cartridge ink consumption efficiency. Both test suites were used (photo printing and text and graphics-based document printing) with at least two cartridges being fully exhausted per device per colour per test suite, except for black cartridges, where only one cartridge was exhausted.

Each cartridge was weighed prior to testing ("Full" weight) and again upon exhaustion ("Used" weight). Cartridge exhaustion was based on when an "ink out"/ "empty" notification was displayed by the printer. Average weights based on test results were recorded for full and used weights, and used in the calculations listed in the report. A cleaning routine was carried out in accordance with manufacturer instructions when streaking or other quality defects were exhibited during the test.

One exhausted cartridge of each product type and of each colour was then disassembled and flushed of all unused ink and allowed to dry thoroughly before being weighed to establish "Empty" weight.

The wasted ink ratio of one cartridge was calculated using the following formula. The wasted ink ratio of the colour cartridges is the average wasted ink ratio of cyan, magenta and yellow).

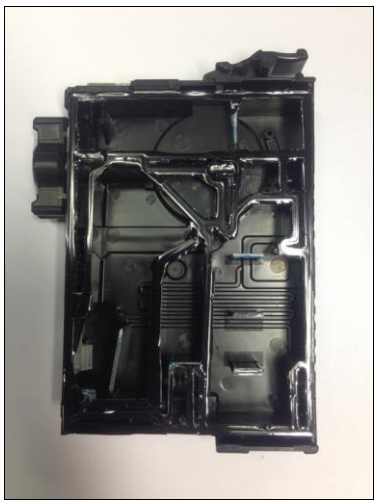
Wasted Ink Ratio =

$$\frac{\text{Weight of Used Ink Cartridge} - \text{Weight of Empty (flushed) Ink Cartridge}}{\text{Weight of New (full) Ink Cartridge} - \text{Weight of Empty (flushed) Ink Cartridge}}$$

The overall percentage of ink consumption efficiency was established by using the formula:

Ink Consumption Efficiency (%) = (1 – Wasted Ink Ratio) x 100

Pre-flushed and Flushed Ink Cartridges

Epson cyan cartridge pre-flushed and flushed.


Epson magenta cartridge pre-flushed and flushed.


Epson yellow cartridge pre-flushed and flushed.

Top: Canon 540 standard black cartridge pre-flushed and flushed.
Bottom: Canon 541XL (high yield) colour cartridge pre-flushed and flushed.

HP 302XL (standard yield) colour cartridge pre-flushed and flushed.

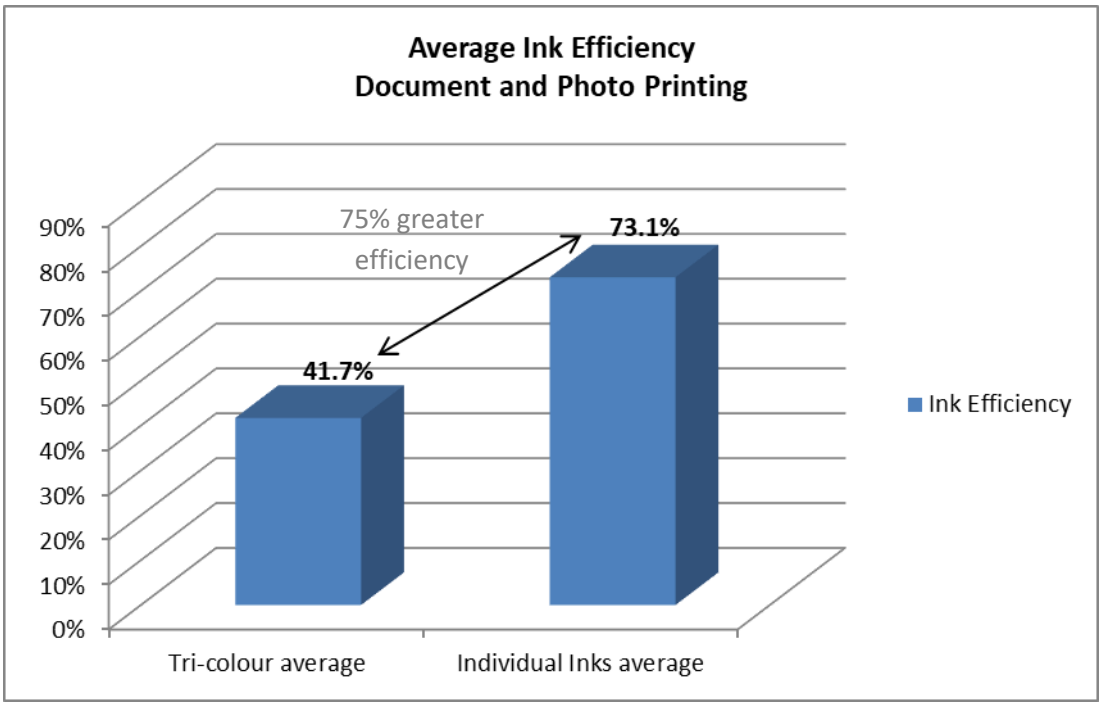
Ink Efficiency Performance – Epson Summary of BLI Test Results

In order to give a fair representation of an end user's typical print output, Epson weighted the BLI test results in accordance with the findings from the 2EUROPE 'Printing Usage & Attitudes' study - November 2019 (Appendix A).

The 2EUROPE survey demonstrates end users' propensity to print either Documents or Photos. Inkjet printer owners are more likely to print Documents (96%) compared to Photos (4%).

