Ink and Image Durability Testing

December 2010 *Final*

Conducted for:

Brother International Europe

by:
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Introduction

As part of its campaign to promote the use of original Brother inkjet supplies, Brother International Europe (BIE) had a requirement for testing of its own LC1100 ink set and photo media against popular brands of third party compatible inks and media to show that its inkjet ecosystem performs better than unbalanced third party ink/media combinations. Testing was also required for comparison of Brother's own plain paper inkjet media against a typical generic office plain paper.

Target inks

A total of 14 popular third party inks were selected and sourced from around Europe for comparison with Brother's original LC1100 ink set – Note: some inks area available in more than one country (availabilities shown are not necessarily inclusive):

• ActiveJet	Poland
• Aqprox!	Spain
• Armor	France/Germany
• Brother	Pan-European
• Cartridge World	UK
• Conzumo	Spain
• Data Becker PrintMaxx	Germany
• EcoStore	Italy/Spain
• Geha	Germany
• Inkrite	UK
• MBP PrintPack	France
• Pelikan	Germany
• Prink	Italy/Spain/UK
• Printerinks	UK
• Stinky ink	UK

Target media

Three popular pan-European third party glossy photo papers were sourced within the UK for comparison with Brother's BP71 media:

Glossy photo media:

- Brother BP71
- Ilford 1146567
- Inkrite PPIPG2606450
- Verbatim #45012

In addition, one popular A4 plain office paper was sourced for comparison with Brother's BP60 plain paper inkjet media:

Plain paper office media:

- Brother BP60
- Xerox Performer

Tests undertaken

- Optical Density
- Print Quality – General Appearance, Colour Fidelity and Ink Bleed
- Light Fastness – photo under indoor display conditions behind glass
- Light Fastness – photo under indoor display conditions without glass
- Light Fastness – office document under indoor conditions without glass
- UV Light Fastness – photo without glass
- Water Fastness
- Image Transfer

Test results

This report should be read in conjunction with the accompanying MS Excel workbook, with reference also to product photographs, print samples and PDF files of image deterioration due to exposure to white light and UV light and water.

General Assessment

While no ink or ink/media combination is perfect, the variance in performance of third party inks and media against OEM original inks and branded media is extraordinary.

There is no doubt that Brother LC1100 series inkjet multifunction owners will benefit significantly from maintaining a rigid regime of using only Brother original innobella inks.

On overall performance, taking into account all aspects of testing, there is no third party ink that can even begin to compete with the OEM inks. Brother BP71 glossy photo media also outperforms third party glossy papers and the two together is an unbeatable combination. Particularly where users with long-term, rigorous and particularly photographic printing aspirations are concerned, there is no contest – OEM is best.

As a balance to this statement, prospective buyers should consider their printing profile and determine which tests may be relevant to them. Because initial print quality of office documents varies little between inks, where prints are required purely as short-life transitional materials, then from the purely supplies expenditure angle it could, potentially, work out cheaper to buy certain third party supplies.

However, part of the reason for using only original OEM materials is the overall 'user experience' and this includes experience with the cartridges themselves, before, during and after use within the printing device.

For instance:

- Will the multifunction device accept the cartridge in the first place?
  Two brands of third party cartridge tested here were reluctant to be recognised by the device.
- Will the cartridge feed ink into the device efficiently?
  Cartridges from several third party brands 'dried up' when still nearly full, requiring multiple cleaning cycles to re-prime the system (thus wasting considerable quantities of ink).

- Will the cartridge alert the multifunction device when it is empty?
  Problems were experienced with cartridges drying up without alerting the device, thus requiring multiple cleaning cycles to re-prime the system (thus wasting considerable quantities of ink).
- Will the cartridges deliver all of the available ink they contain?
  All ink systems based on a permanent print head and separate ink tanks (rather than cartridges with integrated print heads) require some ink to remain in the tank to prevent the ink system running dry. However, the amount of ink remaining varies considerably and some third party ink tanks display such serious design flaws that it is impossible for ink delivery to be anywhere near maximised. One tank tested delivered only 38% of the ink it contained before registering as empty while that cartridges from that brand wasted more than 37% of their ink on average.
- Are the cartridges clean to use and dispose of?
  Many of the third party cartridges tested here leaked before, during or after use – some very seriously – due to design flaws. Several were found to have leaked inside their sealed packaging when purchased, including one where the ink had even managed to escape from the sealed packaging.
- Do the cartridges have a quality 'look and feel' about them?
  Some third party designs look good and perform poorly while others perform reasonably well but look hideous.

In essence, the only reason for buying third party is to save money – user's should be aware that the out of pocket expenses involved with buying printer supplies is only part of the Total Cost of Printing. They should also understand that buying third party supplies, with characteristics such as those described in this report, is likely to cause them difficulties, the need to reprint and frustrations that boost real cost (including materials, user time and/or labour costs) to the point where the overall Total Cost of Printing and user satisfaction are heavily outweighed by the simplicity, dependability and predictable costs of buying only OEM supplies.

Printer OEMs publish the number of pages (standard test pages – user pages will vary) that the user should be able to expect from a cartridge. Third party manufacturers will not commit to a number of pages – either because they are unwilling to invest in the cost of testing, perhaps because the amount of ink pumped into the cartridges is inconsistent or possibly just to attempt to hide the real costs of using their products.

Third party manufacturers prefer to publish a quantity of ink in millilitres – some of which is not accessible. Some cartridges may seem cheap to buy but contain, or deliver, very little ink. In terms of Cost per Page, therefore, it is possible for third party inks to be more expensive than OEM original inks due to:

- Poor reliability
- Poor ink delivery
- Low volume of ink delivered
- Inadequate or unreliable 'ink out' alert

Brother's original cartridges are designed and deliver overall reliability, efficient delivery of ink, efficient 'ink out' notification and clean handling. Because they are ink tanks rather than cartridges with integrated print heads, the cost to third parties of collecting and refilling empties is higher than manufacturing copies. It is in this design and manufacturing process that most of the reliability issues experienced by third party cartridges are to be found.

Overall Highlights

- Despite minor imperfections, Brother's LC1100 inks outperform all third party inks in almost every respect
- Brother's original ink cartridges are not susceptible to any ink leakage before, during or after use whereas all but one brand of third party cartridge were found to be liable to leakages
- Ink wastage can be high with third party cartridge sets, with one set exceeding 37% wastage on average (Data Becker PrintMAxx) and peaked at 68% with one cartridge
- Unreliability is a feature of some third party cartridge designs – 10 sets of Geha cartridges were required to complete testing against one set of several other brands
- Less than one-third of the glossy photo ink/media combinations can be considered to present a photo print quality equivalent to samples printed with Brother's original supplies
- 40% of glossy photo ink/media combinations present entirely unacceptable print quality
- Brother BP71 glossy photo paper offers a substantially higher print quality overall than any other glossy paper tested (especially Inkrite and Verbatim paper), regardless of the ink used
- Brother BP60 inkjet paper boosts Optical Density and print quality of office style documents for all inks, offering a significantly brighter and more vivid printed image than generic plain office paper
- Only Geha and Pelikan use a pigment Black ink to match the Brother original Black ink
- Pigment inks offer better white-on-black printing performance
- Use of original OEM ink is the important factor in preventing light fade
- Brother original inks are outperforming all third party inks by orders of magnitude in Light Fastness testing – whether exposed to UV light or white light with glass protection or without glass protection
- Only Ilford's 1146567 glossy paper matches Brother's BP71 glossy paper for Light Fastness, outperforming Brother BP71 paper with two-thirds of the inks tested (no glass)
- By 25 years of exposure to white light, without glass protection, every photo sample other than those printed with Brother original inks had failed (more than 30% average loss of CMY), while Brother's inks on Brother's BP71 paper had suffered only 11.8% loss
- Brother's inks on BP71 glossy photo paper (exposure to white light without glass protection) outperformed the worst performing ink/paper combination (Conzumo ink on Inkrite paper) by 47 times
- After 100 years of exposure to white light, with glass protection, all but one glossy photo samples (Stinky Ink on Ilford glossy paper) had failed (more than 30% average loss of CMY), while Brother original inks had faded by only 5.9% on Brother BP71 paper – and Stinky Ink on Brother paper is on the cusp of failing
- After 55 years of exposure to white light, with glass protection, all samples printed with third party inks on Inkrite and Verbatim glossy papers had failed
- By contrast, after 55 years of exposure to white light, with glass protection, only 5 of the 30 samples printed on Brother or Ilford glossy paper had failed
- Under UV light, no third party ink, even when printed on Brother BP71 paper, failed later than 253 hours (more than 30% average loss of CMY) compared to 674 hours for the Brother OEM combination

- When subjected to soaking in water, Brother BP71 glossy photo paper performed significantly better than any other paper, with no print sample proving to be completely unacceptable after soaking – 56% of samples involving third party supplies proved to be completely unacceptable for use after soaking
- Brother BP60 inkjet plain paper holds all inks in place to a very high degree compared to generic plain paper when water soaking occurs
- Brother's use of pigment black ink makes it eminently suited to printing vulnerable material, such as addresses on envelopes

Cartridge Design / Reliability

Brother's original cartridge design ensures that the customer experience is maximised.

- There is no potential for ink leakage either before or after use
- Ink flow into the AiO is assured
- Ink-out notification is assured and reliable, minimising the amount of ink remaining in the cartridge

Third part cartridge designs vary considerably, with varying degrees of success, reliability and aesthetic appeal. Several cartridge designs are used by multiple suppliers. Geographic location of cartridge fill and source of ink may vary. However, an identical cartridge design does not guarantee identical ink or identical performance.

Spectrometry (undertaken at BIE's head office in Audenshaw, Greater Manchester) was used to determine whether any inks were identical to Brother's original inks. Only Black and Magenta inks were tested, on the basis that all three colours for any particular brand can be assumed to be from the same source.

No inks were found to be identical to Brother's original.

Few cartridge designs gave a user experience even closely approaching that of the Brother original. Problems found include:

- **Poor ink feed** - resulting in the ink system running dry, potentially causing print head damage and certainly requiring multiple cleaning cycles to be run in order to re-prime the system, thus wasting large quantities of ink
- **Inadequate or non-existent ink-out alert mechanism** – resulting in the ink system running dry, with implications as above, or excessive ink remaining in the exhausted cartridge
- **AiO not recognising cartridge** – mainly confined to Geha/Pelikan design, requiring cartridge to be inserted multiple times, hoping that it will eventually be recognised
- **Ink leakage** – usually, but not exclusively, caused by inadequate non-return protection on the air breather hole

Identical third party cartridge designs & reliability

Third party cartridge suppliers for the Brother LC1100 series appear to have five primary manufacturing sources, with up to three brands (within the brands sampled for this study) using cartridges from any particular source.

ActiveJet | **Cartridge World** | **Stinky Ink**

NB. Stinky Ink is an identical physical design to ActiveJet and Cartridge World but uses an all-black casing instead of clear casing on one side.

Of the third party cartridges, these were found to be amongst the most reliable, providing the highest levels of customer satisfaction.

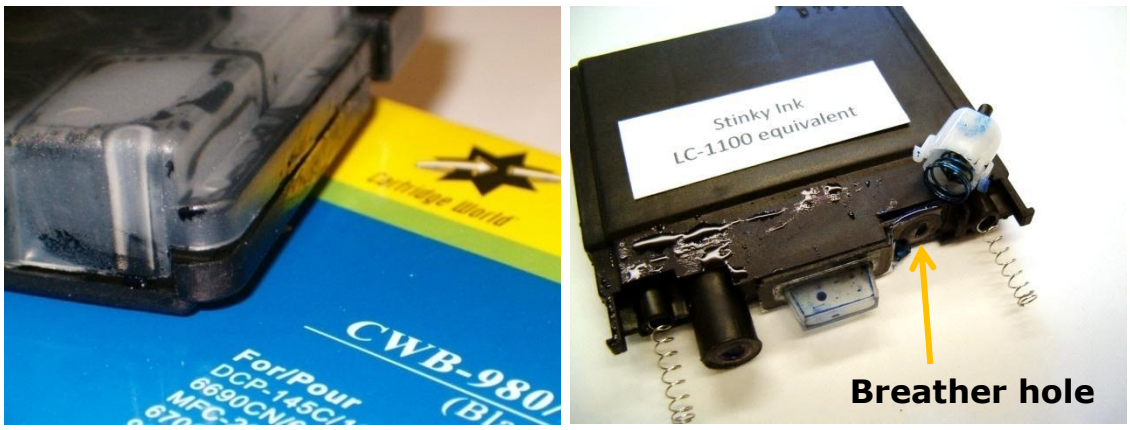
- The Black cartridge is a large, high capacity design, thus offering good value for money
- The breathing hole is not overly susceptible, but certainly not immune, to leaking after use
- Only one unit of each colour from each of ActiveJet and Cartridge World was required to complete printing of test samples, with only one additional Cyan and Yellow being required from Stinky Ink

Utilising the same type of mechanical flag system for 'ink-out' notification as used by Brother, there are no concerns about the ink system running dry after the ink supply is exhausted.

In many respects, this design most closely replicates the original Brother design and, although not responsible for any significant usage problems, frustrations or ink starvation during the test programme, there are concerns over ink leakage.

When removed from the printer while still nearly full, one ActiveJet Black cartridge immediately began to drip from the ink delivery orifice. This is clearly a major problem that could cause high levels of mess and disruption. The associated video (*Activejet_ink_drip.AVI*) shows the cartridge dripping when held horizontally.

In addition, one Cartridge World Black cartridge raised concern over the general quality of manufacturing - where it was found to have split along a seam, releasing a significant quantity of ink.



Ink leakage is largely the result of an inadequately protected air breather hole. A seal is pierced by a somewhat flimsy plastic pin arrangement when the cartridge is inserted into the AiO but there is an inadequate non-return mechanism that is not reliable in preventing ink escaping from the orifice where the air enters.

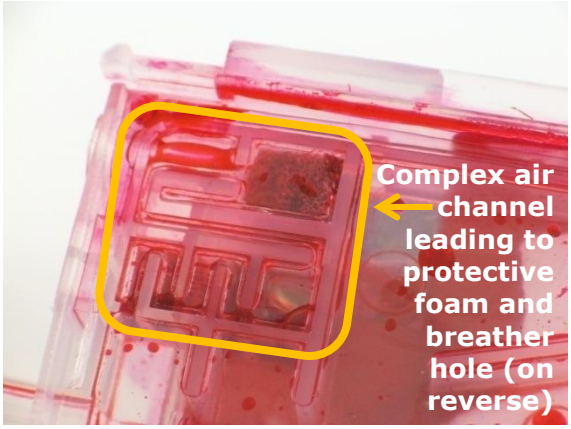
EcoStore **Inkrite** **Prink**

Another design using the mechanical flag system similar to Brother's for reliable 'ink-out' notification, this cartridge design has a horrendous propensity for leaking after use if the user is not fully aware of the danger and takes the necessary precautions.

This is due to the design of a breather hole that is covered by tape on purchase.

However, after the tape has been removed, the breather hole is completely open to the outside, with only a piece of low density foam as protection. Even though the cartridge manufacturer has attempted to design the air channel to avoid(?), or

minimise, the danger of ink reaching the foam, the result is totally ineffective and this foam actually offers no real protection at all, allowing ink to flow out of the 'empty' cartridge quite freely. Many of the cartridges used in the test programme leaked profusely once discarded.



Unlike the ActiveJet/Cartridge World/Stinky Ink cartridges, this design does not allow for a large, high capacity black.

Like the ActiveJet/Cartridge World/Stinky Ink cartridges, however, this design does have an intelligently designed ink feed channel, allowing a very high proportion of the ink contained in the cartridge to be used. This is demonstrated by the fact that an average of only 2.5 cartridge units of each colour were required to complete testing.

Unfortunately, there was one instance (EcoStore) of a cartridge failing and running dry without any notice.

Curiously, the basic cartridge uses a soft cellophane membrane on one side of the cartridge (as does Brother on both sides of the ink tank), which is covered by a snap-on plastic cover. This appears to serve no purpose and certainly does not deter refilling.

Aqprox! **Conzumo** **Printerinks**

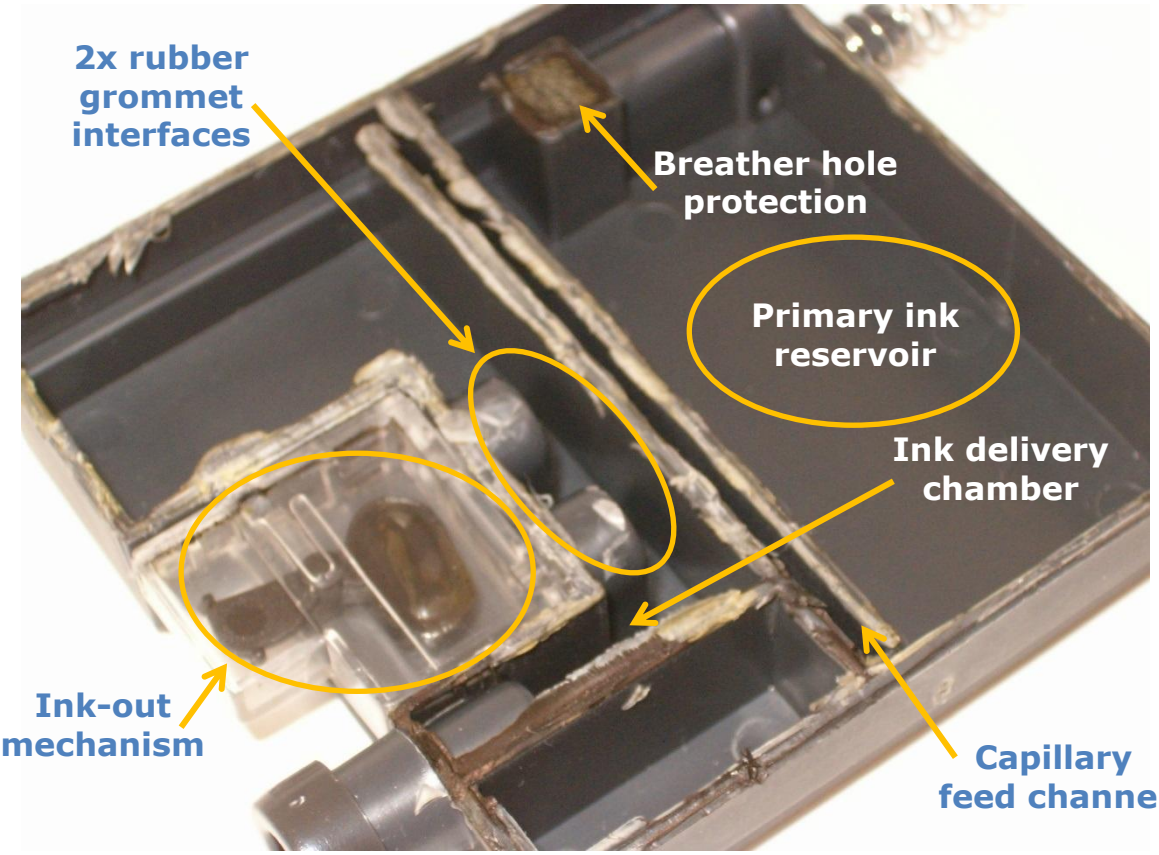
Possibly the most ingenious and attractive of the third party designs, these cartridges give the initial impression of being high quality and reliable. This is certainly true, in part, and the cartridges did provide a reasonably good customer experience in some respects, with only two units of each colour required to complete testing of the Aqprox! and Conzumo brands but only one unit each for the Printerinks brand.

Offering a high capacity black, this design should have little or no scope for leakage as air breather hole protection appears to be particularly effective.

However, one Conzumo cartridge (black) had leaked inside its sealed packaging. This appears to have been caused by the seal over the breather hole having been pierced at some point during the manufacturing process (or possibly during packaging or transportation) and could easily have resulted in the leakage if the cartridge was subjected to low air pressure during transportation.

In addition, small amounts of ink have been noted as having leaked from other cartridges.

This design is only Brother-like and is not close enough to the Brother concept not to cause some problems. In this instance, the flag mechanism is very small and contained inside a very small clear plastic pod that interfaces with the main cartridge via two rubber grommets.



Not only does ink appear to be able to escape from this interface, either before or after use, but also the size/design of the flag mechanism makes it unreliable and inaccurate.

Furthermore, the main ink reservoir is located at the back of the cartridge, with the ink being required to pass up a capillary-type channel that separates the reservoir from the delivery chamber before entering the delivery chamber. This was found to be severely unreliable, with the potential for the capillary transport to fail, thus rendering potentially large quantities of ink inaccessible in the reservoir chamber.

At least two of the cartridges of this design failed very shortly after being inserted in to the AiO. In both instances, the ink supply dried up completely, despite shaking the cartridge revealing that a significant quantity of ink remained in the reservoir, requiring the ink system to be completely re-primed by running multiple cleaning cycles – at the considerable expense of Cyan and Magenta ink.

Data Becker PrintMaxx **MBP PrintPack**

This must undoubtedly rank as one of the worst cartridge designs of all time, despite having a very attractive look and feel with its colour-coded front cowl.

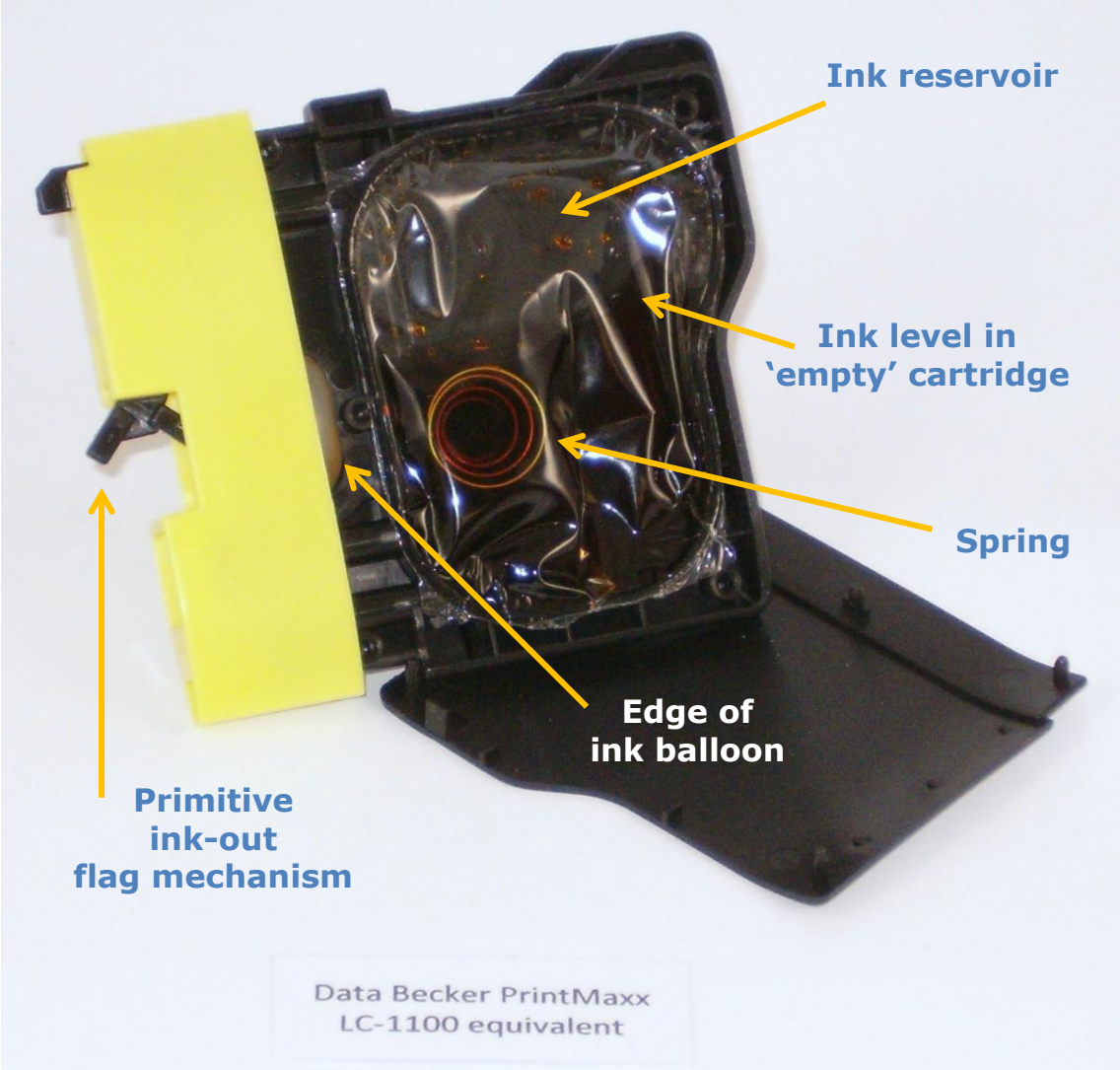
However, scrape beneath the surface and everything falls apart from the customer experience perspective. In particular, the ink delivery and ink-out notification mechanisms are so ill-conceived that they are inherently impractical and unreliable, failing to deliver more than 62% of their ink on average.

Inside the attractive casing and under the removable plastic side cover, lies a flexible cellophane diaphragm that creates a pouch or bag that acts as the ink reservoir.

Within this bag is a spring – clearly designed to prevent the bag from collapsing completely, thereby preventing all of the ink from being delivered. The cartridge photographed here (below) registered as empty in the AiO while still clearly containing a vast quantity of ink.

Attempting to act as an ink-out alert mechanism is a very primitive mechanical flag that is held in the 'OK' position by a small rubber balloon. As soon as the spring in the ink reservoir sucks the rubber balloon in, the flag drops and the AiO reports an ink-out status.

A full colour cartridge weighs around 34.5g while the cartridge casing itself weighs around 21g. This means that around 13.5ml of ink is contained in a full cartridge. Both Data Becker and MBP claim that cartridges contain 15.6ml of ink but that appears to be reserved only for the black.



Having been totally appalled at how few pages these cartridges were printing, and how much ink we could hear was still in the cartridges when shaken, we dismantled a cartridge (see photo) and then extracted as much ink as possible from each of the supposedly 'empty' cartridges.

From eight 'empty' cartridges, we extracted an average of 5.1 ml of ink, representing more than 37% of the ink that was inserted into the cartridges during manufacture but completely inaccessible to the user.

Indeed, on one black cartridge, the ink-out notification was received when only 5.8ml of ink had been used – only 38% of the claimed capacity (62% wastage!).

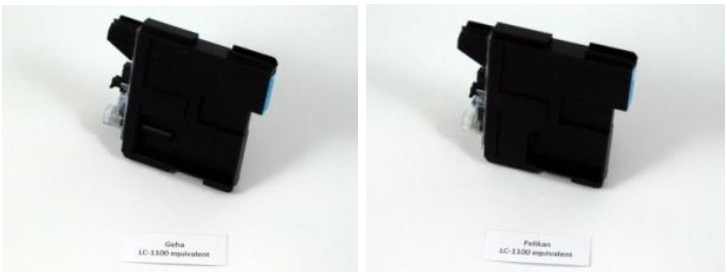
This design does not just represent a poor implementation of ink cartridge design but verges on the deceptive and fraudulent – letting customers believe that they are going to be able to benefit from 15.6ml of ink when, in fact, the cartridges contain only 13.5ml, of which an average of only 8.4ml is accessible. No wonder the manufacturer quotes ink capacity and not page yield!!

Surprisingly, only two units of Data Becker Cyan and Magenta were required to complete testing while three units of Black and Yellow were required. Of the MBP PrintPack brand, only one unit each of Cyan and Magenta were required but two each of Black and Yellow.

From the cost-effectiveness perspective, MBP scores because a bonus Black cartridge is included in each multi-pack.

Although not susceptible to ink leakage after use, one new Yellow cartridge from Data Becker was found to have leaked inside its sealed packaging.

Geha **Pelikan**



Again, a frankly appalling design, the cartridges from Geha in particular caused many times more problems than those experienced with all of the other cartridge sets put together.

Not only were they unattractive but also unreliable, inefficient and horrendously annoying as a customer experience. The one and only redeeming factor is that there is no air breather hole for ink to leak from!

In fact, so bad were they that a second batch of five sets of Geha cartridges had to be purchased in order to complete the printing of the necessary test samples. In all of that time, not one set of cartridges (10 sets) was left untouched. By comparison, testing was completed for several brands using just one cartridge of each colour.

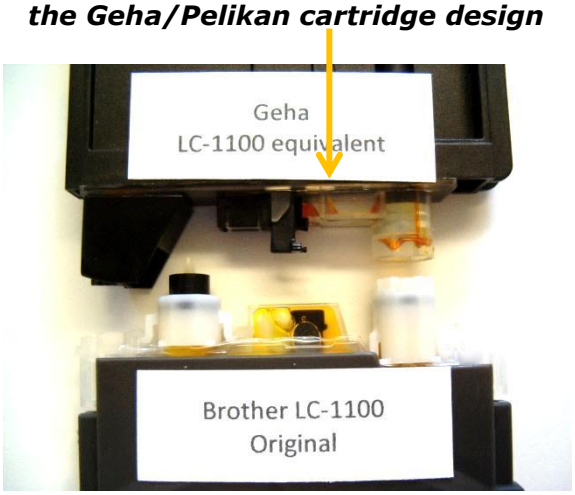
Essentially, the problem is three-fold:

- Unreliable ink delivery
- Utterly ineffective and nonsensical design of the ink-out mechanism
- Inability of the cartridges to be recognised by the AiO

First of all, ink appeared to be very reluctant to flow from the cartridges into the AiOs ink system. Even when ink had been encouraged onto the page through use

of multiple cleaning cycles (wasting huge amounts of ink from the other cartridges), there was no guarantee that it would continue to flow. In addition, the waste of ink from the other cartridges leads us to the second problem – the lack of an effective ink-out mechanism.

Inadequate ink-out mechanism on the Geha/Pelikan cartridge design

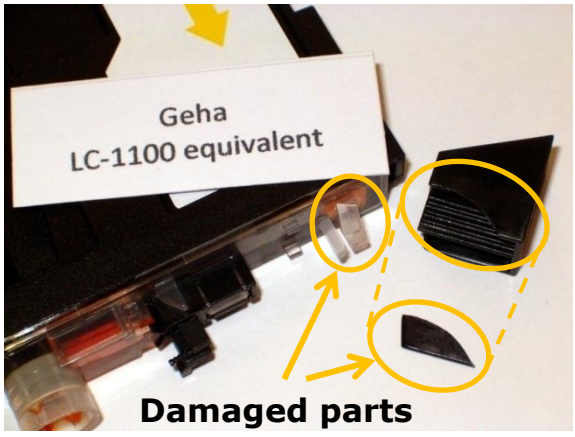


When one cartridge had been encouraged into life, there was a high probability that one of the other cartridges would no longer contain enough ink to undertake the printing of test pages. But, the lack of an effective ink-out system meant that this would not be notified and the AiOs ink system would run completely dry.

Therefore, it would be necessary to insert a new cartridge of that colour and run multiple cleaning cycles again just to encourage that new cartridge into life – a never ending circle!

Just to add insult to injury, the cartridges were frequently not recognised by the AiO, even after repeated attempts and requests from the AiO to 'insert a cartridge' – 'slowly'! This constituted a significant disincentive to check the quantity of ink in any cartridge, in case it could not be successfully reinserted into the machine.

There was NEVER any confidence that the Geha cartridges would work successfully and little more with the Pelikan cartridges.



In addition, a number of cartridges were found to be damaged on first opening. Out of the ten multi-packs purchased, three packs (all from the first batch) were found to contain damaged cartridges. In one pack, three of four cartridges were damaged; in another two out of four; and in the third, one out of four.

Damage was not catastrophic, nor did it prevent the cartridge from being used – but only by repairing them, something a user with a local supply may prefer not to do in favour of returning the damaged units. It did, however, require the black plastic piece to be glued onto the cartridge as the retention clip was broken. An exhausted cartridge was useful here to take an undamaged piece from.

All of this added up to a horrendous number of Geha cartridges being used to complete testing, while Pelikan fared rather better.

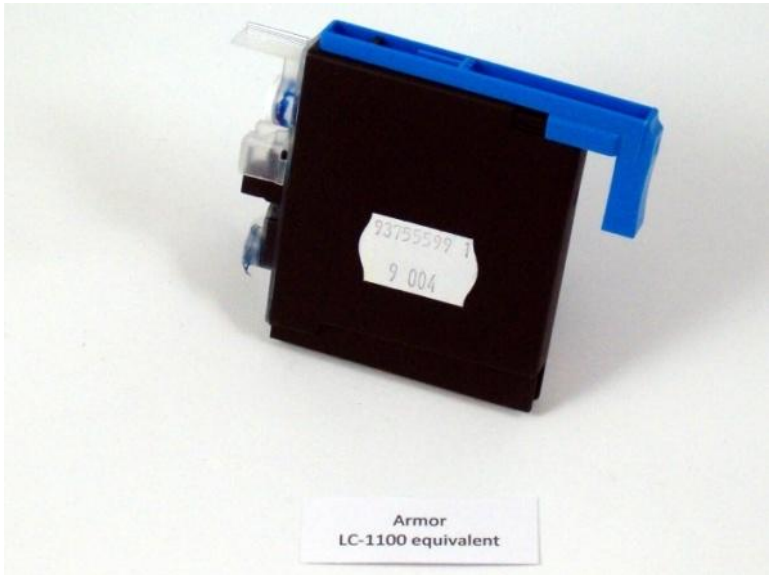
	Black	Cyan	Magenta	Yellow
Geha	8	9	10	6
Pelikan	2	3	3	3

Ink leak even extended outside of the packaging!

Finally, although not susceptible to ordinary leakage, one other area of damage was found with this design in the form of a Geha cartridge that had leaked within its sealed packaging. In fact, so serious was the leakage that not only was the paper label totally saturated with ink but some ink managed to escape from the sealed packaging!

Unique third party cartridge design & reliability

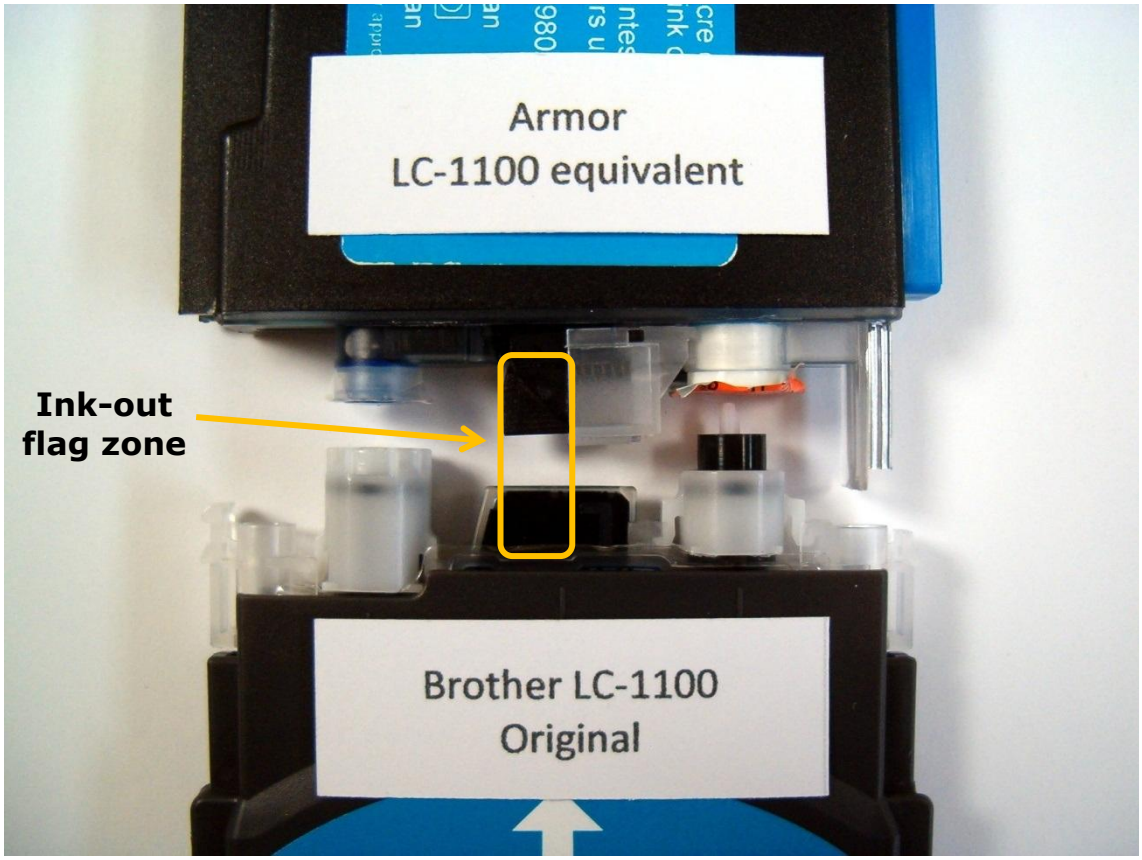
Armor



A bizarre design, the front face of this cartridge bears little resemblance to the original Brother design. Having been packaged in a professional and attractive (if hugely oversized) box, the experience of seeing the cartridge for the first time is enormously disappointing.

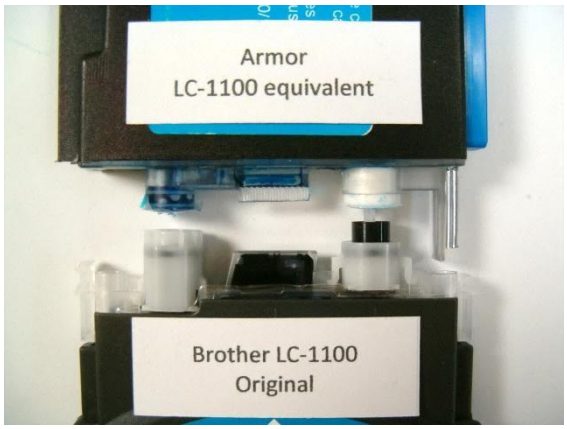
Breathing is handled by an aperture on the printer interface edge of the cartridge, covered by a tape that needs to be removed by the user prior to use. Non-return protection appears to be effective as no leakages were noted from this cartridge design.

Of some concern though, is the ink-out alert mechanism, which, at first sight, appears to be non-existent. In fact, comparing this cartridge with the Brother original, it looks as though the space occupied by a 'cartridge active' flag is semi-permanently blocked. The flag section is actually sprung and moved out of the line of the sensor beams by the sensor posts themselves and the cartridge is not recognised by the AiO if this assembly is removed.



However, there is no link from this mechanism to the inside of the cartridge, and it is hard to see how the ink-out mechanism could possibly be effective. So, it was with some surprise to find that the cartridge appears to communicate very effectively with the printer to prevent the ink system from running dry.

Even more bizarre, perhaps, is that the Yellow cartridges are slightly different (or perhaps of a different generation), dispensing with the sprung flag assembly and having slightly longer fins on the ink window than the other cartridges. Despite this difference, the AiO still recognises the cartridge properly and the ink-out alert is just as effective.



Armor Cyan cartridge with sprung flag assembly removed

Armor Yellow has no flag assembly

All in all, despite its bizarre and very off-putting looks, the Armor design proved to be one of the best third party cartridges tested from the customer experience perspective:

- There has been no evidence of leakage at all
- Cartridges are high capacity, containing approximately 20ml of ink
- Only one unit of each colour was required to complete the testing, meaning that it will also prove to be one of the most cost-effective alternatives.

Cartridge Problems/Failures

	Cartridge Problems/Failures
ActiveJet	Some ink leakage from cartridges after use One Black cartridge began to drip seriously when removed from the printer, see video *Activejet_ink_drip.AVI*
Aqprox!	Yellow cartridge failed immediately on replacement (no ink feed) Some ink leakage from cartridges after use
Armor	No problems experienced
Brother	No problems experienced
Cartridge World	One cartridge split at the seam – causing major leakage Some ink leakage from cartridges after use
Conzumo	Yellow cartridge failed immediately on replacement (no ink feed) One black cartridge leaked in sealed packaging Some ink leakage from cartridges after use
Data Becker PrintMaxx	Black ink alerted as empty when only 5.8ml of the 15.6ml claimed capacity had been used High proportion of ink trapped in cartridge One yellow cartridge leaked in sealed packaging
Eco Store	Yellow ink supply failed without warning Serious ink leakage from cartridges after use
Geha	High proportion of cartridges broken on delivery (25% of batch purchased) Cartridges frequently not recognised by printer Ink system runs dry with no notification One yellow cartridge leaked in sealed packaging (ink escaped from sealed packaging)
Inkrite	Serious ink leakage from cartridges after use
MBP PrintPack	No operational problems noted … but … Significant proportion of ink trapped in cartridge
Pelikan	Cartridges sometimes not recognised by printer
Prink	Serious ink leakage from cartridges after use
Printerinks	Some ink leakage from cartridges after use
Stinky Ink	Serious ink leakage from cartridges after use

Cartridges used

	Number of third party cartridges required to complete test prints			
	Cyan	**Yellow**	**Magenta**	**Black**
ActiveJet	1	1	1	1
Aqprox!	2	2	2	2
Armor	1	1	1	1
Cartridge World	1	1	1	1
Conzumo	2	2	2	2
Data Becker PrintMaxx	2	2	3	3
Eco Store	2	2	3	3
Geha	9	10	6	8
Inkrite	2	3	3	2
MBP PrintPack	1	1	2	2
Pelikan	3	3	3	2
Prink	2	2	2	1
Printerinks	1	1	1	1
Stinky Ink	2	1	2	1

Optical Density Colour Fidelity & Photo Print Quality

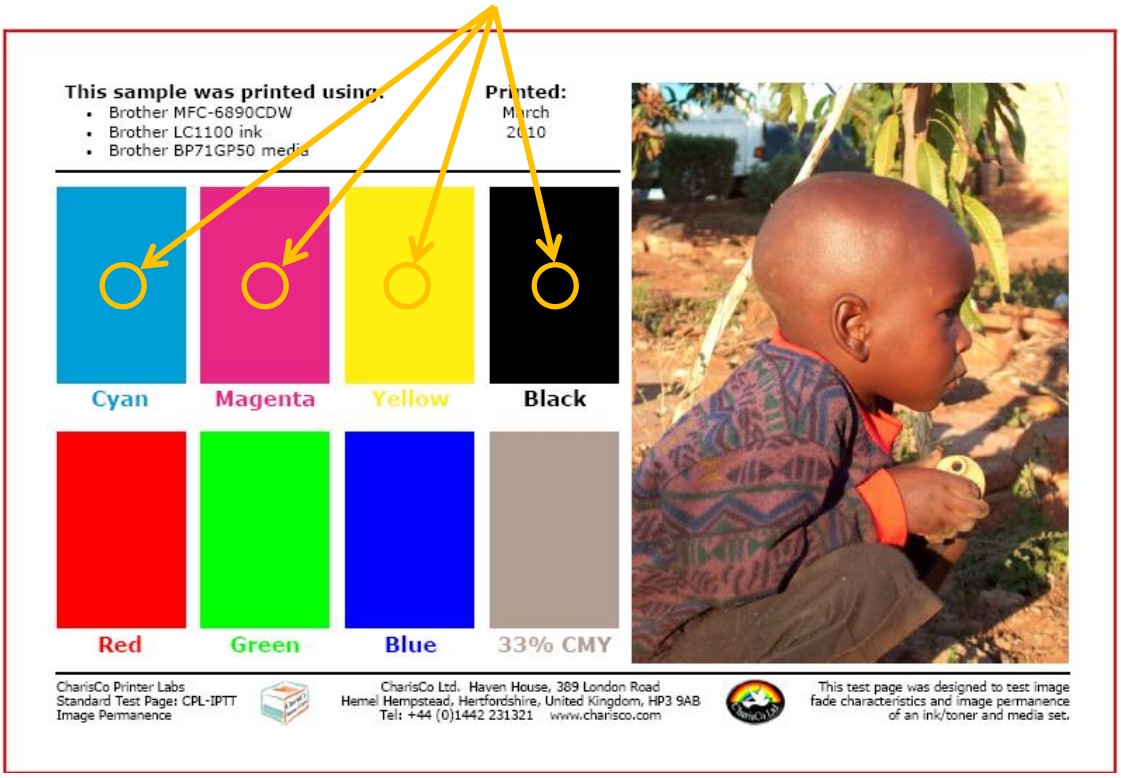
Highlights

- No ink/paper combination produces a higher photo print quality than Brother ink on Brother BP71 glossy paper
- Brother BP71 glossy photo paper offers a substantially higher print quality overall than any other glossy paper tested (especially Inkrite and Verbatim paper), regardless of the ink used
- Ilford 1146567 glossy photo paper also offers a substantially higher print quality than Inkrite and Verbatim paper, regardless of the ink used
- Print Quality on Inkrite and Verbatim papers are universally poor
- Optical density of inks printed on glossy papers (all inks and all papers) varies by as much as 18.5% above and 25.3% below the optical Density seen from Brother original inks
- Printing on Brother BP71 glossy paper only, optical density varies by as much as 16.6% above and 22% below Brother original inks

Methodology

Optical density gives a measure of how close third party inks compare to original Brother inks for potential to produce accurate print results. Optical density for Cyan, Magenta, Yellow and Black was measured for every print sample of the CPL-IPTT test page – 20 copies of each ink/paper combination – and an average calculated.

Optical density measurement zones



Test results

NB. This section should be read in conjunction with the accompanying spreadsheet and with reference to the print samples

With printed optical density varying by as much as 25% from the Brother original combination, there is more than a little scope for the quality of printed results using third party inks or media to be less than desirable.

Yellow is the ink that varies most, with optical density varying between 18.5% and -24.2% from Brother's original overall and between 16.6% and -22% when comparing inks printed exclusively on Brother paper.

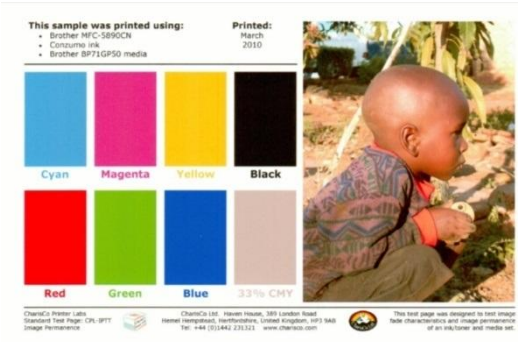
Although the optical density of the printed image, as measured here, does not necessarily relate directly to the visual appeal and print quality of an ink/paper combination, certain trends are observed, characteristics noted and direct consequences found.

Logic would suggest that, the higher the optical density of an ink printed on paper, the darker that ink would appear on paper. However, there are other factors at work in the ink/media ecosystem that can affect the visual impression of the ink on paper – such as, how deep the ink penetrates into the paper and the 'whiteness' of the paper itself.

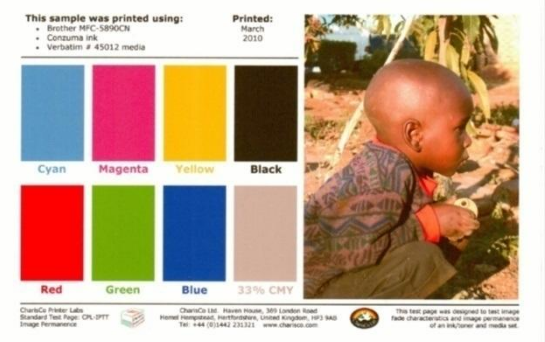
Most of the visual impression of quality is dependent on the paper rather than the ink. However, a poor ink on a poor paper emphasises the loss of print quality.

For instance, using visual inspection for assessment, the worst ink by far is Conzumo. Optical Density readings for the ink paper combinations show that yellow ink from Conzumo gives a very high density reading on all four glossy papers (16.6% higher than Brother's original ink/paper combination), while all other inks demonstrate a density significantly lower than Brother's (Cyan on Verbatim paper, -23.7%).