Taking a weighted average of document and photo printing, as described above, and an average of the results for standard and high yield cartridges for each class of printer, the BLI test results show that Epson's individual colour ink cartridges are 75% more efficient compared to rival tri-colour cartridges. For marketing purposes, Epson will communicate a 50% greater efficiency compared to rival tri-colour cartridges.

Figure 1. Average Ink Efficiency – Document and Photo Printing



Excerpt from BLI test results – Overall Performance

"For the devices in this test Epson offers individual colour ink cartridges, which means ink can be replaced as and when required. Conversely, the Canon and HP cartridges incorporate cyan, magenta, and yellow ink in a single cartridge—with the tri-colour variety, once any of the colours runs out the cartridge must be disposed of, resulting in wasted, unused ink for the other two colours. During the text and graphics document print test, high levels of ink waste were being incurred with the Canon and HP cartridges due to the disparity in the rates at which certain colours of ink were being used. Cyan depleted faster than magenta and yellow, and "empty" cartridges still contained a considerable amount of these two colours."

Test Environment/Conditions

Testing was conducted in Buyers Lab's UK test facility located at Unit 11, The Business Centre, Molly Millars Lane, Wokingham, RG41 2QZ. Testing was conducted under ambient conditions of 22.0°C (+/- 2.7°C) and 45% relative humidity (+/- 10%); monitored daily by an Extech RH 520 Humidity and Temperature Digital Recorder.

Printers, paper, and cartridges were acclimatized to the above conditions for a minimum of eight hours prior to testing. Prior to acclimatization, packaging and shipping materials were opened in a manner that prevented damage from occurring to the cartridges during conditioning. Paper was acclimatized in ream wrappers. Printers, printer components, paper, and cartridges were handled in a manner that prevented exposure to condensation.

Buyers Lab's dedicated test network in Europe consists of Windows 2008 servers, Windows 10 workstations, 10/100/1000BaseTX network switches, and CAT5e/6 cabling.

About Keypoint Intelligence - Buyers Lab

Keypoint Intelligence is a one-stop shop for the digital imaging industry. With our unparalleled services and unmatched depth of knowledge, we cut through the noise of data to offer clients the independent insights and responsive tools they need.

For over 50 years, Buyers Lab has been the global document imaging industry's resource for unbiased and reliable research, test data, and competitive information services. In addition to publishing the industry's most comprehensive and accurate test reports, each representing months of hands-on testing in our U.S. and UK laboratories, we have been the leading organization for extensive specifications/pricing databases on MFPs, printers, scanners, and software. Buyers Lab also provides consulting services and a range of private testing services that include document imaging device beta and pre-launch testing, performance certification testing, consumables testing (toner, ink, fusers, and photoconductors), solutions evaluations, and media runnability testing.

For more information, please call David Sweetnam at +44 (0) 118 977 2000 or email him at david.sweetnam@keypointintelligence.com.

Appendix A. Excerpt from 2EUROPE 'Usage & Attitudes' study - November 2013

Printing Usage and Attitudes

November 2019

[2EUROPE] www.2-europe.com +44 (0)1442 831711

Approach & Methodology

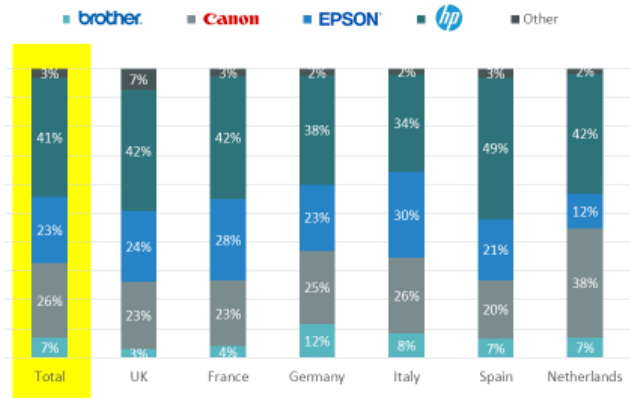
- 2Europe were commissioned by Epson to conduct research in to printing usage and attitudes towards printing.
- The research consisted of 1,800 interviews across 6 markets, via online survey.
- The survey lasted ~15 minutes and consisted of closed-style questions and the occasional open end.
- Participants were recruited on the basis of being users of ink jet or ink tank printers and printing regularly.
- A range of ages and a mix of gender were recruited to provide a mix of profiles.

Market	# of interviews
United Kingdom	300
Spain	300
Germany	300
France	300
Italy	300
Netherlands	300
Total	**1,800**

[2EUROPE] EPSON

Printer Ownership

Brands of Printer owned – Split by market



- HP, Epson and Canon were the most owned brands among those surveyed.
- HP was most used in all markets (total usage 41%), followed by Canon and Epson which had varying usage levels by market.
- 'Other' consisted of small responses for Dell, Lexmark and Kodak.

Base: All respondents (1,800); Markets (300 each)

[2EUROPE]

Printer Use

Type of printing conducted – Split by printer type

- By the type of printer owned, there was a small difference in what they used their printers for.
- Whilst the majority of respondents mainly print documents, ink tank users print more photos than inkjet users.
- By market or brand there was no significant difference to the 'Total'.

Base: All respondents (1,800); Those mainly using inkjet (1,715), Those mainly using ink tank (85)

[2EUROPE]

END

November 2019

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