Brother LC1100 inks on Brother BP71 glossy paper



Conzumo ink on Brother BP71 paper



Conzumo ink on Verbatim paper

By comparison, yellow inks from other third party manufacturers demonstrate optical densities that are mostly well below the density of the Brother original combination – as low as -24.2% (Aqprox! ink on Ilford paper) – or just a few percentage points above the Brother combination. The average variance from the Brother original combination is -9% and the average of the yellow inks printed on Brother paper only is -9.7%. So, the Conzumo yellow ink really stands out as having an inordinately high optical density.

Visual inspection of the image on CPL-IPTT shows that Yellow is, indeed, overpowering on all four glossy papers but the print quality on Inkrite and Verbatim papers is noticeably worse than the image printed on Brother and Ilford papers (image is grey and lacks contrast) due to the much lower optical density of the Cyan and Magenta inks on these papers.

Colour coding has been applied to the spreadsheet to give a quick visual indication of the severity by which Optical Density for a particular ink/paper combination varies from the Brother original combination (used as the datum). Green indicates little divergence, Amber an intermediate divergence and Red a severe divergence.

Because every ink and every paper is different, resulting in different Optical Density and print quality characteristics, there is no absolute measurement of when an ink/paper combination can be considered to have failed the test. The thresholds between the colours are essentially arbitrary, chosen to emphasise the different interactions between inks and papers and how it impacts on print quality.

Note that most of the images on Inkrite and Verbatim papers (highlighted as red in the spreadsheet) show Optical Density readings that diverge from the Brother datum either:

- by a significant percentage for two colours … or …
- by a significant percentage for either Cyan or Magenta … or …
- by a very high percentage in the Yellow

There is certainly a high correlation between Optical Density readings of the colour inks and photo print quality as determined by, albeit subjective rather than objective, visual inspection.

In principle, we can take it from the readings that increased Optical Density is more of a problem than decreased Optical Density and that decreased density of Cyan and Magenta are more of a problem than decreased density of Yellow. Where low Yellow density is noted, the image tends to hold up fairly well unless either combined with a significantly low density of Cyan or Magenta or where the lack of density from the Yellow ink is a particularly significant.

What we can state for certain is that Optical Density readings from the Inkrite and Verbatim papers will almost always show as worse than the readings from Brother and Ilford papers. This is more than satisfactorily born out under visual inspection, with images on these papers comparing very poorly with the images on the Brother and Ilford papers.

For instance, while almost all Conzumo readings vary from Brother readings by a considerable percentage, showing as a high proportion of Red and Amber in the spreadsheet, the results for Conzumo inks on Brother and Ilford papers clearly diverge far less from the Brother datum than the same ink on Inkrite and Verbatim papers. However, these readings are based on intense positive readings for the Yellow ink and high negative readings for the other inks.

On the other hand, an anomaly has arisen in the colour coding resulting from the conditional formatting used in the spreadsheet. Where Geha and Pelikan inks are concerned, the colour coding makes it look as though Brother and Ilford papers would perform worse than Inkrite and Verbatim papers. However, this is not the case. The percentages that these readings vary from the Brother datum are significantly less negative than we see from many other inks, triggering the colour change in the spreadsheet. Reality is that the lower Optical Density measurements for these inks on the Inkrite and Verbatim papers is an indication that print quality is actually noticeably poorer than that seen on the Brother and Ilford papers.

Comments on the Print Quality of each combination are contained in the spreadsheet. Amber and Red shading have only been applied to the spreadsheet where there is a clearly noticeable difference between that image and the Brother-on-Brother reference image.

Optical Density & Plain Paper Print Quality

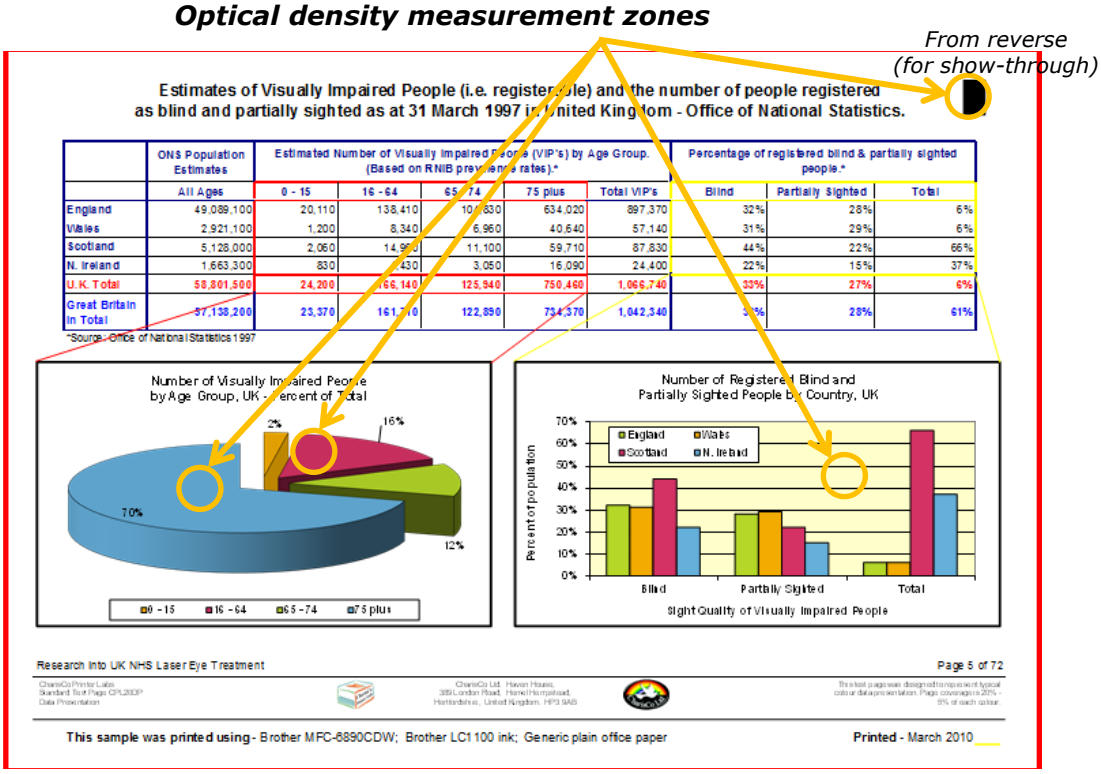
Highlights

- Brother BP60 paper offers a significantly brighter and more vivid printed image than generic plain office paper
- Third party inks noted as printing heavy and dark photographic images offer a more appealing result when printing office documents
- Only Geha and Pelikan use a pigment Black ink to match the Brother original
- Pigment Black inks (Brother/Geha/Pelikan), remain on the surface of the paper, presenting an image with higher contrast and the ability to resolve finer lines more satisfactorily than dye inks
- PrinterInks' Black ink produces a heavier image, with more ink splatter, than any other ink
- Some degree of ink bleed is evident with all ink/paper combinations but none are significantly poor

Methodology

Optical density gives a measure of how close third party inks compare to original Brother inks for potential to produce accurate print results. Optical density for the Blue, Red, Yellow and Black fills, together with the degree of showthrough on the reverse side of the paper, was measured for every print sample of the CPL20DP test page – 20 copies of each ink/paper combination – and averages calculated.

Optical density measurement zones



Printed samples were inspected for general appearance, ink bleed, any flaws and print quality issues such as text sharpness, fine line reproduction and accuracy of colour fills.

Test Results

NB. This section should be read in conjunction with the accompanying spreadsheet and with reference to the print samples

General Appearance

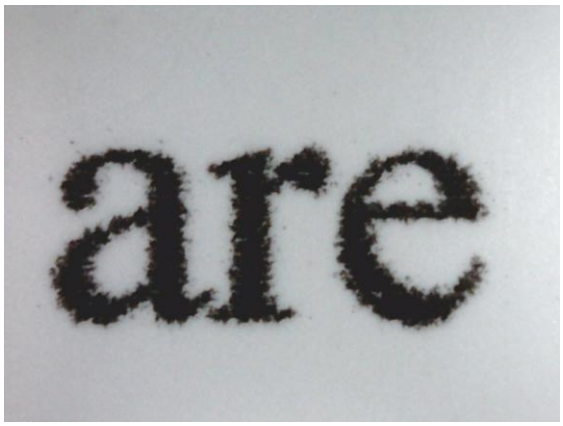
Unlike printing glossy photographs, printing of office documents benefits from a heavier (higher density) ink and the placement of enough ink on the paper to give a bright and vibrant result. Whereas many of the glossy photo samples were too dark, lacking contrast and detail in the shadow areas, by comparison to the samples printed with Brother inks, when we consider plain paper office documents, it is those same inks that tend to offer the most appealing printed results against the somewhat insipid and grey office document prints achieved from the Brother original inks.

Aside from the density of the inks and brightness of the printed image, visual inspection reveals little by way of significant differences in print quality between the inks. However, there is no doubt that the Brother BP60 inkjet paper provides a brighter and more vivid result than the generic plain paper.

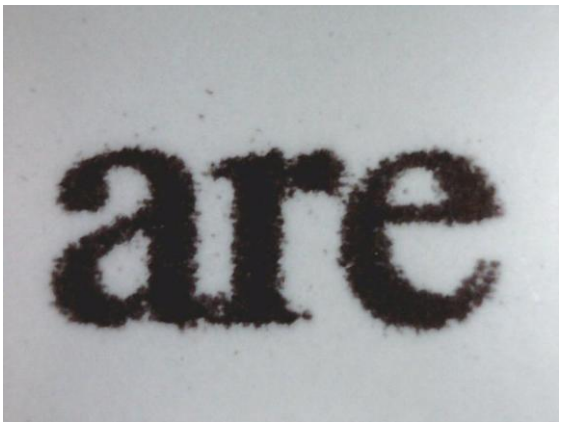
Two inks stand out as producing prints that visibly differ from the rest. These are:

- Conzumo, where the over-bearing nature of the Yellow ink turns the blue fill towards green

- PrinterInks where there is a very slight tendency towards the heavy Yellow ink turning the blue fill towards green. In addition, there is a distinct heaviness about PrinterInks office samples compared to samples of all other inks (and there is also a tendency for the Inkrite samples to display a very slightly heavier image).



Brother LC1100 ink on BP60 paper

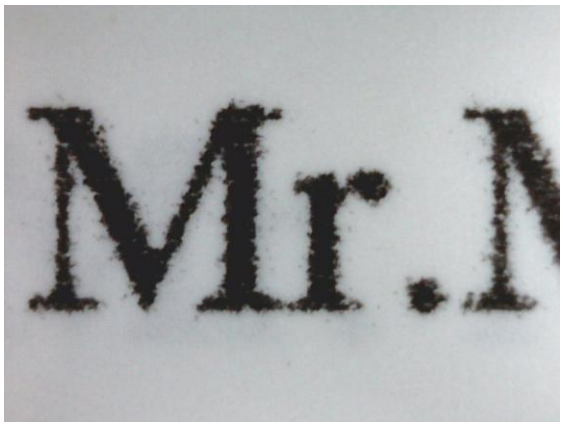


PrinterInks ink on BP60 paper

Under the microscope, the impression is that PrinterInks text is bold and that certain characters have been printed twice – an error that could not occur because every sample office page printed (from seven different documents using three different applications) displays the same characteristics. This does, of course, have implications on fine line weight, white lines on black background and small text, where the loose ends of

some characters (e.g. 'a', 'g' and 'e' – depending on the font used) can become joined in to the rest of the character.

There is also a distinctly higher degree of ink splatter visible on the samples from PrinterInks.



Brother LC1100 ink on BP60 paper

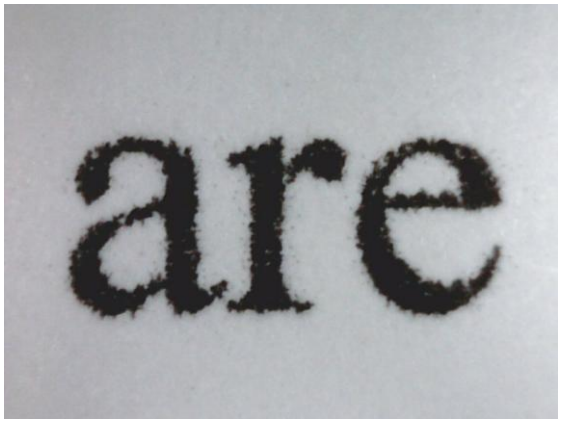
PrinterInks ink on BP60 paper

Use of Pigment inks

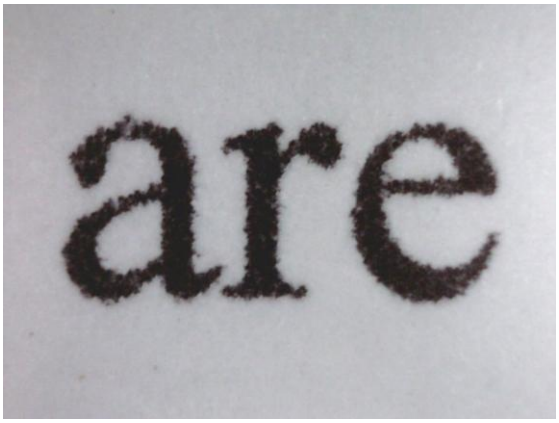
Only Geha and Pelikan ship pigment inks in their third party products to match the pigment ink used by Brother.

From a visual perspective, to the naked eye, this is impossible to detect. However, under magnification, the differences in print characteristics are evident.

Firstly, because pigment ink sticks firmly to the surface of the paper, there is no soaking effect – meaning that the edges of text and lines can appear more ragged than when printed with a dye ink that soaks into the paper, smoothing out the edges.



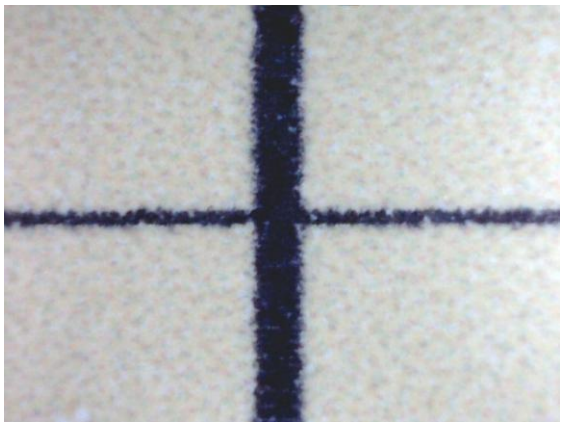
Pigment ink from Pelikan
(Xerox Performer paper)



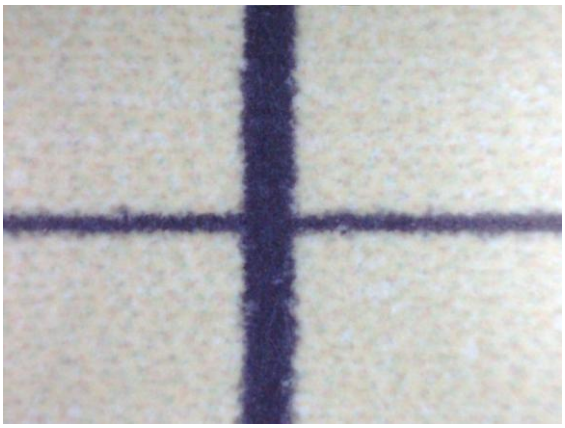
Dye ink from Prink
(Xerox Performer paper)

The advantage is that the contrast between paper and text is usually higher with pigment ink, again because the ink sits on the surface rather than soaking into the paper.

Higher contrast is particularly noticeable in magnified images taken to determine the level of ink bleed. Pigment ink clearly produces a darker black with higher contrast against the colour background.



Geha ink on BP60 paper



Inkrite ink on BP60 paper

Image showthrough

For print quality to be maximised and the printed document to be most useable, especially for double sided use, the image must not show through to the reverse side of the paper to any significant degree. Therefore, the lower the Optical Density, as measured on the reverse side of the paper, offers a measure of quality of the ink/media combination.

Brother's BP60 paper is a thinner paper than the generic Xerox Performer paper (70gsm as opposed to 80gsm) and therefore is subject to a higher level of showthrough – by an average of approximately 8.8%.

Because pigment inks do not soak into the paper, they are less susceptible to showthough than dye inks. On average, pigment inks (Black) show through by about 2.7% less on Brother's BP60 paper and by about 4.3% less on Xerox Performer paper.

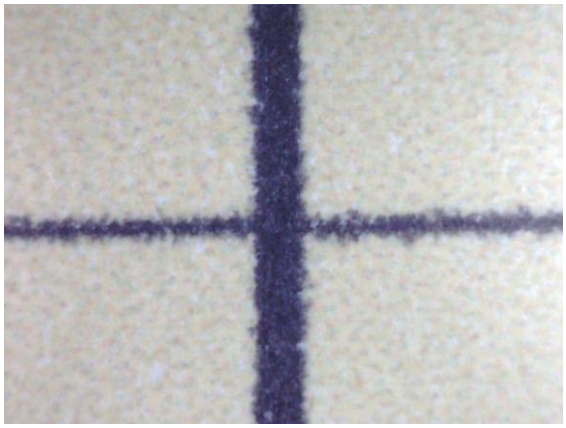
Overall, the conclusion here is that showthrough is not significantly affected by type of ink (dye vs pigment) but that a thinner paper is liable to increase showthrough.

Ink bleed

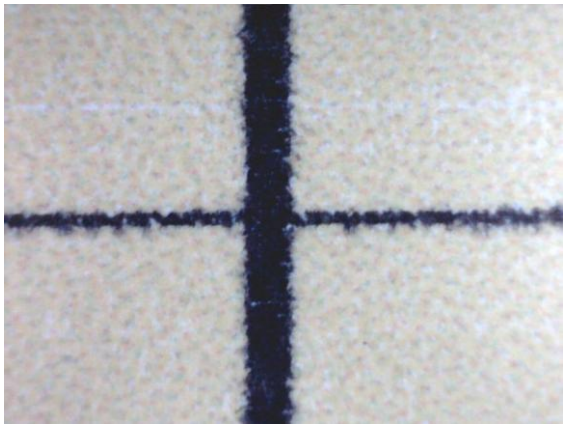
Surprisingly, the levels of ink bleed in all of these samples are remarkably low. The samples demonstrating a slightly higher degree of bleed than typical are:

- Aqprox! ink (dye) on both papers
- Cartridge World ink (dye) on Performer paper
- Conzumo ink (dye) on both papers
- Geha ink (pigment) on Performer paper
- Inkrite ink (dye) on both papers
- Pelikan ink (pigment) on both papers
- Stinky Ink (dye) on Performer paper

However, none of the samples display an unacceptable level of ink bleed. The two worst examples are shown below.



Cartridge World ink – dye
(Xerox Performer paper)



Geha ink – pigment
(Xerox Performer paper)

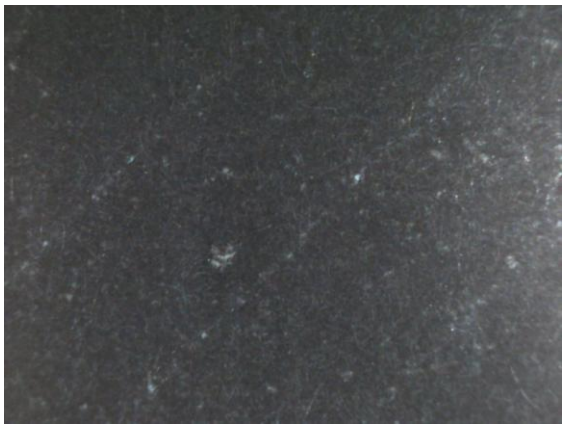
Fine Line Reproduction

Even though all four printers used for these tests were Brother MFC-5890 and MFC6890 models, using identical engines, the degree to which the various inks coped with printing fine lines (black on white and white on black) varies considerably.

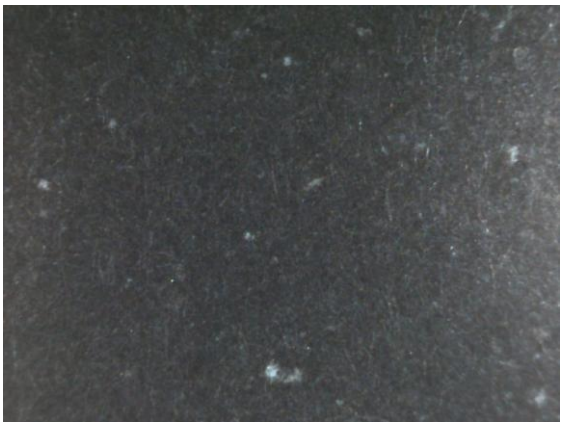
Whereas all inks are capable of resolving fine black lines very satisfactorily and Brother's original inks are also capable of resolving the finest of the white lines on a black background (at least discernable, even if not actually completely white), several of the third party inks fill in the black background so much that they either completely, or virtually, obliterate white lines on both of the two sets of finest white line test blocks at normal reading distance (both papers):

- ActiveJet
- Aqprox!
- Cartridge World
- Conzumo
- Data Becker PrintMaxx EcoStore
- Inkrite
- MBP PrintPack
- Prink
- PrinterInks
- Stinky Inks

In fact, PrinterInks ink obliterates the lines to the extent that they are not even discernable under magnification.



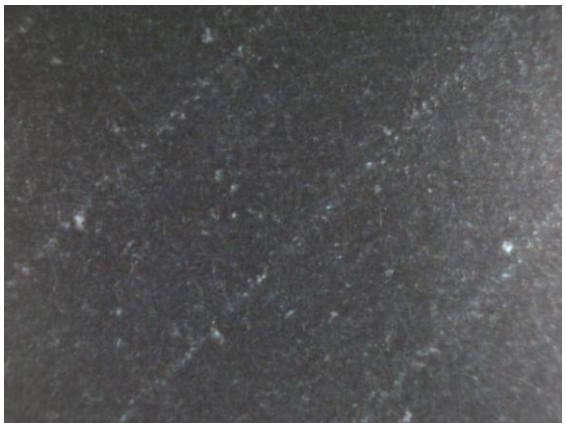
Fine white line on black - Stinky Ink



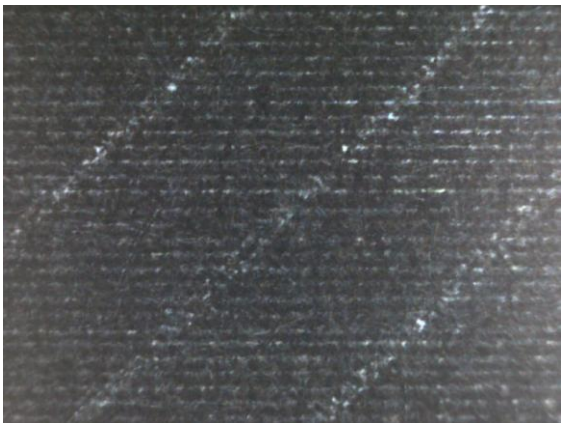
Fine white line on black – PrinterInks ink

Just one third party ink does not quite completely obliterate the fine white lines but leaves them as just discernable at normal reading distance:

- Armor



Fine white line on black – Armor ink



Fine white line on black – Brother ink

Only Geha and Pelikan inks perform to the same level as the Brother ink, proving that the pigment inks provide better edge-holding capabilities on plain papers than dye inks. Note that the horizontal striping from the pigment Brother ink is further evidence that pigment inks do not spread on the paper.

Image transfer

Methodology

After conditioning for 24 hours after printing, five specimens of each ink/paper combination, glossy papers and plain papers (including both simplex and duplex samples of plain paper office documents) were prepared for testing by interleaving them between clean sheets of the test paper. Each sample was subjected to a load of approximately 7kPa (0.0714 Kg per square centimetre) for a period of seven days.

After 7 days under pressure, samples were examined for Image Transfer.

In addition, a set of 10 photos was printed with each ink/media combination and allowed to stack in the printer delivery tray. The stack was left in the delivery tray for 15 minutes after the final print emerged before being removed. Samples were transferred immediately for pressure testing, with no prior conditioning or extended drying time, and placed under a load of approximately 7kPa (0.0714 Kg per square centimetre) for a period of 24 hours.

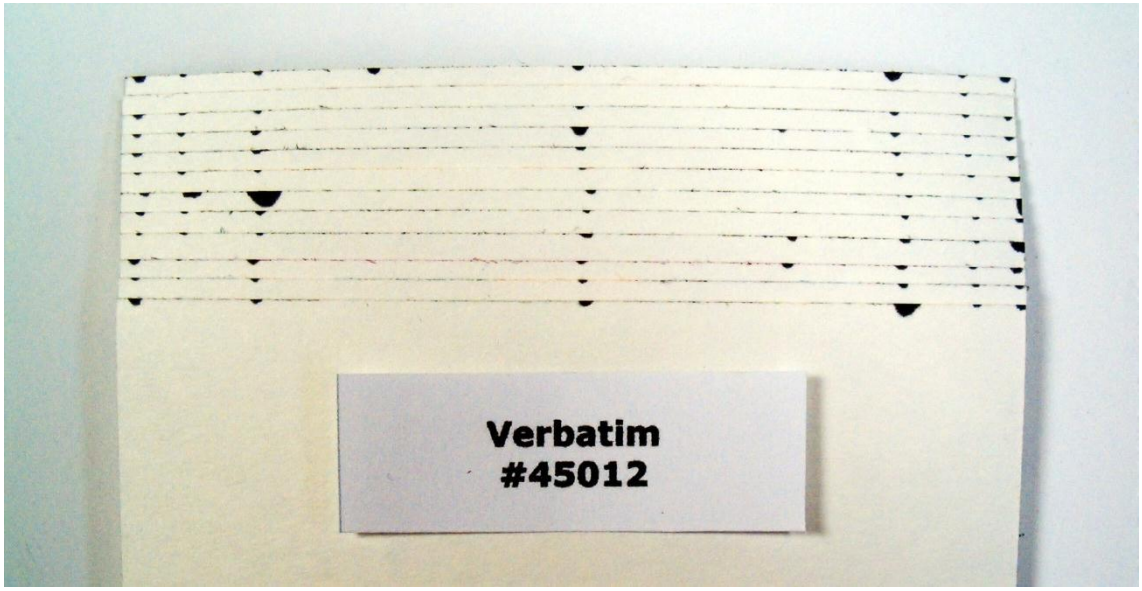
Prints were assessed for ink smearing on the reverse side of the photo media and were examined for Image Transfer after 24 hours under pressure.

Test results

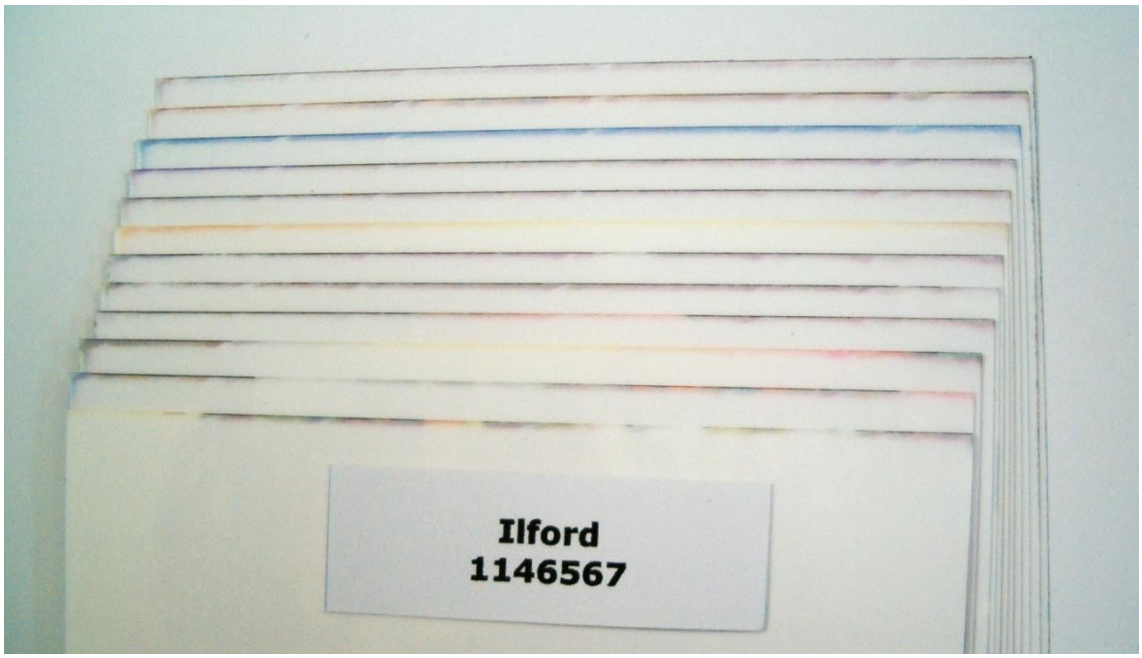
Testing showed that no image transfer occurred between any of the print samples, whether glossy or plain paper, simplex or duplex printing and regardless of ink and paper brand.

Other blemishes
Blemishes were found to occur only on glossy paper images.

Firstly, a small smear of ink could be picked up on the back of the paper, at the trailing edge of the sheet, from the exit path of the printer. This blemish was found to be linked with paper rather than ink, affecting all papers except for Ilford. Varying in its intensity across the ink and paper combinations, there is little consistency except that Verbatim paper tended to pick up the smear more than Inkrite and Brother papers.



Ilford paper, however, was found to be susceptible to ink leeching into the edge of the paper, especially the leading edge, when borderless photos were printed (not part of the formal test programme).



Neither of these blemishes affect the quality of the image itself, only the look and feel of the photos when handled.

Light Fastness – Indoor photo, without glass

Highlights

- Brother original inks are outperforming all third party inks by orders of magnitude
- Brother's original supplies reached failure point at 99.4 years
- Ilford's 1146567 glossy paper is outperforming Brother's BP71
- Brother's original inks on Ilford 1146567 paper is expected to fail at 123 years
- By 25 years of exposure, every sample other than those printed with Brother original inks had failed

Methodology

Light, both daylight and indoor fluorescent light, is destructive to both dyes and pigments, affecting paints and printing inks. Fade of ink with a poor chemical composition is very rapid while other inks can be designed to be more resistant to light. The degree and speed of fade is dependent both on the ink itself and the media used to print on, with media affecting the printing ecosystem as much as ink.

Test specimens (CPL-IPTT) printed on the four glossy photo papers were exposed to an intense fluorescent light source to simulate accelerated image fade as a result of normal exposure to office or home lighting. A total of 60 specimens were involved – one for each ink/paper combination.

Optical Density readings of the Cyan, Magenta, Yellow and Black colour blocks were taken before testing and at regular intervals during testing – approximately every five days – representing approximately five years of exposure. In addition to reading Optical Density at intervals, test samples were scanned to illustrate the comparative extent of fade.

Once a specimen demonstrates fade to the value of 30% average loss of Optical Density across the three primary colours (Cyan Magenta and Yellow), such that the image is reduced to 70% of its original state, the specimen is declared unusable.

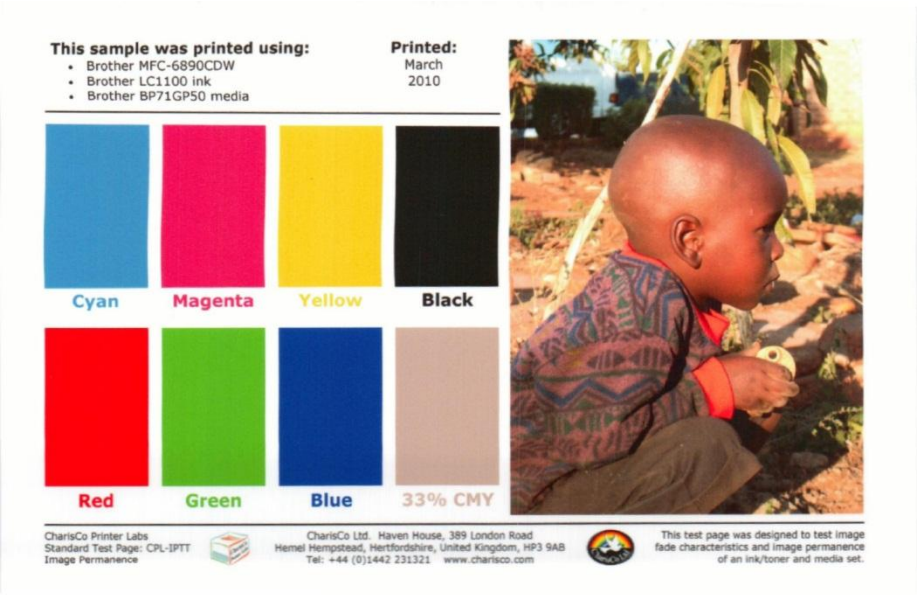
Time taken for specimens to reach this unusable state were recorded and compared and an estimate of Permanence (in years) calculated using the following formula, where it is assumed that display conditions involves exposure to an average light intensity of 500 Lux for 10 hours per day.

$$\text{Permanence (years)} = \frac{\text{test time (hours)} \times \text{test light intensity (Lux)}}{365 \text{ days} \times 10 \text{ hours} \times 500 \text{ Lux}}$$

Where light intensity = approximately 75,000 lux

Test results

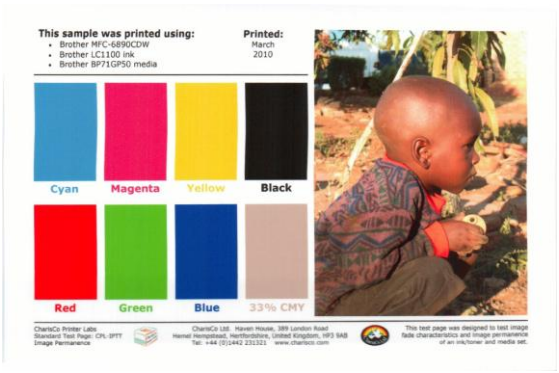
NB. For detailed results, please refer to the accompanying spreadsheet data and PDF files of scanned images.



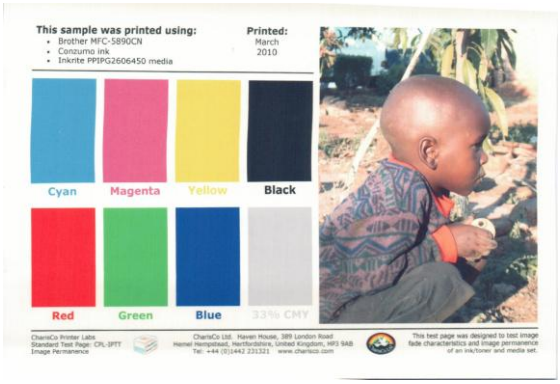
Scan of Brother original inks on Brother BP71 paper

Significant fade was noted right from the first inspection, with certain ink/paper combinations showing immediate failure of one ink at 5 years of exposure. These include Armor, Cartridge World, Conzumo, Geha, Pelikan, Printerinks and Stinky inks – all on Inkrite paper!

Performing worst was Conzumo ink on Inkrite paper, with failure occurring at around the 2½-year mark and showing 43% average CMY fade by the time five years had passed. Of the six other inks that also failed on Inkrite paper by the time five years had passed, average CMY fade at five years ranged from 31% to 40%.



Scan of Brother inks on Brother paper after 5 years – Av. image loss = 4.3%



Scan of Conzumo inks on Inkrite paper after 5 years – Av. image loss = 43.1%

Inkrite paper had failed with all of the third party inks by the time 10 years-worth of exposure had accumulated, while Brother inks on Inkrite paper had faded by only 11% and Brother inks on Brother paper by only 4.9%.

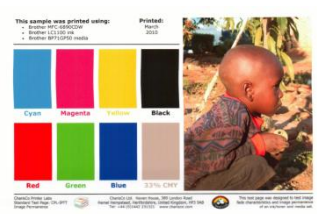
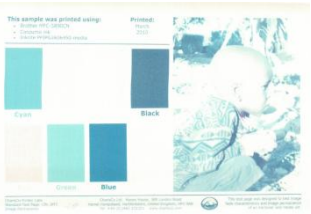
Performing best overall, almost regardless of ink, is actually Ilford's 1146567 glossy paper, where the worst fade after 10 years was 26% (Printerinks) but with only 3.2% fade using Brother's original inks. Brother's BP71 paper compared very well, experiencing only 4.9% fade after 10 years and actually beating Ilford's paper with Printerinks' ink with slightly lower fade of 21.5%.

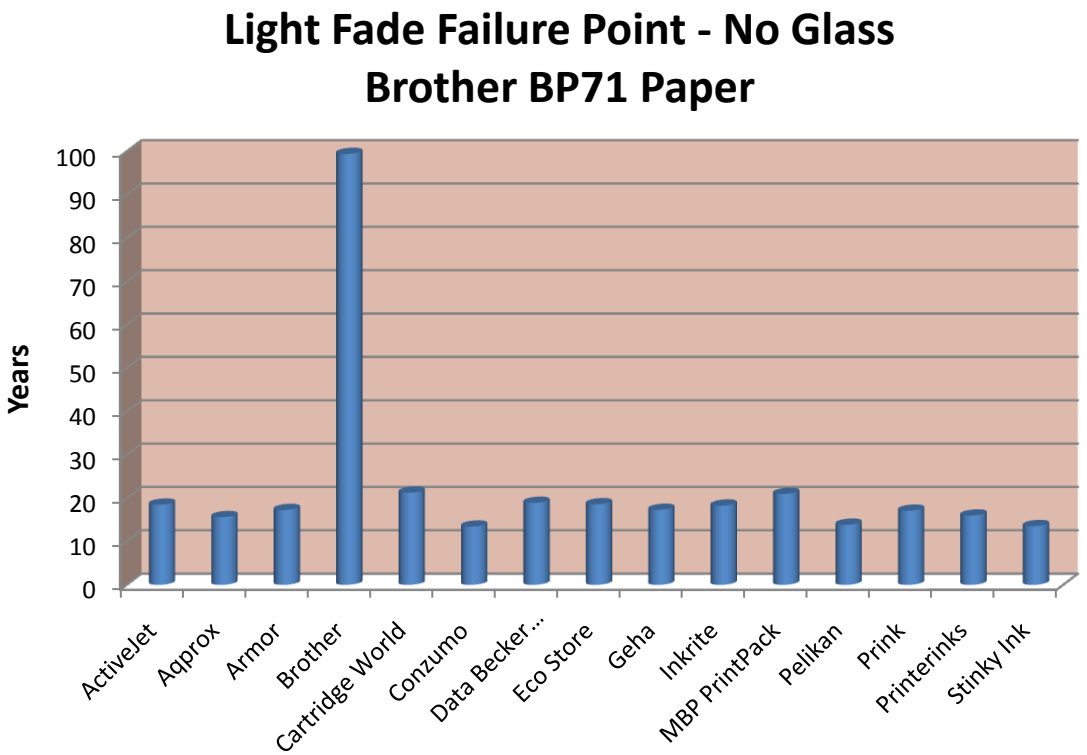
On average, Brother's ink on Brother's paper is virtually unbeatable, with only Ilford paper posing any threat – and then only when original Brother inks are used. Failure of this combination is expected to occur at 123 years, while Brother's original supplied failed at 99.4 years.

Every third party ink had failed on all four papers (Brother BP71 included) by the 25-year point.

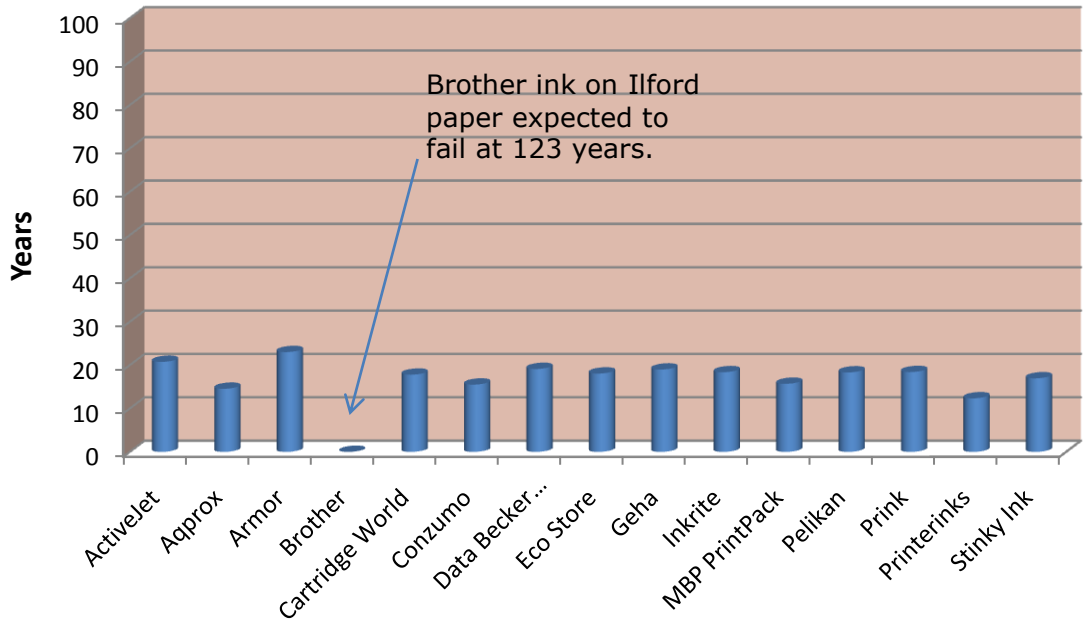
	Failure point (To 100yrs) - Years			
	Brother	**Ilford**	**Inkrite**	**Verbatim**
ActiveJet	18.5	20.8	6.5	8.7
Aqprox!	15.6	14.6	6.6	10.8
Armor	17.3	23.0	2.5	7.8
Brother	99.4	(-24.5%)	52.5	86.5
Cartridge World	21.3	17.8	2.8	8.6
Conzumo	13.4	15.5	2.1	8.1
Data Becker PrintMaxx	18.9	19.1	7.9	12.4
Eco Store	18.6	18.1	6.8	11.1
Geha	17.3	19.0	2.3	8.0
Inkrite	18.3	18.4	7.6	12.4
MBP PrintPack	21.0	15.7	6.6	8.7
Pelikan	13.9	18.3	2.2	7.5
Prink	17.1	18.4	7.3	12.7
Printerinks	16.0	12.4	2.9	7.9
Stinky Ink	13.5	17.0	2.6	7.6

Note: Exposure has reached 100 years and Brother inks on Ilford paper have suffered just 24.5% average CMY image loss, suggesting a probably failure point of approximately 123 years.

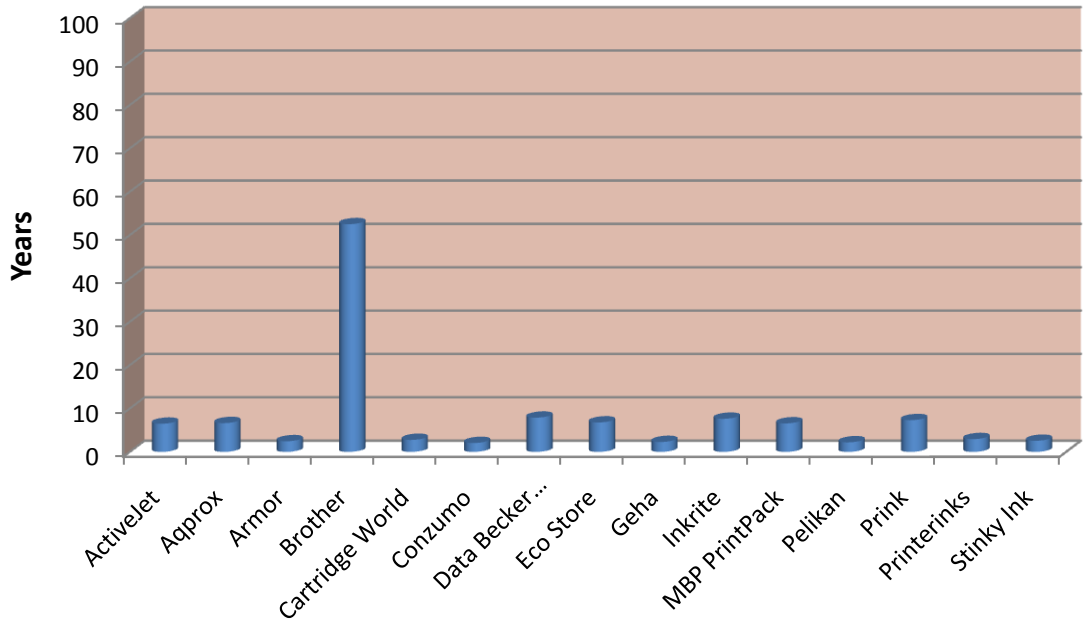
	Zero years	50 years	100 years
Brother paper Brother inks			
Ilford paper Armor inks			
Inkrite paper Conzumo inks			

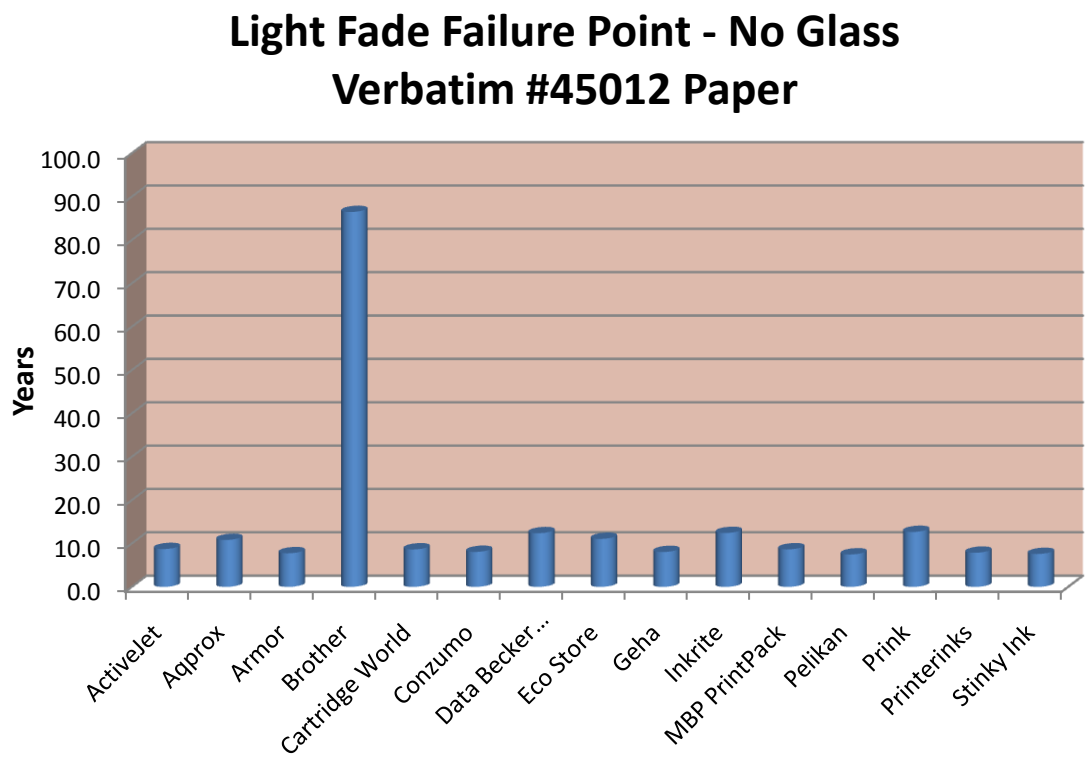


Light Fade Failure Point - No Glass
Ilford 1146567 Paper

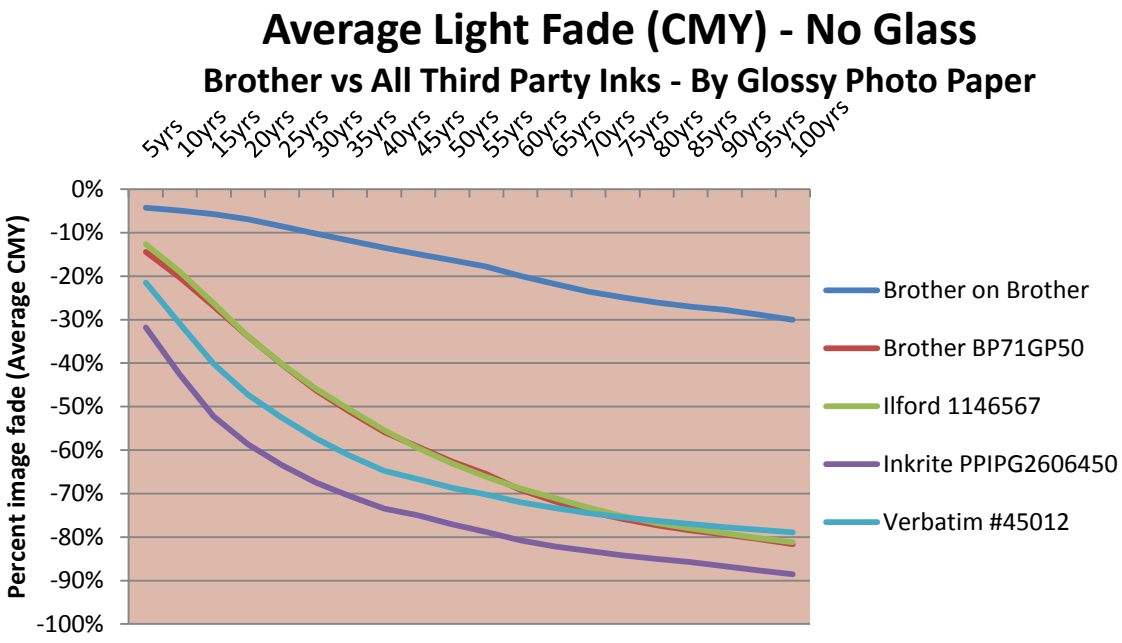


Light Fade Failure Point - No Glass
Inkrite PPIPG2606450 Paper

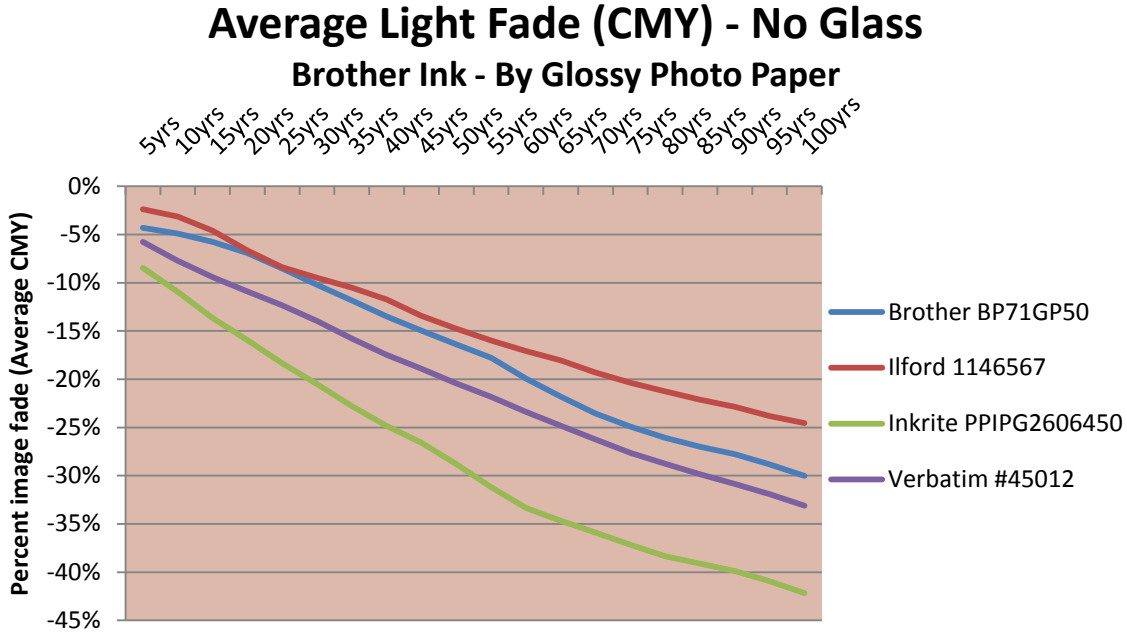




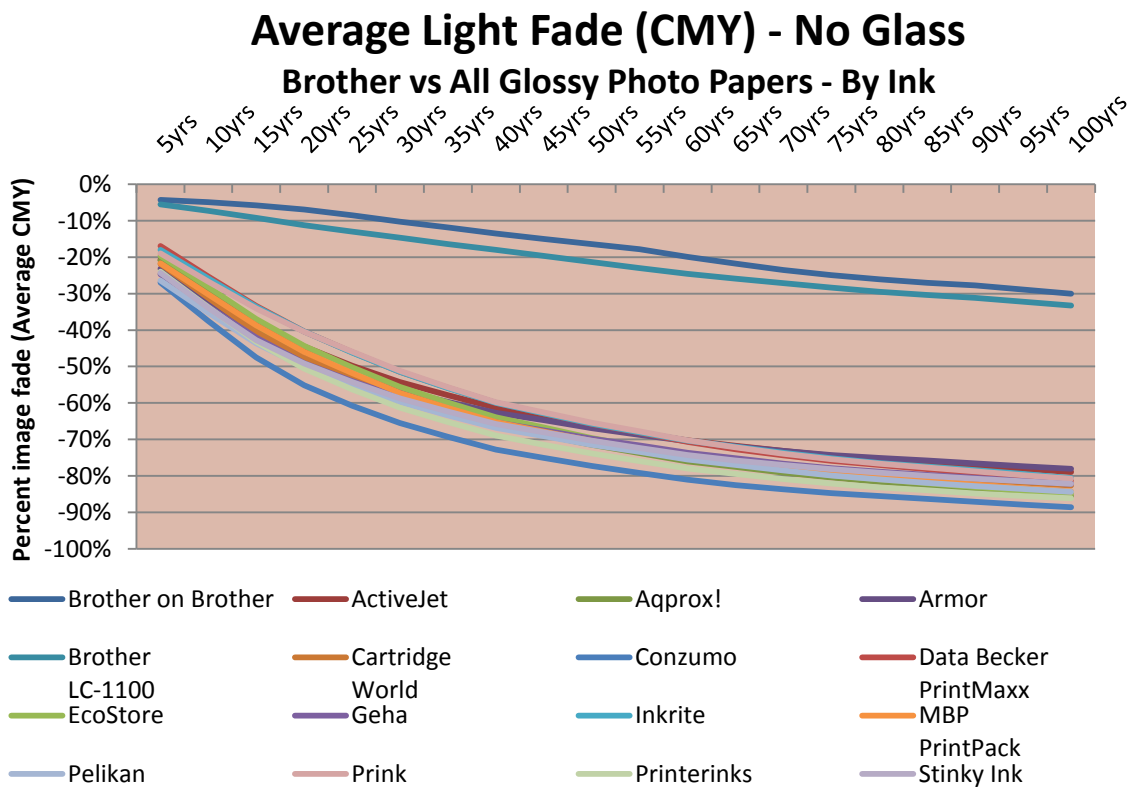
Brother's original supplies outperformed all third party supplies combinations by orders of magnitude.

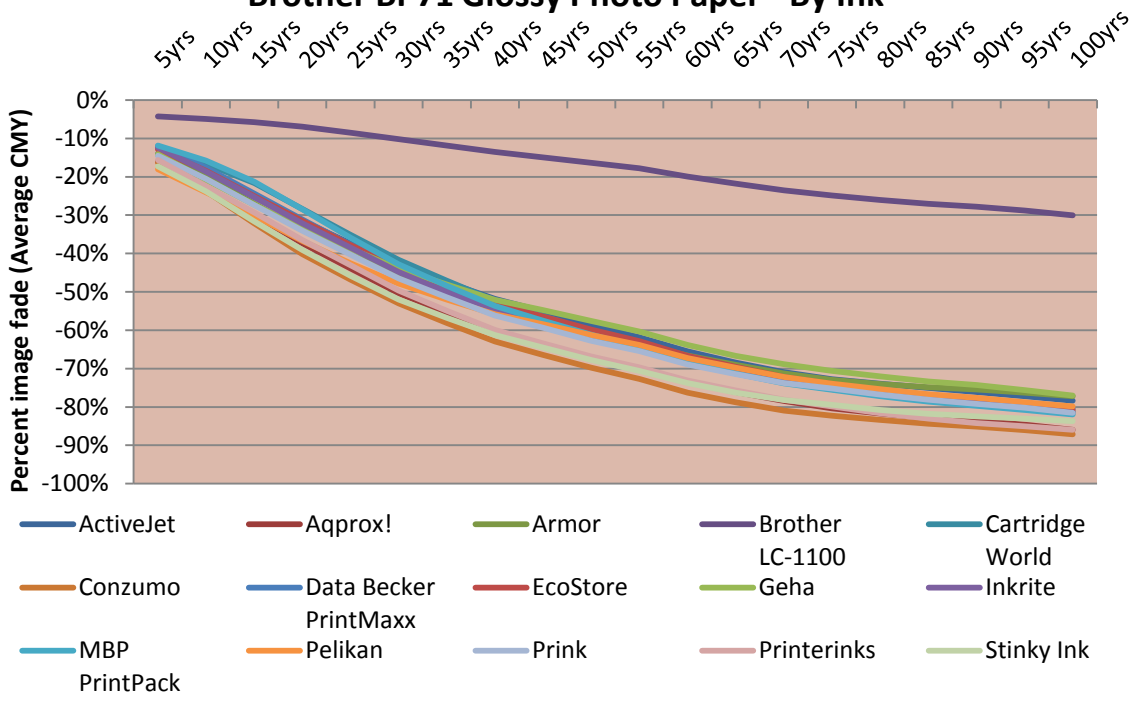


Only Ilford's glossy paper outperforms Brother's BP71. However, this is only significant when Brother original inks are used.



Emphasising the fact that ink quality has a more significant impact on durability than paper quality, when comparing inks (using average fade over all papers), the chart below shows that Brother's original inks again outperformed every third party ink by orders of magnitude. Indeed, average CMY fade of Brother inks, taken as an average over all papers, does not exhibiting a great deal more fade than the Brother on Brother combination.


Average Light Fade (CMY) - No Glass
Brother vs All Glossy Photo Papers - By Ink
Percent image fade (Average CMY)
5yrs 10yrs 15yrs 20yrs 25yrs 30yrs 35yrs 40yrs 45yrs 50yrs 55yrs 60yrs 65yrs 70yrs 75yrs 80yrs 85yrs 90yrs 95yrs 100yrs
0% -10% -20% -30% -40% -50% -60% -70% -80% -90% -100%
Brother on Brother
ActiveJet
Aqprox!
Armor
Brother LC-1100
Cartridge World
Conzumo
Data Becker PrintMaxx
EcoStore
Geha
Inkrite
MBP PrintPack
Pelikan
Prink
Printerinks
Stinky Ink


Average Light Fade (CMY) - No Glass
Brother BP71 Glossy Photo Paper - By Ink
Percent image fade (Average CMY)
5yrs 10yrs 15yrs 20yrs 25yrs 30yrs 35yrs 40yrs 45yrs 50yrs 55yrs 60yrs 65yrs 70yrs 75yrs 80yrs 85yrs 90yrs 95yrs 100yrs
0% -10% -20% -30% -40% -50% -60% -70% -80% -90% -100%
ActiveJet
Aqprox!
Armor
Brother LC-1100
Cartridge World
Conzumo
Data Becker PrintMaxx
EcoStore
Geha
Inkrite
MBP PrintPack
Pelikan
Prink
Printerinks
Stinky Ink

Light Fastness – Indoor photo behind glass

Highlights

- Brother inks on Brother BP71 paper outperforms all third party ink/paper combinations
- Inkrite paper has performed universally poorly
- Ilford paper has performed universally well
- Armor and Conzumo inks on Inkrite paper failed well within 10 years of exposure
- Use of OEM brand inks is more significant to durability against light fade than use of OEM brand paper
- While Conzumo ink on Inkrite paper lost 30% image density after 6.7 years, Brother inks on Brother BP71 paper lost only 6% image density in 100 years (approximately 76x the light fade performance!).

Methodology

Glass offers some protection to photos, causing reduced fade over time compared to photos not protected by glass.

For health and safety reasons, the glass used is 6mm laminated glass and is therefore liable to offer greater protection than standard 2mm or 3mm photo frame glass. However, the relative performance of inks and papers is valid.

Test specimens (CPL-IPTT) printed on the four glossy photo papers were exposed to an intense fluorescent light source to simulate accelerated image fade as a result of normal exposure to office or home lighting as if in photo frame protected by glass. A total of 60 specimens were involved – one for each ink/paper combination.

Optical Density readings of the Cyan, Magenta, Yellow and Black colour blocks were taken before testing and at regular intervals during testing – approximately every five days – representing approximately five years of exposure. In addition to reading Optical Density at intervals, test samples were scanned to illustrate the comparative extent of fade.

Once a specimen demonstrates fade to the value of 30% average loss of Optical Density across the three primary colours (Cyan Magenta and Yellow), such that the image is reduced to 70% of its original state, the specimen is declared unusable.

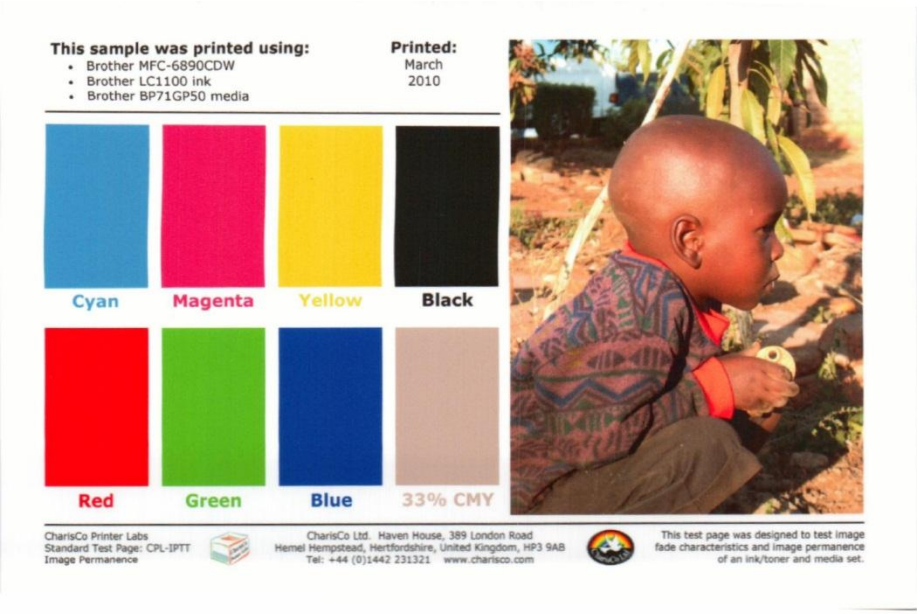
Time taken for specimens to reach this unusable state will be recorded and compared and an estimate of Permanence (in years) calculated using the following formula, where it is assumed that display conditions involves exposure to an average light intensity of 500 Lux for 10 hours per day.

$$\text{Permanence (years)} = \frac{\text{test time (hours)} \times \text{test light intensity (Lux)}}{365 \text{ days} \times 10 \text{ hours} \times 500 \text{ Lux}}$$

Where light intensity = approximately 75,000 lux

Test results

NB. For detailed results, please refer to the accompanying spreadsheet data for UV fade and PDF files of scanned images.



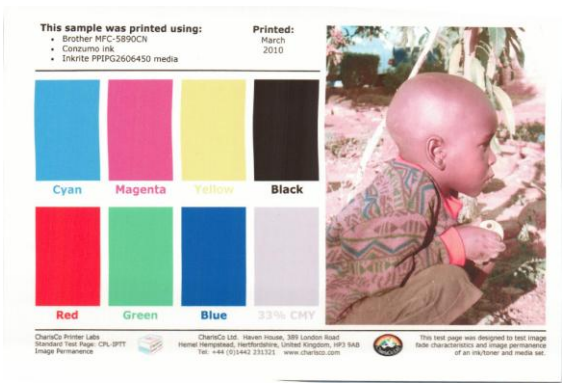
Scan of Brother original inks on Brother BP71 paper

Despite the protection afforded by the glass covering, a surprisingly high degree of light fade was noted right from the first inspection. Although fade is considerably suppressed by comparison to the unprotected samples, two ink/paper combinations failed after just 10 years of exposure, with three more following at the 15-year mark.

Those failing at 10 years, Armor and Conzumo inks on Inkrite paper, experienced huge levels of fade from the Yellow ink, losing 47% and 40% respectively in the first 5 years-worth of exposure.

Scan of Brother inks on Brother paper after 10 years – Av. image loss = 2.2%

Scan of Armor inks on Inkrite paper after 5 years – Av. image loss = 38.0%



Scan of Conzumo inks on Inkrite paper after 5 years – Av. image loss = 41.7%

By the time the samples had experienced 20 years of exposure, Inkrite paper had failed with eight of the 14 third party inks. By contrast, only two of the samples on other papers had failed at that point – again involving Armor and Conzumo inks, this time on Verbatim paper – while Brother original inks had faded by only 3.3% on Brother and Ilford papers and only 10% on Inkrite paper.

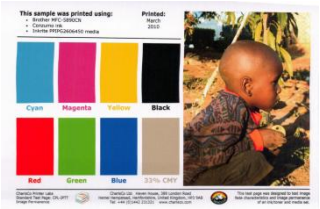
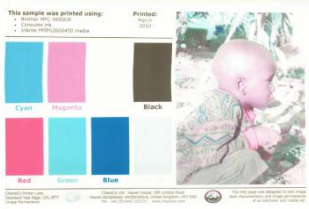
Brother original ink on Brother BP71 paper is outperforming all third party ink/paper combinations by orders of magnitude. However, where glossy photo papers are concerned, Ilford paper is performing at a level equivalent overall to Brother BP71 and often exceeding its performance.

On the other hand, Inkrite paper is a consistent poor performer.

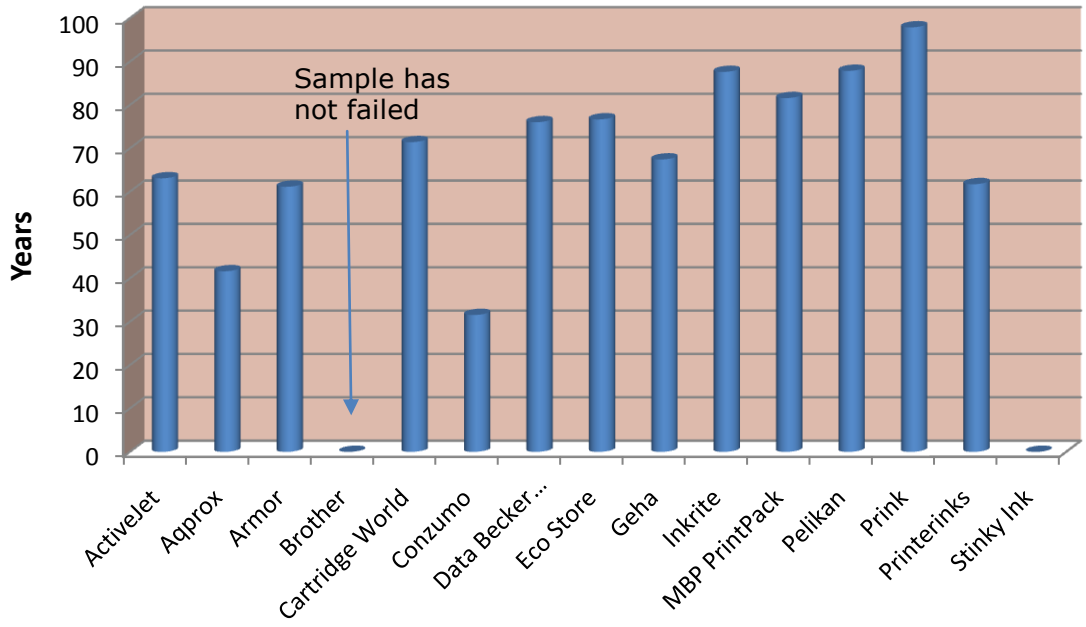
	Failure point (To 100yrs) - Years			
	Brother	**Ilford**	**Inkrite**	**Verbatim**
ActiveJet	57.5	63.1	16.9	26.6
Aqprox!	48.6	41.7	18.7	27.7
Armor	40.0	61.2	7.4	16.8
Brother	(-5.9%)	(-6.2%)	(-15%)	(-7.9%)
Cartridge World	56.8	71.5	12.8	26.6
Conzumo	37.0	31.6	6.7	18.6
Data Becker PrintMaxx	76.2	76.3	38.1	52.8
Eco Store	82.8	76.7	27.8	42.5
Geha	76.1	67.5	11.5	27.5
Inkrite	88.6	87.6	38.3	52.7
MBP PrintPack	81.8	81.6	37.9	52.6
Pelikan	81.8	87.9	11.5	28.4
Prink	92.9	97.9	32.5	73.9
Printerinks	84.2	61.7	27.3	47.4
Stinky Ink	66.6	(-29.7%)	16.7	32.2

Note: Exposure has reached 100 years and Brother inks are still far from reaching failure point. Stinky Inks are just on the cusp of reaching failure point.

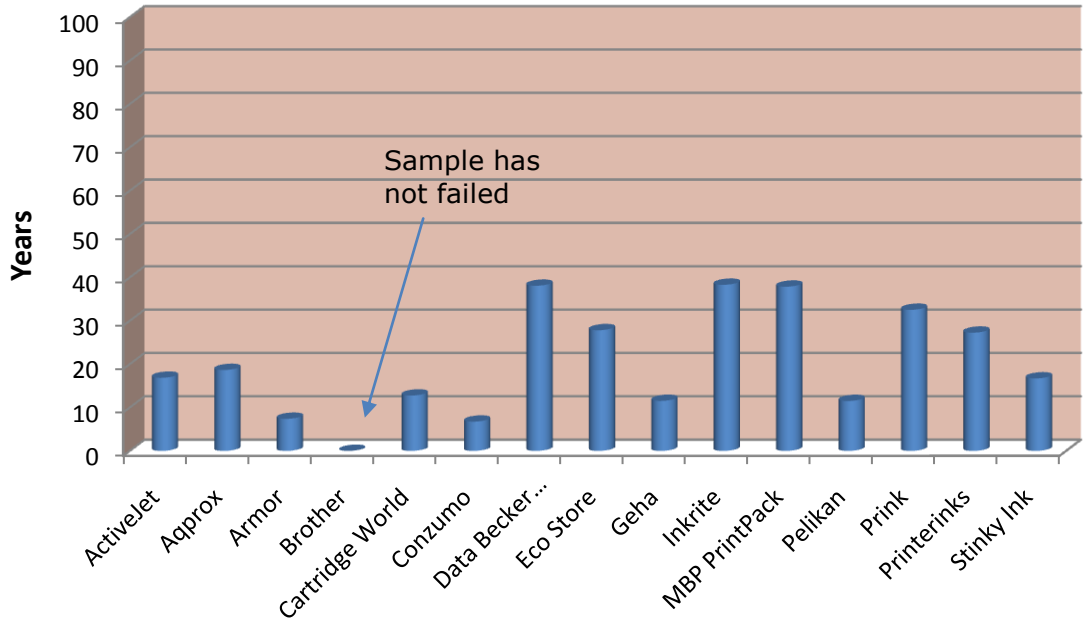
At the 100-year point, Brother original supplies have still not faded by more than 6%, whereas the first third party ink/paper combination (Conzumo ink of Inkrite paper) failed after just 6.7 years (30% average loss of CMY image).

	Zero years	50 years	100 years
Brother paper Brother inks			
Ilford paper Prink inks			
Inkrite paper Conzumo inks			

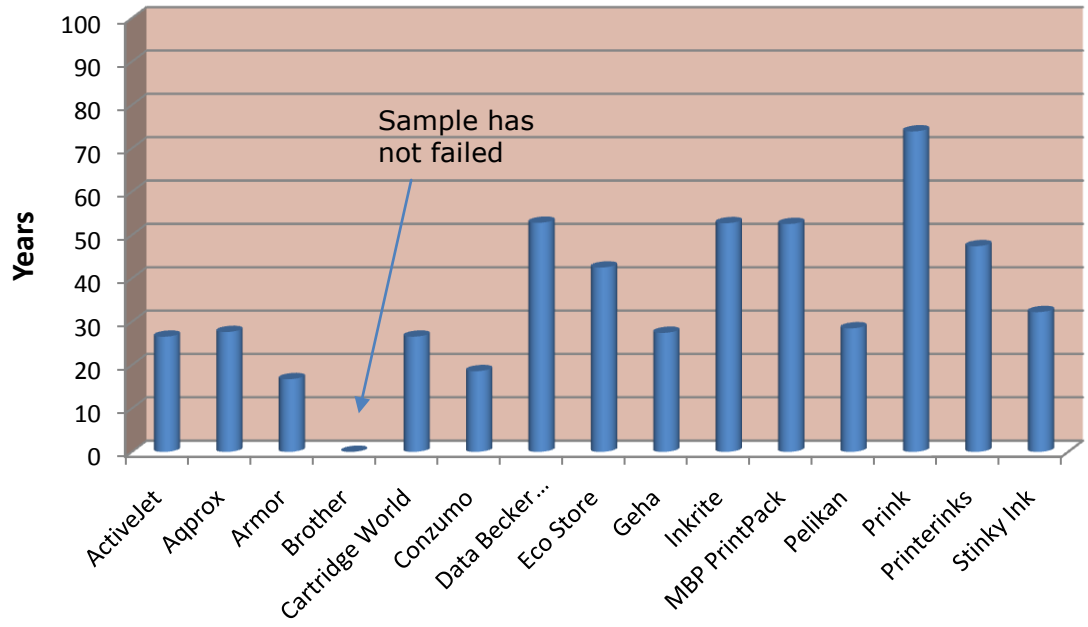
Light Fade Failure Point - With Glass
Ilford 1146567 Paper



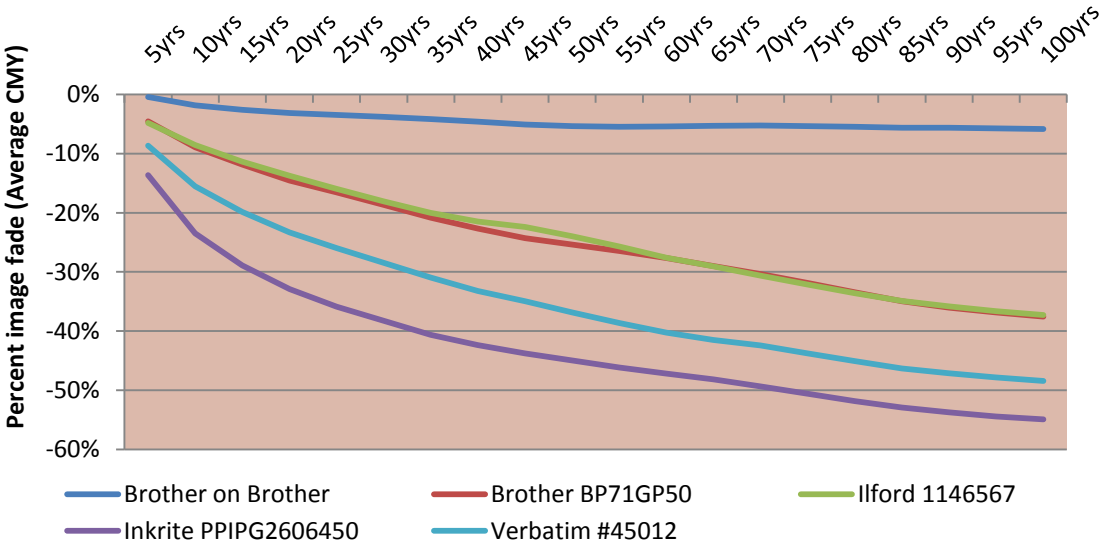
Light Fade Failure Point - With Glass
Inkrite PPIPG2606450 Paper



Light Fade Failure Point - With Glass
Verbatim #45012 Paper

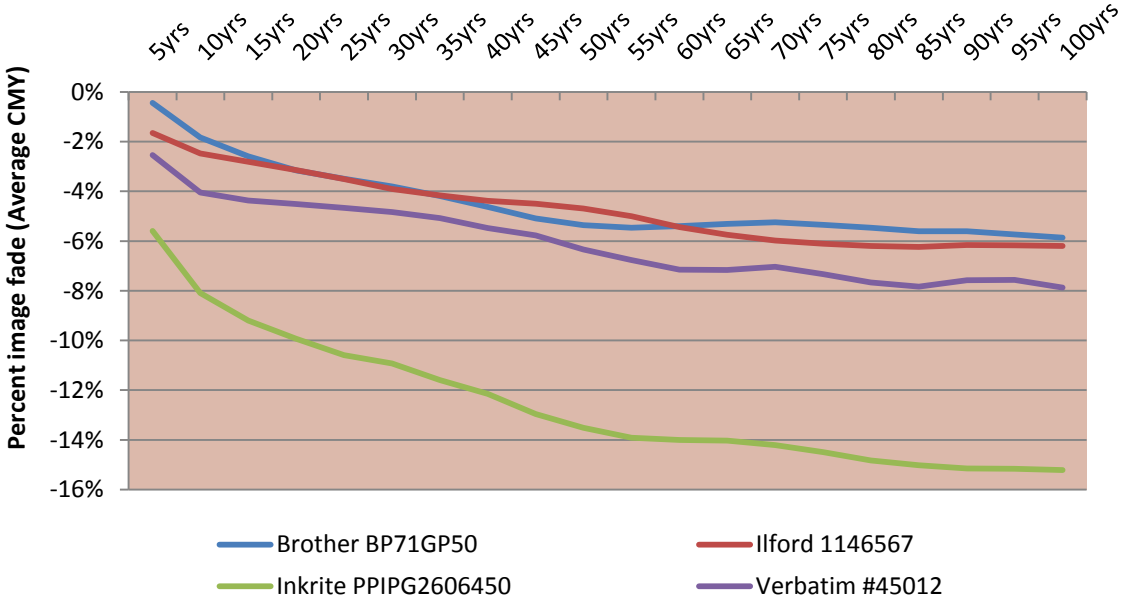


Average Light Fade (CMY) - With Glass
Brother vs All Third Party Inks - By Glossy Photo Paper



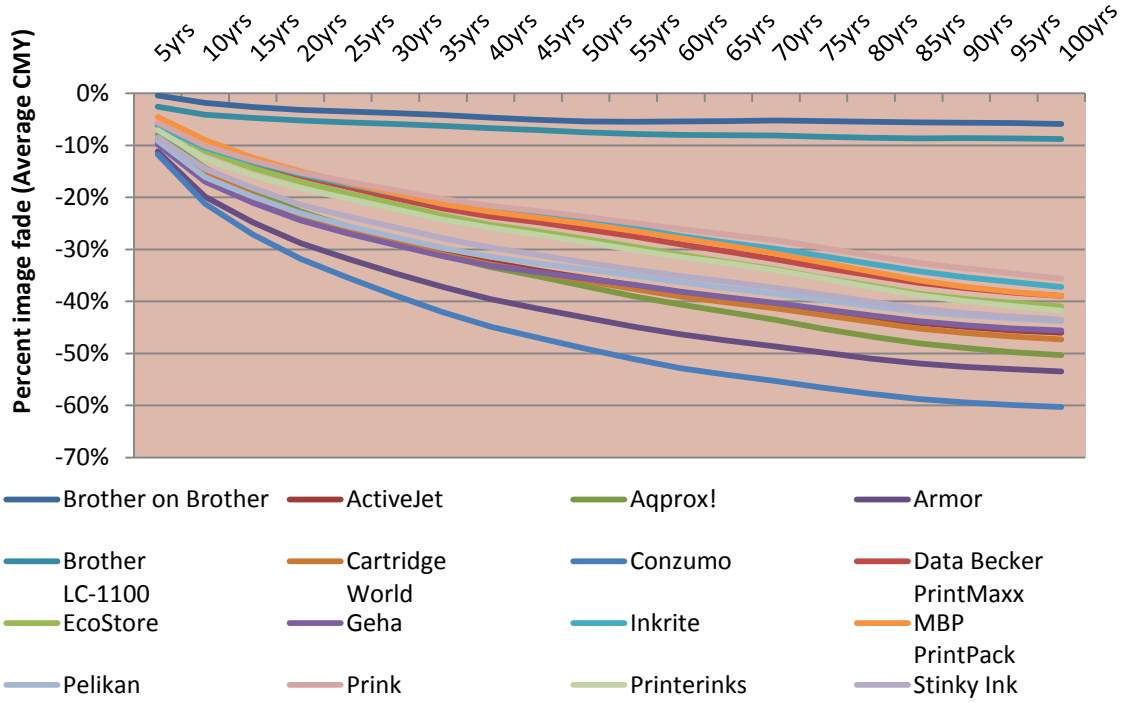
Average Light Fade (CMY) - With Glass

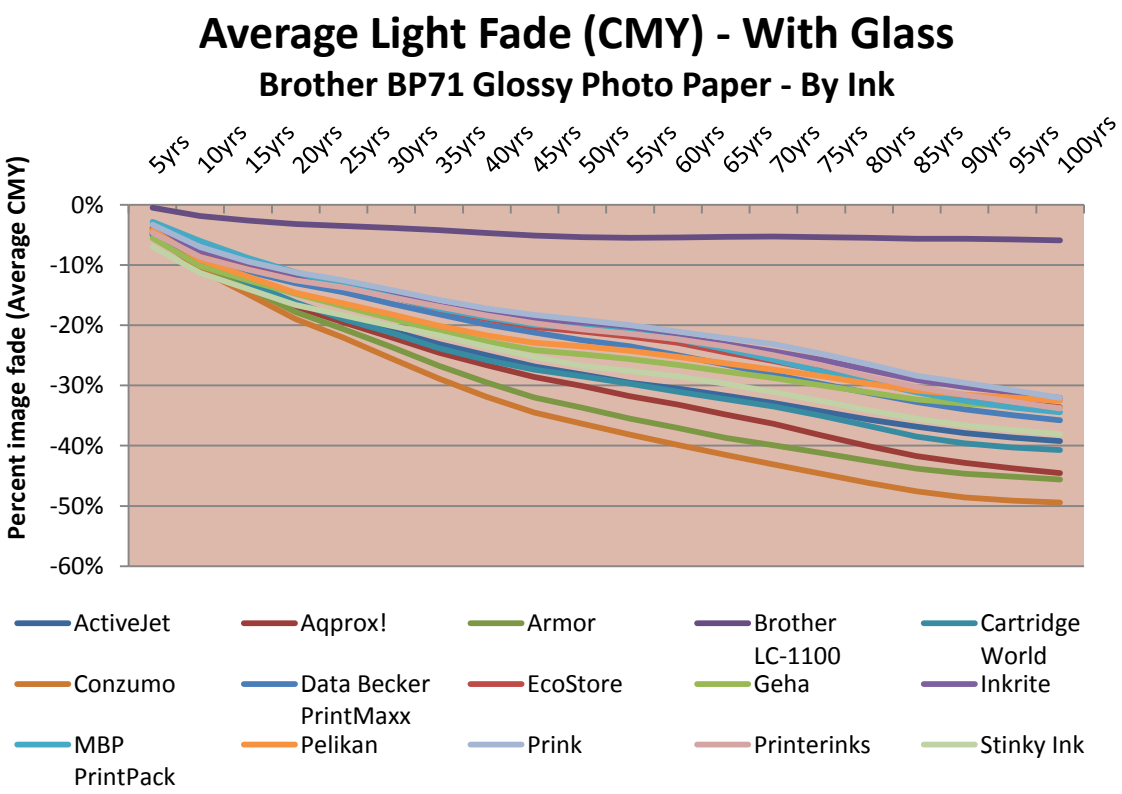
Brother Ink - By Glossy Photo Paper



Average Light Fade (CMY) - With Glass

Brother vs All Glossy Photo Papers - By Ink




Average Light Fade (CMY) - With Glass
Brother BP71 Glossy Photo Paper - By Ink
Percent image fade (Average CMY)
5yrs
10yrs
15yrs
20yrs
25yrs
30yrs
35yrs
40yrs
45yrs
50yrs
55yrs
60yrs
65yrs
70yrs
75yrs
80yrs
85yrs
90yrs
95yrs
100yrs
0%
-10%
-20%
-30%
-40%
-50%
-60%
ActiveJet
Aqprox!
Armor
Brother LC-1100
Cartridge World
Conzumo
Data Becker PrintMaxx
EcoStore
Geha
Inkrite
MBP PrintPack
Pelikan
Prink
Printerinks
Stinky Ink

Light Fastness – Office document without glass

Highlights

- Brother inks outperformed third party inks by at least 21½ years (126%) on Brother BP60 inkjet paper and around 15 years (63.5%) on Xerox Performer plain office paper
- Using Brother original inks, Brother BP60 and Xerox Performer papers maintained quality to almost precisely the same extent, failing at 38.7 and 38.1 years respectively
- In all but one instance (Prink), third party inks on Xerox Performer plain paper outperformed third party inks on Brother BP60 paper – by between 11% and 98%
- Failing at only 8.5 years, Conzumo inks again proved to be the poorest ink set tested

Methodology

Light, both daylight and indoor fluorescent light, is destructive to both dyes and pigments, affecting paints and printing inks. Fade of ink with a poor chemical composition is very rapid while other inks can be designed to be more resistant to light. The degree and speed of fade is dependent both on the ink itself and the media used to print on, with media affecting the printing ecosystem as much as ink.

Test specimens (CPL20DP) printed on the two office plain papers were exposed to an intense fluorescent light source to simulate accelerated image fade as a result of normal exposure to office or home lighting. A total of 30 specimens were involved – one for each ink/paper combination.

Optical Density readings were taken for each of the primary colours (Cyan Magenta and Yellow) in the Blue and Red segments of the pie chart and in the Yellow background fill of the chart before testing and at regular intervals during testing – approximately every five days – representing approximately five years of exposure. In addition to reading Optical Density at intervals, test samples were scanned to illustrate the comparative extent of fade.

Once a specimen demonstrates fade to the value of 50% average loss of Optical Density across the three primary colours (Cyan Magenta and Yellow) in the coloured fills, such that the image is reduced to 50% of its original state, the specimen is declared unusable.

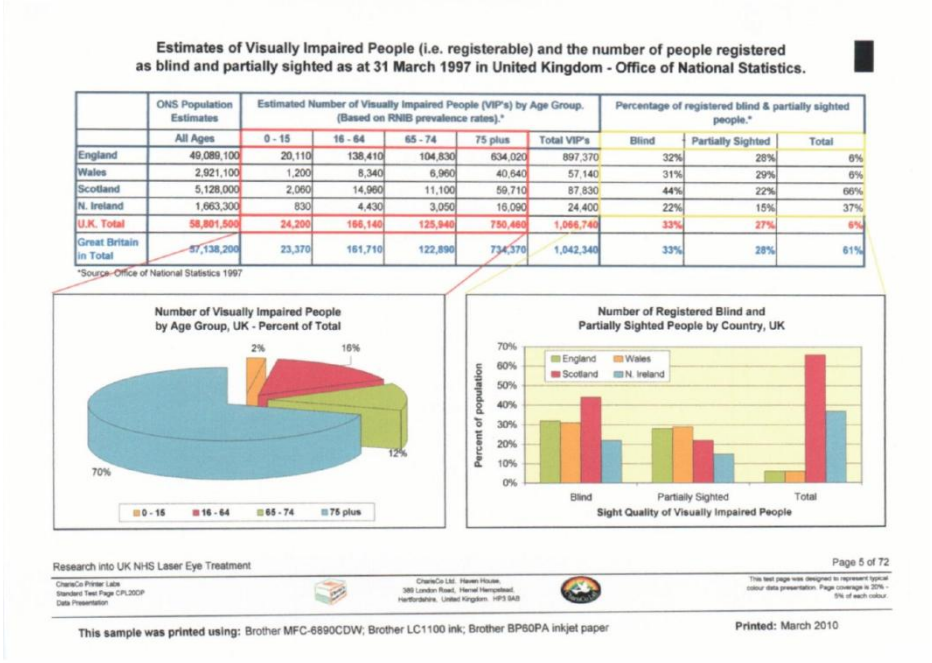
Time taken for specimens to reach this unusable state were recorded and compared and an estimate of Permanence (in years) calculated using the following formula, where it is assumed that display conditions involves exposure to an average light intensity of 500 Lux for 10 hours per day.

$$\text{Permanence (years)} = \frac{\text{test time (hours)} \times \text{test light intensity (Lux)}}{365 \text{ days} \times 10 \text{ hours} \times 500 \text{ Lux}}$$

Where light intensity = approximately 75,000 lux

Test results

NB. For detailed results, please refer to the accompanying spreadsheet data and PDF files of scanned images.



Estimates of Visually Impaired People (i.e. registerable) and the number of people registered as blind and partially sighted as at 31 March 1997 in United Kingdom - Office of National Statistics.

	ONS Population Estimates	Estimated Number of Visually Impaired People (VIP's) by Age Group. (Based on RNIB prevalence rates).*					Percentage of registered blind & partially sighted people.*		
	All Ages	0 - 15	16 - 64	65 - 74	75 plus	Total VIP's	Blind	Partially Sighted	Total
England	49,089,100	20,110	138,410	104,830	634,020	897,370	32%	28%	6%
Wales	2,921,100	1,200	8,340	6,960	40,640	57,140	31%	29%	6%
Scotland	5,128,000	2,060	14,960	11,100	59,710	87,830	44%	22%	66%
N. Ireland	1,663,300	830	4,430	3,050	16,090	24,400	22%	15%	37%
U.K. Total	58,801,500	24,200	166,140	125,940	750,460	1,066,740	33%	27%	6%
Great Britain in Total	57,138,200	23,370	161,710	122,890	734,370	1,042,340	33%	28%	61%

*Source: Office of National Statistics 1997

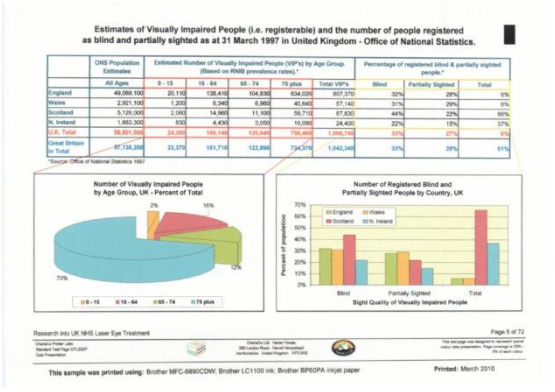
Scan of Brother original inks on Brother BP60 paper

While Cyan inks are again noted as being the most resistant to light fade, significant fade is also noted again from the outset. Eight (27%) of the ink/paper combinations had failed (to 50% of original Optical Density) after only 10 years of exposure and a further 13 (43%) had failed by the 15-year inspection.

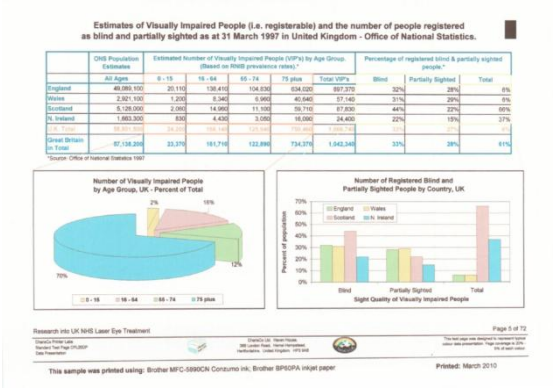
Other than straight life-expectancy, it should be noted that pigment black inks (Brother, Geha and Pelikan) prove to be far more durable than the remaining third party black inks, which are dye-based. There was little, if any, degradation of pigmented text and lines, whereas significant degradation of dye-based black text and lines is observed.

Brother BP60 inkjet paper

Performing worst on Brother BP60 paper by a short margin was Conzumo, failing at the 8½-year mark. Even at the 5-year point, the yellow ink had faded by 32% in the blue fill, 41% in the red fill and 51% in the yellow background fill. In the red fill, Magenta ink had faded by just over 45% in the same timescale.



Scan of Brother inks on Brother paper after 10 years – Av. image loss = 17.3%



Scan of Conzumo inks on Brother paper after 5 years – Av. image loss = 54.8%

Following close behind, failing at between 8.6 and 9.2 years, were ActiveJet, Aqprox!, Armor, Cartridge World, Inkrite, Printer Inks and Stinky Ink.

Most of the remaining third party inks (Data Becker PrintMaxx, EcoStore, Geha, MBP PrintPack and Pelikan) did not fail till the 12-year point was approaching – 11.7yrs/11.8yrs. Prink, all on its own, proved most durable of the third party inks, surviving till 17.1 years before failing.

Brother inks (failing at 38.7 years) outlasted the best of the third party inks by a margin of 126%, outlasting the worst by more than 3½ times (355%).

Xerox Performer plain paper

Printing on a basic everyday plain paper produced some surprisingly different results.

Here, we find that the two most durable ink sets when printed on Brother BP60 inkjet paper (Brother and Prink) perform slightly worse on the generic plain paper. Brother's inks failed at 38.1 years instead of 38.7 years while Prink inks failed at 16.9 years instead of 17.1 years. *These differences should not be considered to be statistically significant.*

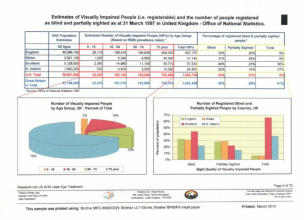
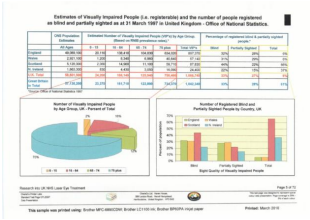
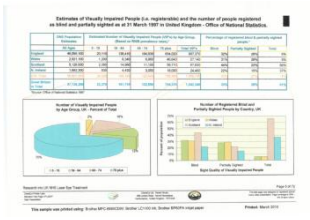
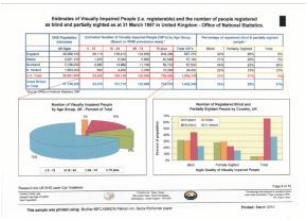
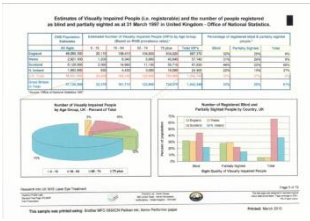
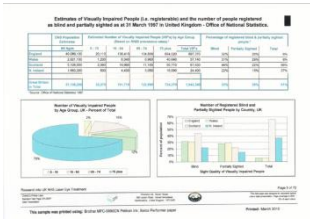
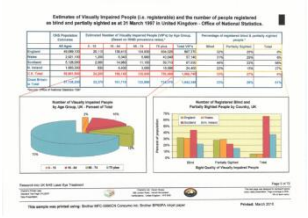
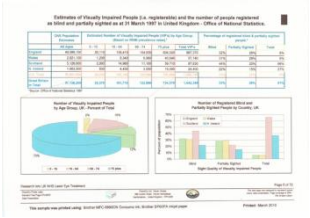
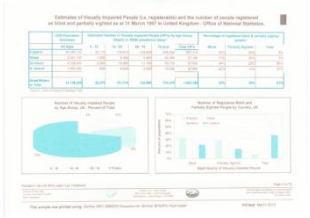
However, the opposite is true of all other inks in the test. Here we find that Xerox Performer paper held the image better than the Brother BP60 paper.

Conzumo inks did not fail till 13.1 years – a 55% improvement, while the worst performer this time proved to be Armor, which failed after 12.4 years – an improvement of only 35%.

Amongst the other third party inks, we find that Pelikan performed best, not failing till the 23.3-year point and demonstrating a 98% improvement over the durability of those same inks printed on Brother BP60. Geha inks (identical cartridge set to Pelikan and also using pigment black inks), proved to be the next most durable of the third party inks, failing at 17.7 years – a 50% improvement.

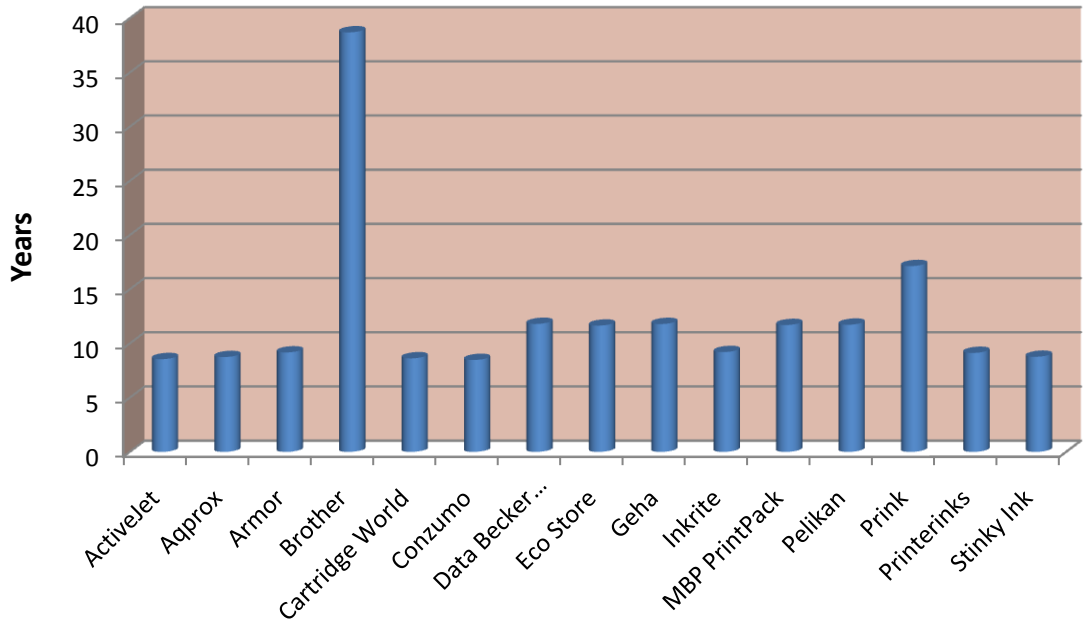
All remaining third party inks failed between about 13 and 17 years, demonstrating an improvement ranging between just 11% (Data Becker PrintMaxx and EcoStore) and 91% (Aqprox!).

With all samples having been exposed until the time that the Brother ink samples reached failure point, almost all of the third party samples displayed very little image remaining at the 40-year point when the test was terminated.

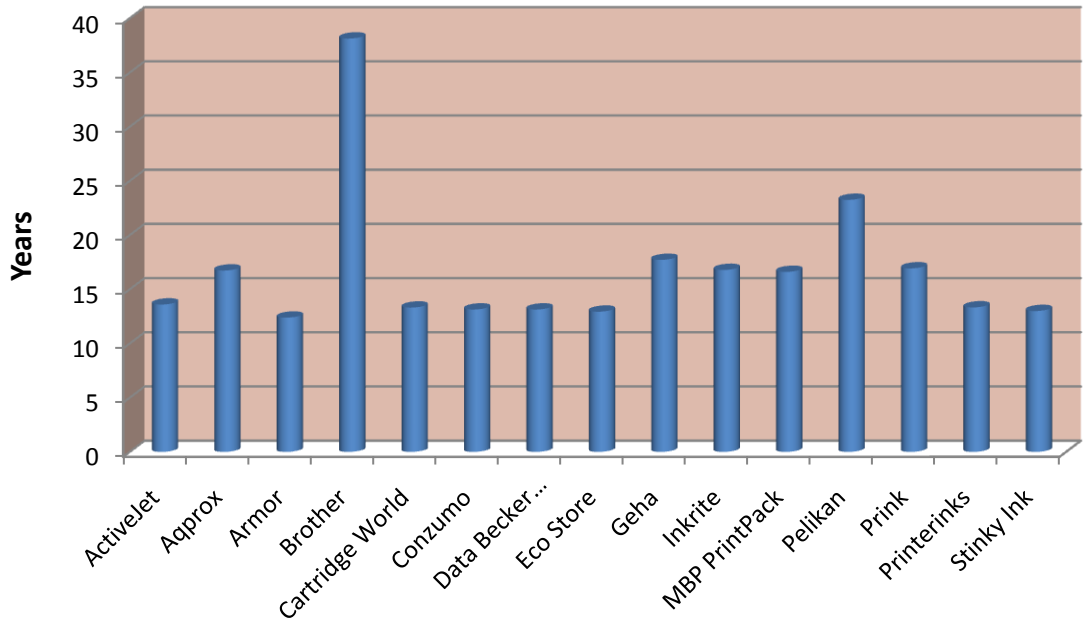
	Zero exposure	10 years	40 years
Brother paper Brother inks			
Xerox paper Pelikan Inks			
Brother paper Conzumo inks			

	Failure point - Years	
	Brother	Xerox
ActiveJet	8.6	13.6
Aqprox!	8.8	16.7
Armor	9.2	12.4
Brother	38.7	38.1
Cartridge World	8.6	13.3
Conzumo	8.5	13.1
Data Becker PrintMaxx	11.8	13.1
Eco Store	11.7	12.9
Geha	11.8	17.7
Inkrite	9.2	16.8
MBP PrintPack	11.7	16.6
Pelikan	11.7	23.3
Prink	17.1	16.9
Printerinks	9.1	13.3
Stinky Ink	8.8	13.0

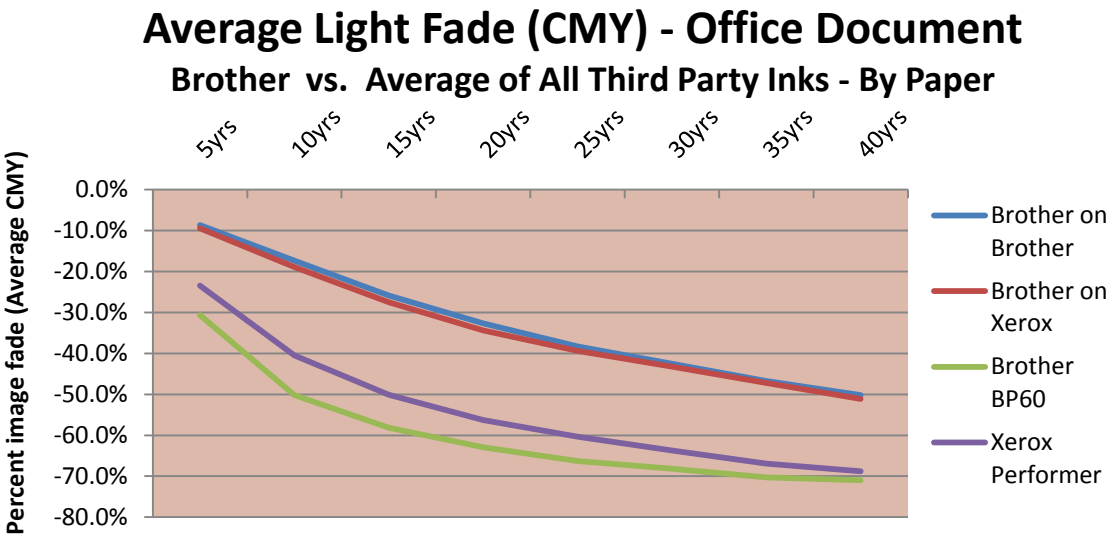
White Light Fade Failure Point
Office Document - Brother BP60 Inkjet Paper



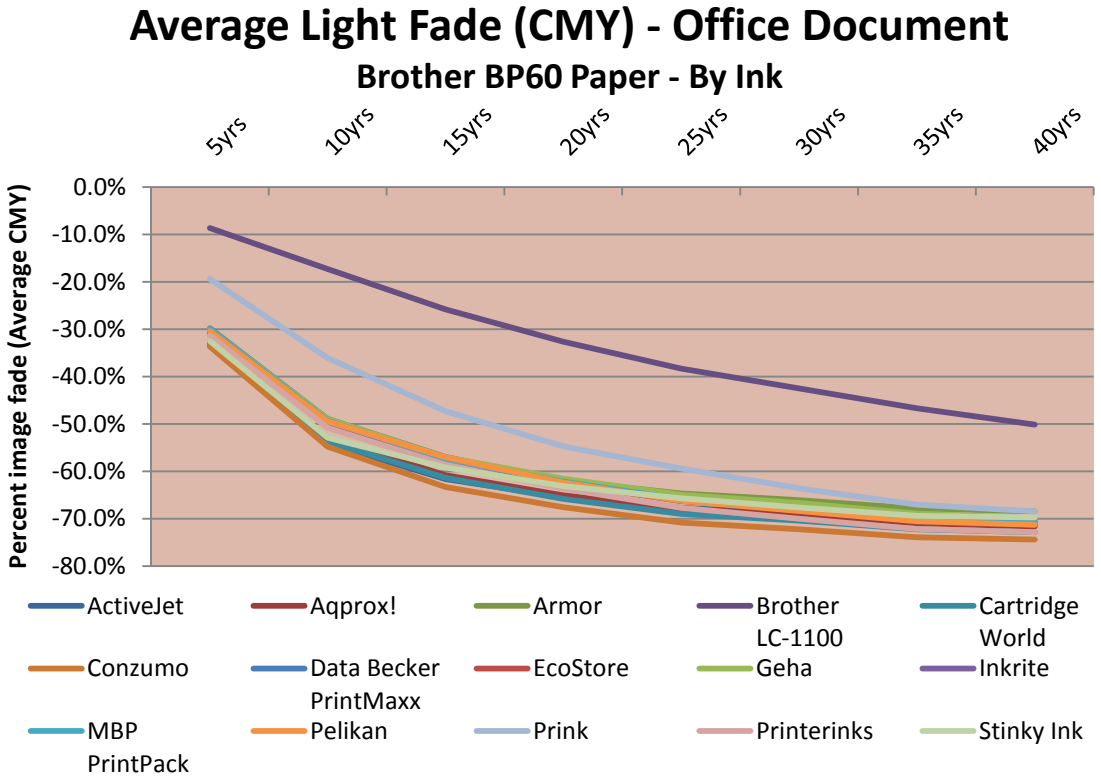
White Light Fade Failure Point
Office Document - Xerox Performer Plain Paper



Below, we see again that original branded ink is the more important factor in achieving high image durability over use of OEM branded paper. Whether printed on Brother or Xerox paper, the Brother inks faded significantly less than the third party inks.

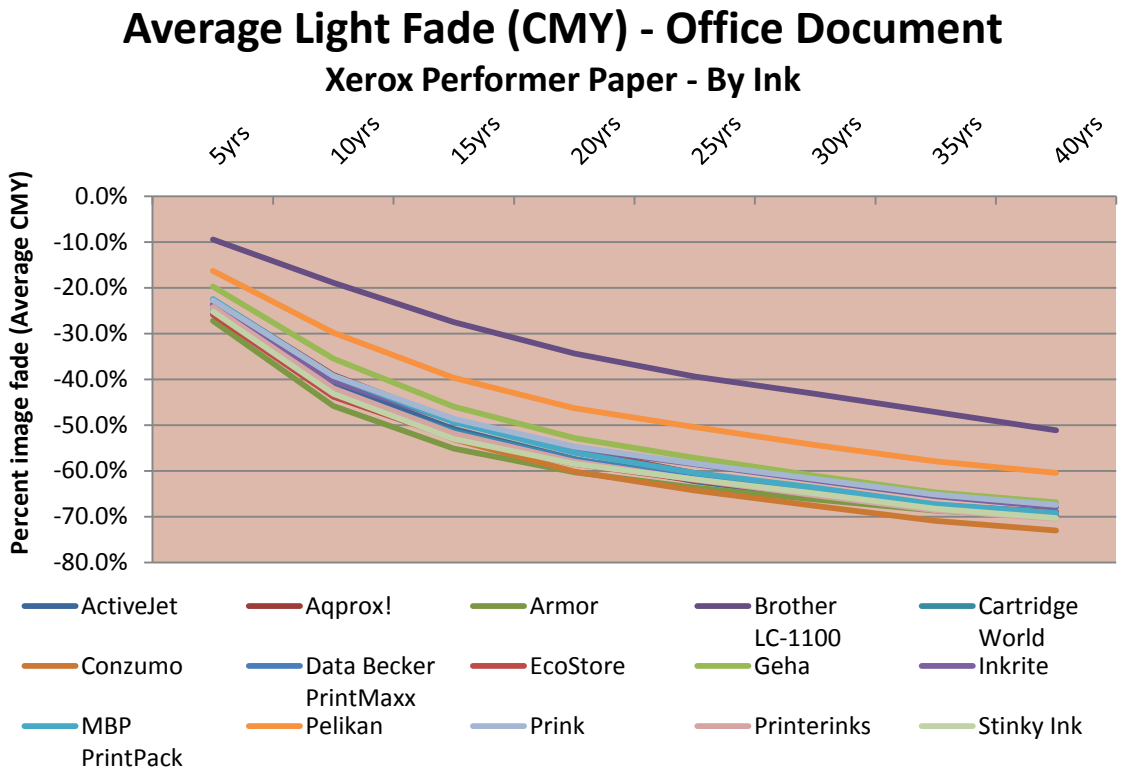


Indeed, pitching the inks individually against one another on each of the papers separately, there can be no doubt over the superiority of the Brother original inks.

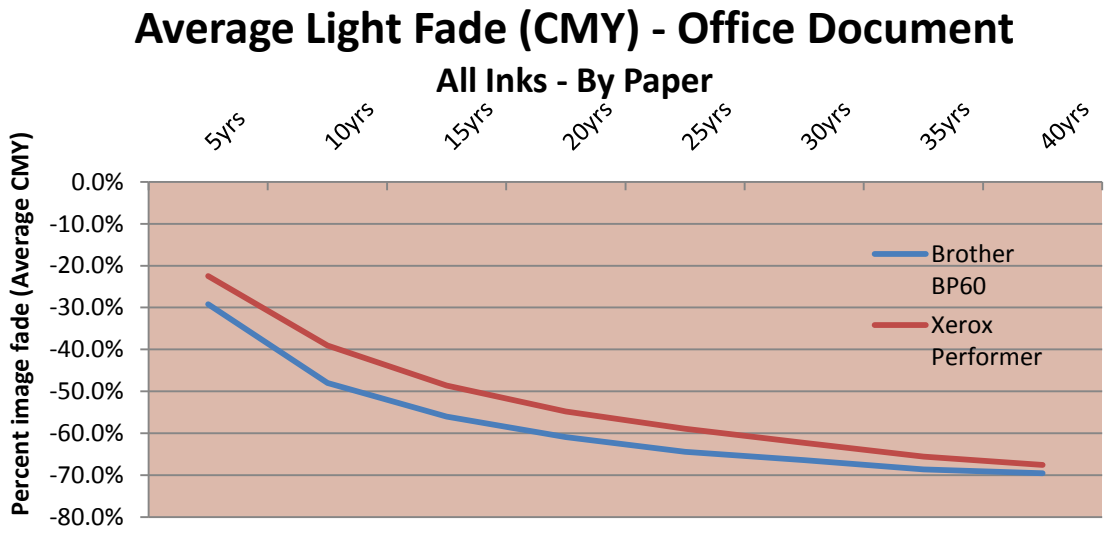


Although Prink ink appeared to perform better than other third party inks in the early stages of the test when printed on Brother BP60 paper, by the time the

Brother inks had reached failure point, the Prink image had deteriorated to almost the same degree as the other third party inks. When printed on Xerox paper, however, it was Pelikan that performed best of the third party inks, even increasing its advantage over time (below).



However, focussing on all inks together (including Brother original) printed on the two separate papers, emphasises that image permanence is slightly better using the Xerox paper.



UV Light Fastness – Photo, without glass

Highlights

- Brother inks on Brother BP71 paper outperforms all third party ink/paper combinations
- No third party ink, even when printed on Brother BP71 paper, failed later than 253 hours compared to 674 hours for the Brother OEM combination
- Some ink/paper combinations failed after less than 48 hours exposure
- Use of OEM brand inks is more significant to UV durability than use of OEM brand paper

Methodology

Ultra Violet light is particularly destructive, both to dyes and pigments, affecting paints, printing inks and the human skin. Fade of ink with a poor chemical composition is very rapid while other inks are resistant to UV light. The degree and speed of fade is dependent both on the ink itself and the media used to print on, with media affecting the printing ecosystem as much as ink.

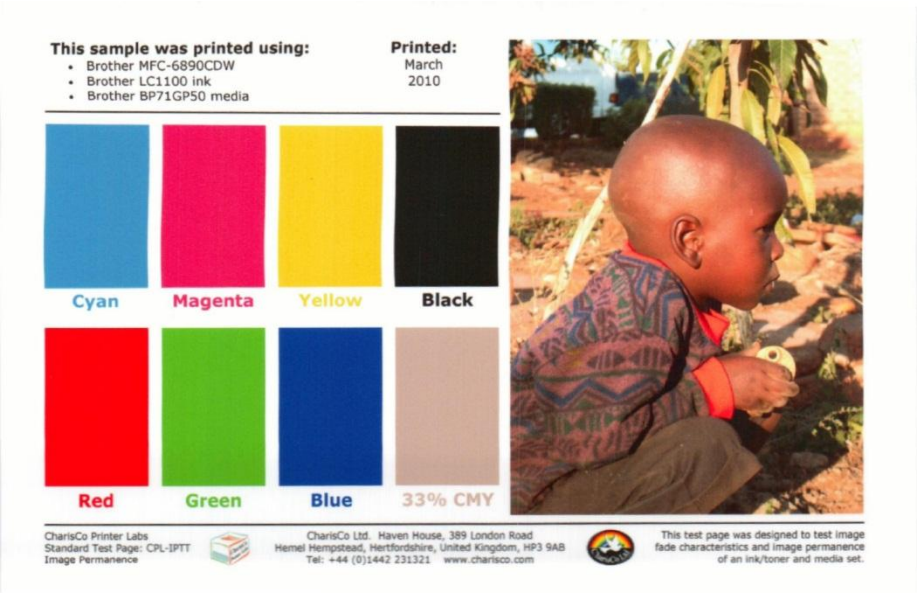
Test specimens (CPL-IPTT) printed on the four glossy photo papers were exposed to an intense UV light source to simulate accelerated image fade as a result of extended exposure to UV light (such as direct sunlight). A total of 60 specimens were involved – one for each ink/paper combination.

Optical Density readings of the Cyan, Magenta, Yellow and Black colour blocks were taken before testing and at regular intervals during testing – every 48 hours. In addition to reading Optical Density at 48-hour intervals, test samples were scanned to illustrate the comparative extent of fade.

Once a specimen demonstrates fade to the value of 30% average loss of Optical Density across the three primary colours (Cyan Magenta and Yellow), such that the image is reduced to 70% of its original state, the specimen is declared unusable.

Test results

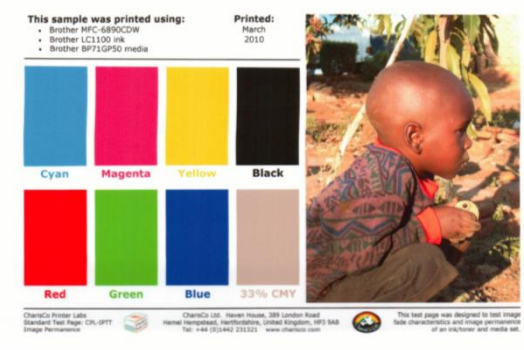
NB. For detailed results, please refer to the accompanying spreadsheet data for UV fade and PDF files of scanned images.



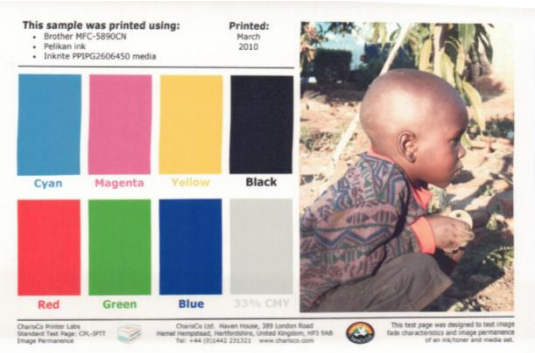
Scan of Brother original inks on Brother BP71 paper

Significant fade was noted right from the first inspection, with certain ink/paper combinations showing failure of one ink immediately at 48 hours of exposure.

Consistent across all inks except Brother original ink, Magenta inks failed within 48 hours when printed on the Inkrite paper. While Brother Magenta ink printed on Inkrite paper had faded by only 10.9%, 12 of the 14 third party Magenta inks (86%) faded by more than 40% and eight of them (57%) faded by more than 50%! In fact, the worst combination in this test, Pelikan ink on Inkrite paper, lost 55.9% of its Magenta Optical Density. This was closely followed by Conzumo Magenta ink on Inkrite paper, losing 55.0%.



Scan of Brother inks on Brother paper after 48 hours – Av. image loss = 2.9%



Scan of Pelikan inks on Inkrite paper after 48 hours – Av. image loss = 39.2%

This is only one ink, however. Even more significantly, Inkrite paper was responsible for the total failure (30% average loss - CMY) of four third party inks

after this initial 48-hour period (Conzumo, Geha, Pelikan and Stinky Ink) and the failure of the remaining 10 third party inks after just 96 hours of exposure.

This means that Inkrite paper had failed across the board (expect when used with Brother original inks) after only 96 hours despite Inkrite's marketing materials claiming that it is "… developed specifically for use with Inkrite original inks to enhance the quality of your prints". Brother's original inks printed on Inkrite paper did not fail till the 336-hour point – having lasted 3½ times longer than the failure point of all the third party inks.

Undoubtedly, Inkrite paper was the worst performing paper overall in these tests. No other paper or ink/paper combination failed at that first 48-hour inspection but Verbatim paper failed with all but one (Aqprox!) of the third party inks at the 96-hour inspection. Even the Aqprox! ink was only half a percentage point away from failing at 96 hours so, in effect, Verbatim paper can be said to have failed with all third party inks at that point.

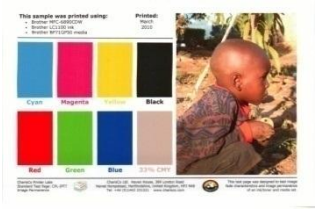
Brother's BP71 paper did not begin to fail till the 144-hour inspection, and then with only three of the third party inks – MBP PrintPack, Prink and Printerinks. However, even this original paper had failed with all third party inks by the time 240 hours had passed.

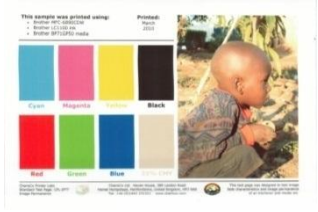
Only Ilford's glossy photo paper performed at an equivalent level to the Brother BP71 paper.

Focussing on the Brother LC1100 original inks, no paper failed till the 336-hour inspection and, yes, that was the Inkrite paper, closely followed by Verbatim 48 hours later!

Brother original inks

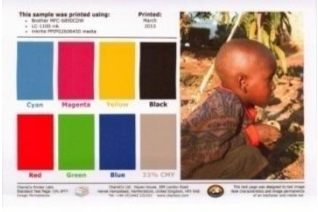
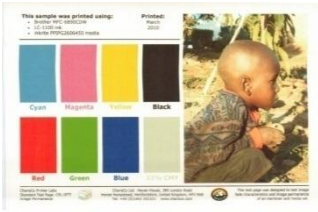
Brother paper





Zero hours | 336 hours | 720 hours

Inkrite paper


Ilford gave the Brother paper fierce competition throughout this test and the combination of Ilford paper with Brother original inks was no exception. Both papers were found to have failed after 720 hours of exposure – 15 times longer than the failure of the first Inkrite/third party ink combinations.

At the end of the 720-hour test period, all but four of the third party combinations had lost more than 75% of their image colour (average of CMY).

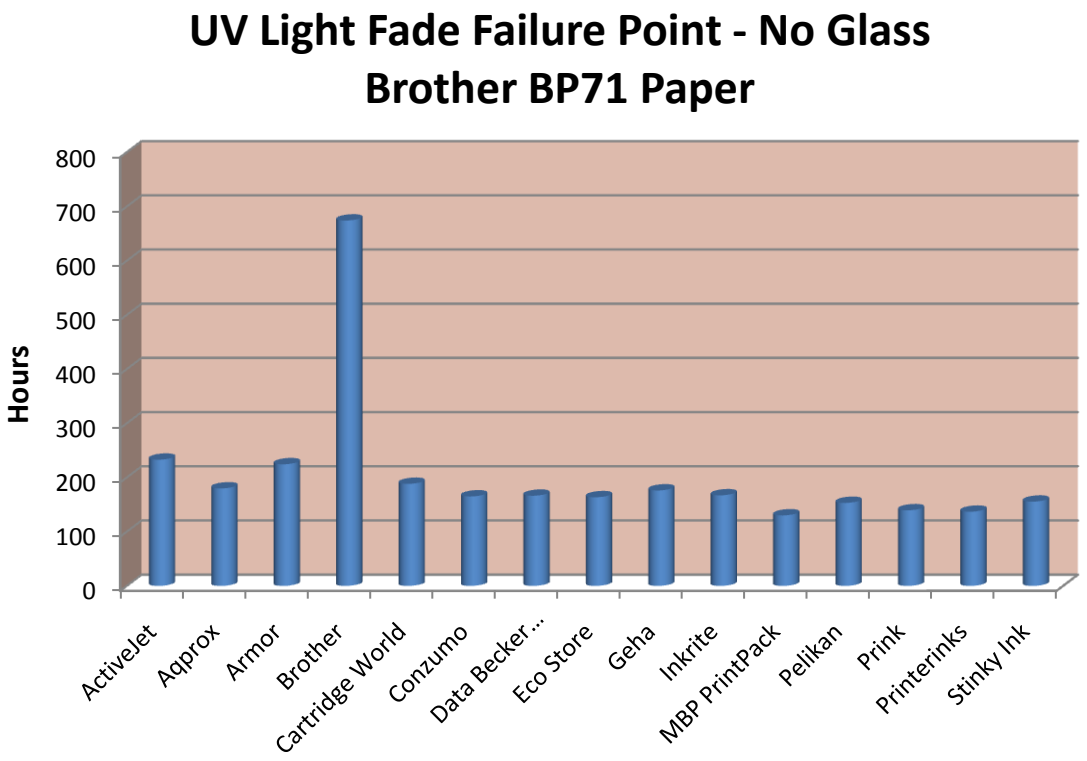
Indeed, many third party CMY inks (including Brother Cyan and Magenta printed on Inkrite paper) were found to have lost 100% of their colour after 720 hours of UV exposure. In fact, this included 22 of the third party magenta ink/paper combinations (39%) and more than one-third of the ink/paper combinations where third party materials were used had lost more than 90% of their colour (average CMY).

By contrast, Brother original materials performed so well that less than 50% of the Magenta was lost, 31.3% of the Cyan and only 16.4% of the Yellow!

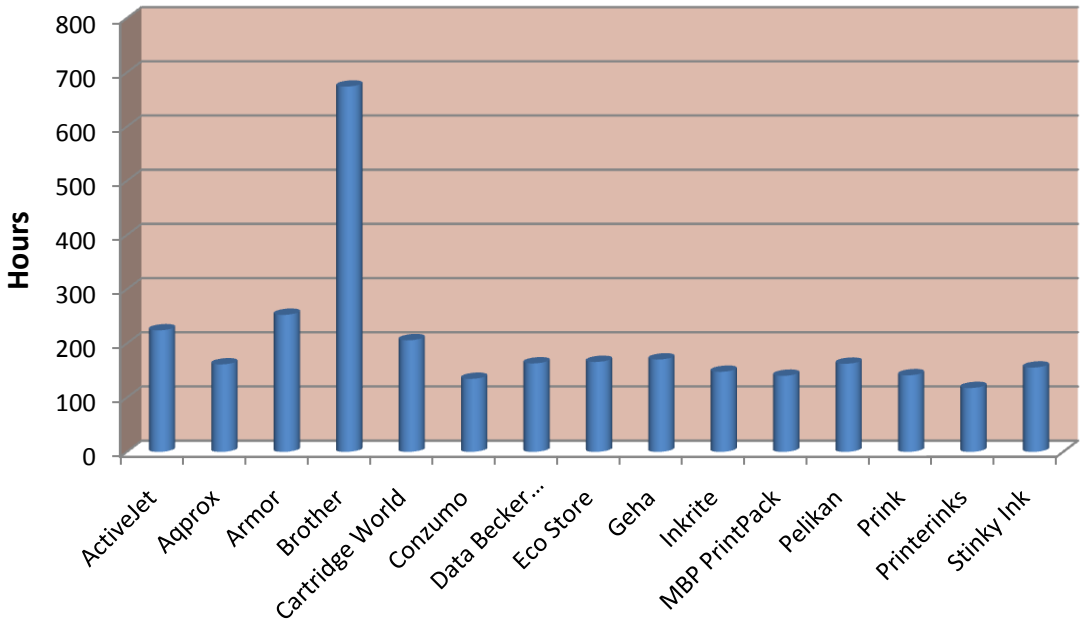
	Zero hours	**336 hours**	**720 hours**
Brother paper Brother inks			
Ilford paper Armor inks			
Inkrite paper Pelikan inks			

In conclusion to this section, then, it is clear that Brother original inks outperform all of the third party inks by orders of magnitude where exposure to UV light is concerned. It is equally clear that Brother BP71 glossy paper outperforms the Inkrite and Verbatim papers, again by orders of magnitude, while the combination of the two – Brother original ink – is only challenged by the use of Brother's original inks on Ilford paper. No other combination comes within 60% of the performance.

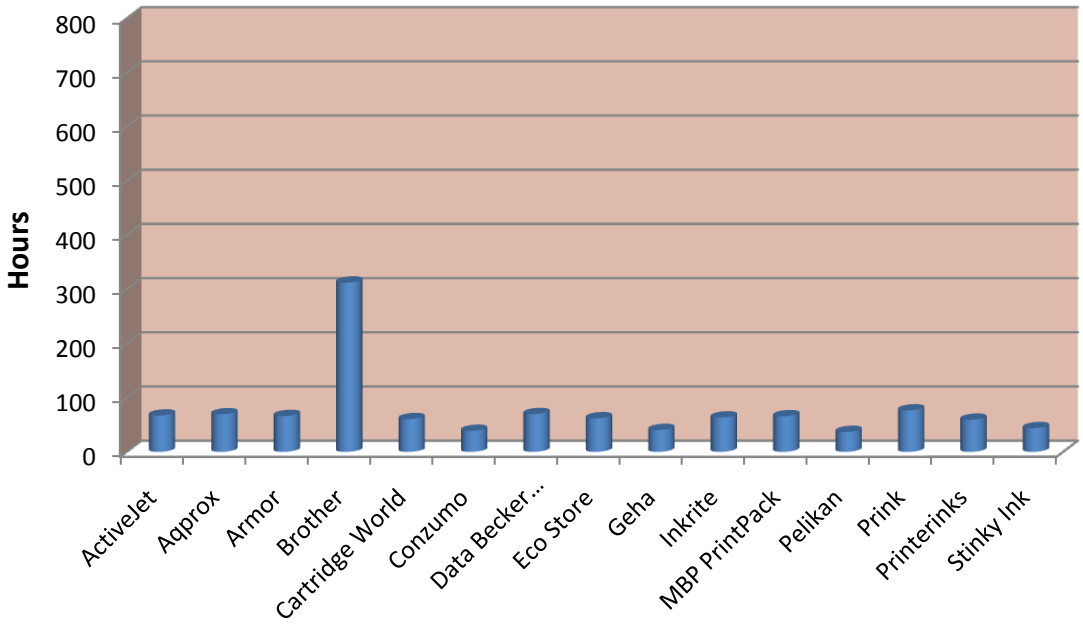
	Failure point - Hours			
	Brother	**Ilford**	**Inkrite**	**Verbatim**
ActiveJet	233	224	67	88
Aqprox!	180	161	69	103
Armor	224	253	66	87
Brother	674	674	312	360
Cartridge World	188	206	60	88
Conzumo	165	135	39	89
Data Becker PrintMaxx	166	163	70	82
Eco Store	164	166	62	79
Geha	176	170	40	78
Inkrite	167	148	63	78
MBP PrintPack	130	140	66	79
Pelikan	153	163	37	72
Prink	140	141	77	93
Printerinks	137	118	59	74
Stinky Ink	156	156	44	72



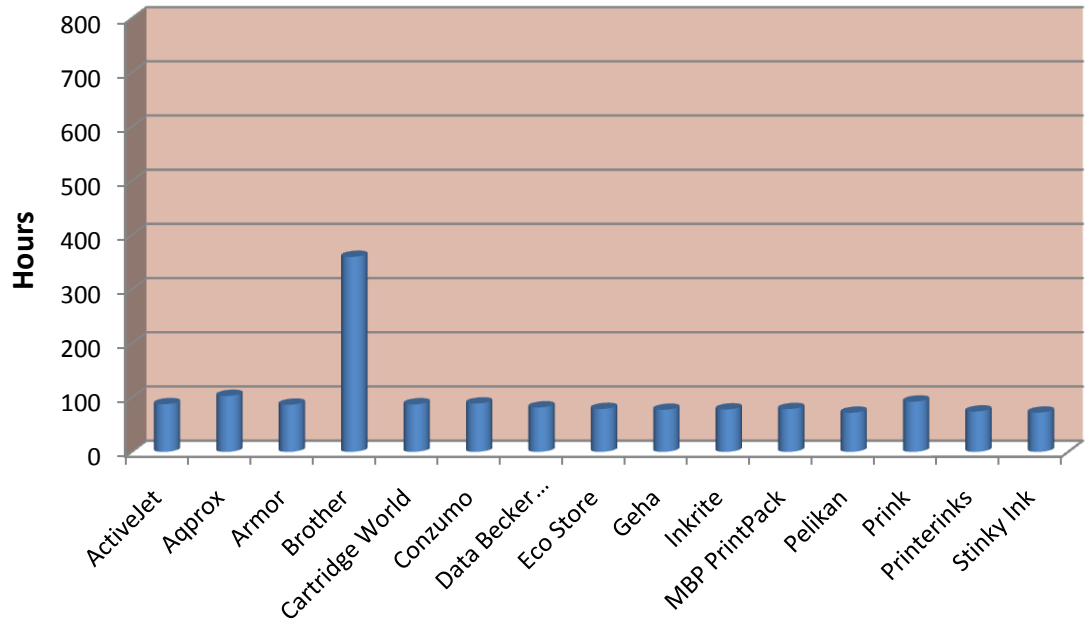
UV Light Fade Failure Point - No Glass
Ilford 1146567 Paper



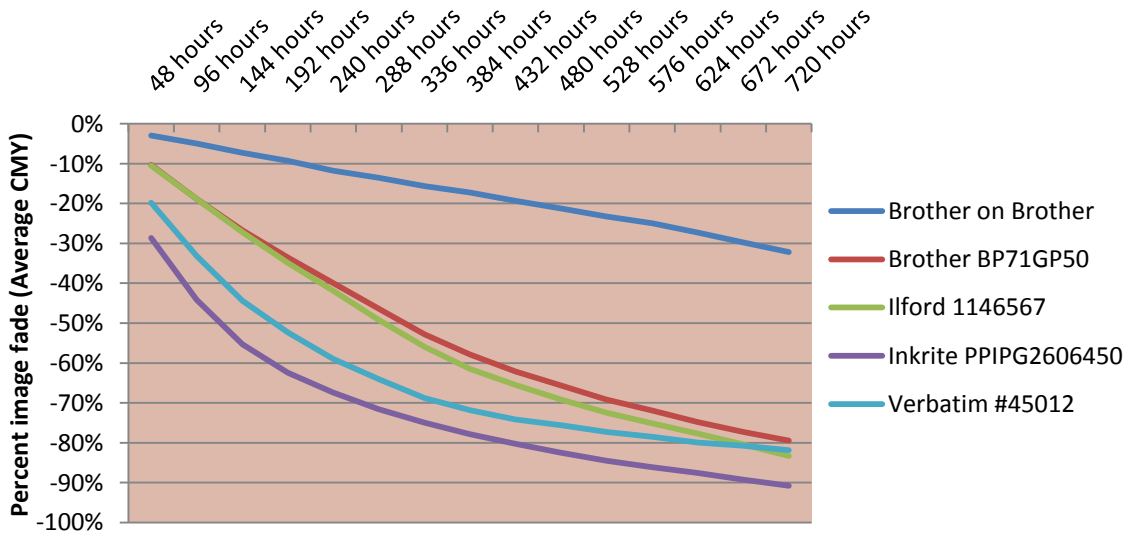
UV Light Fade Failure Point - No Glass
Inkrite PPIPG2606450 Paper

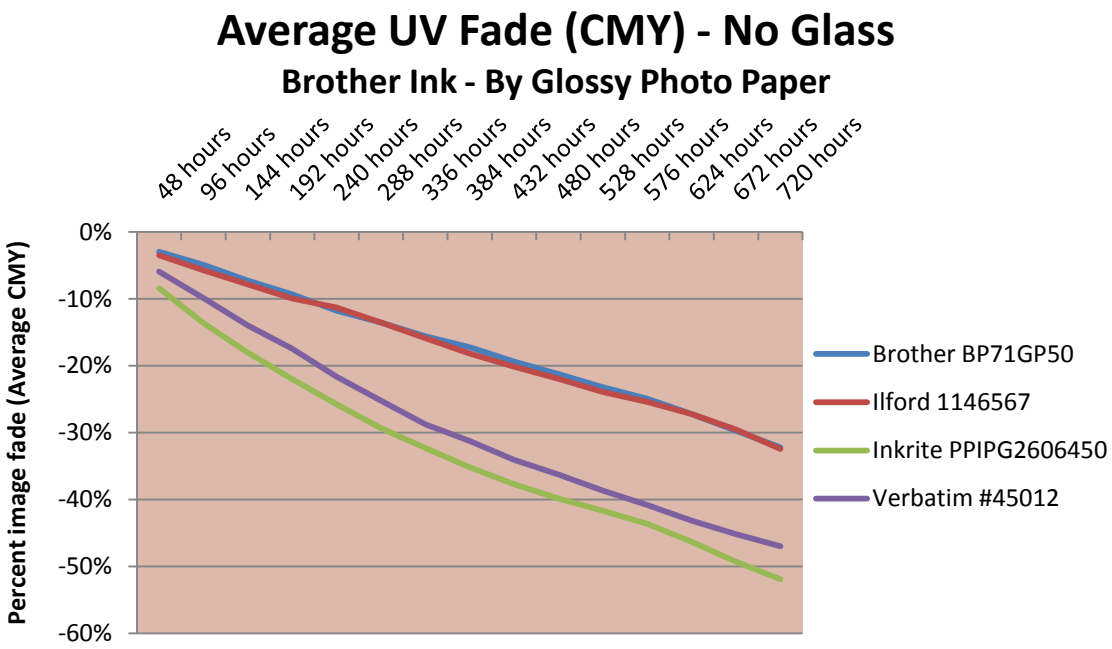


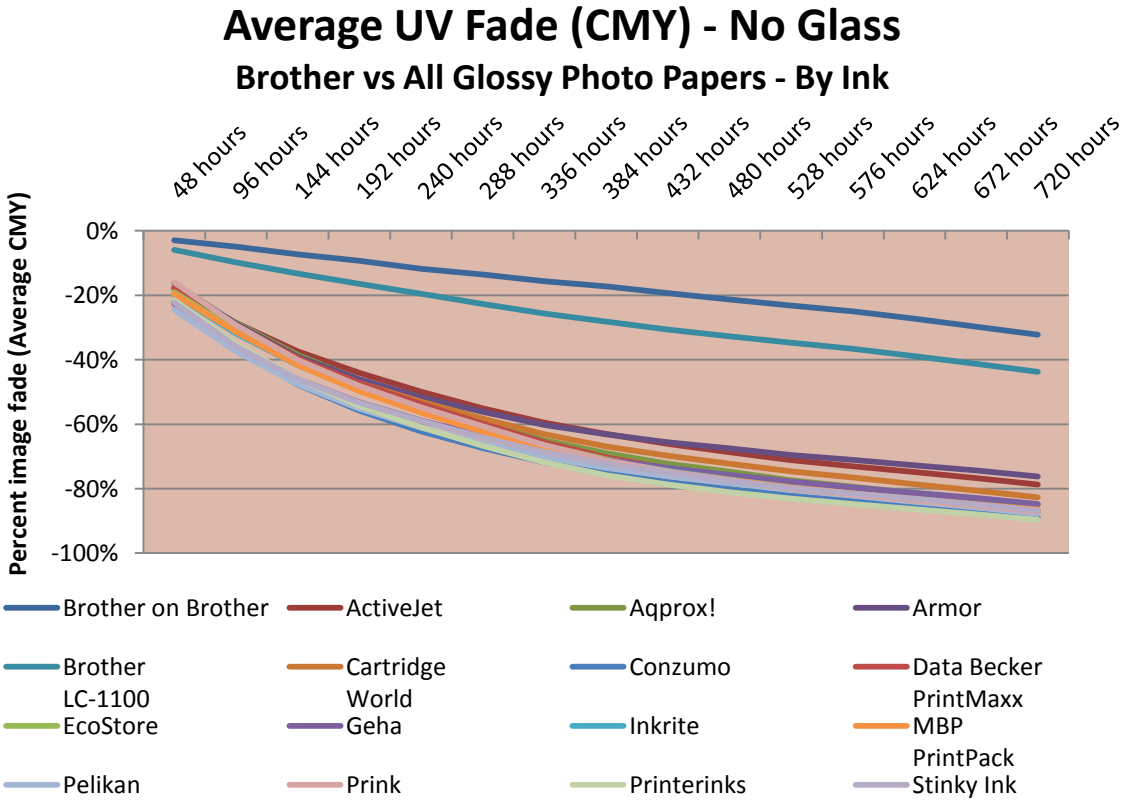
UV Light Fade Failure Point - No Glass
Verbatim #45012 Paper



Average UV Fade (CMY) - No Glass
Brother vs All Third Party Inks - By Glossy Photo Paper

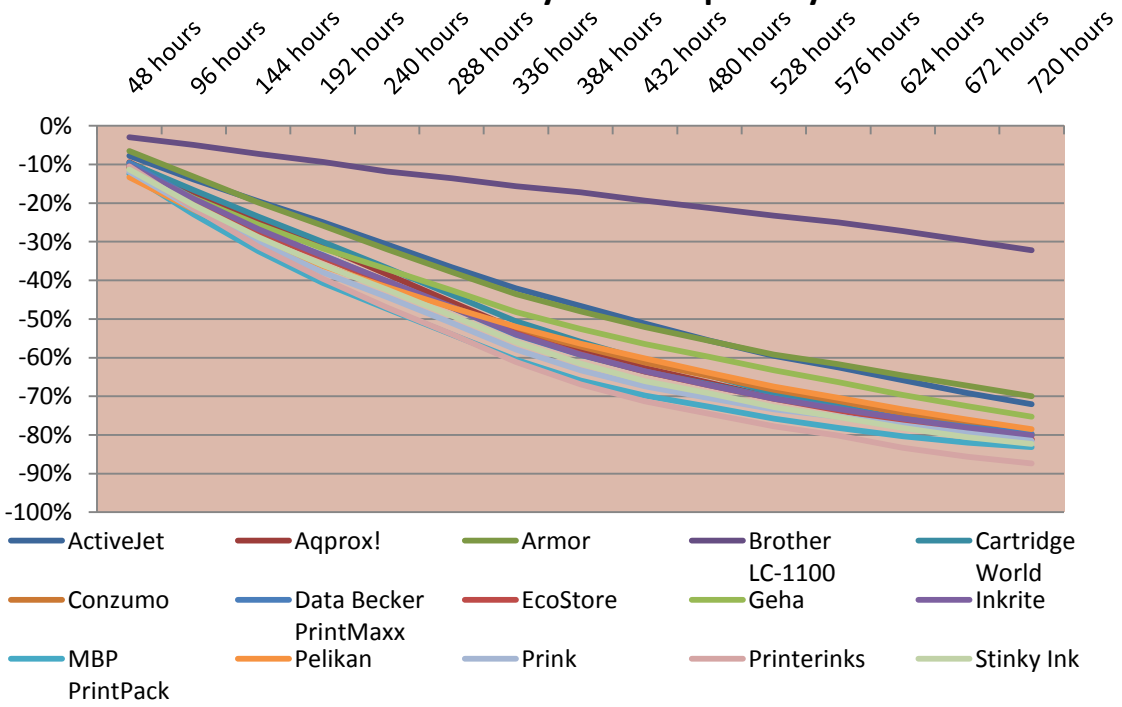



Average UV Fade (CMY) - No Glass
Brother Ink - By Glossy Photo Paper
48 hours
96 hours
144 hours
192 hours
240 hours
288 hours
336 hours
384 hours
432 hours
480 hours
528 hours
576 hours
624 hours
672 hours
720 hours
0%
-10%
-20%
-30%
-40%
-50%
-60%
Percent image fade (Average CMY)
Brother BP71GP50
Ilford 1146567
Inkrite PPIPG2606450
Verbatim #45012


Average UV Fade (CMY) - No Glass
Brother vs All Glossy Photo Papers - By Ink
48 hours
96 hours
144 hours
192 hours
240 hours
288 hours
336 hours
384 hours
432 hours
480 hours
528 hours
576 hours
624 hours
672 hours
720 hours
0%
-20%
-40%
-60%
-80%
-100%
Percent image fade (Average CMY)
Brother on Brother
ActiveJet
Aqprox!
Armor
Brother LC-1100
Cartridge World
Conzumo
Data Becker
PrintMaxx
EcoStore
Geha
Inkrite
MBP PrintPack
Pelikan
Prink
Printerinks
Stinky Ink

Average UV Fade (CMY) - No Glass

Brother BP71 Glossy Photo Paper - By Ink



Water Fastness – Photo

Highlights

- Brother BP71 paper performed significantly better than any other paper in this test, with no print sample proving to be completely unacceptable
- Ilford paper performed significantly worse than any other paper for water fastness, with only one print sample proving to be anything other than totally unacceptable – this sample was printed was Brother original inks where quality was barely affected
- Ilford paper suffered from particularly severe ink leaching from a number of inks
- Inkrite and Verbatim papers, in particular, produced images even darker than the original image after soaking

Methodology

For detailed results, please refer to the accompanying spreadsheet data for UV fade and PDF files of scanned images.

Test specimens (CPL-IPTT) printed on the four glossy photo papers were immersed and soaked individually in deionised water for 24hrs. A total of 60 specimens were involved – one for each ink/paper combination.

Specimens were then laid onto tissue and covered with a clean sheet of tissue and subjected to a load of approximately 7kPa (0.0714 Kg per square centimetre) for 10 minutes.

After 10 minutes under pressure, the load was removed and the specimens allowed to dry completely.

Optical Density measurements were taken for the printed colour blocks, and the background media, to determine the degree to which inks have remained permanent on the media and the degree to which the media has absorbed non-permanent ink.

Test results

NB. Please see accompanying spreadsheet for detailed data and PDF file for scanned images.

Note: all descriptions of subjective visual comparisons in the spreadsheet are comparisons with an original print of the same ink on the same paper, to determine the change due to soaking in water. They are not comparisons between a soaked print using third party supplies and a soaked print using Brother original supplies.

In 32% of cases, the print sample could still be considered to be perfectly usable after being soaked, while 42% of samples would be rejected out of hand. The remaining 27% could still be used but blemishes are reasonably easily noticed.

Unfortunately, although Brother BP71 paper clearly performed better than any other paper, Brother LC1100 inks did not. Only four inks showed noticeable

blemishes when printed on BP71 paper and none were totally unusable, whereas all 14 third party inks on Ilford paper proved unusable. By a *very* small margin, Verbatim paper performed best of the third party papers but both Inkrite and Verbatim papers performed considerably worse than Brother's BP71 paper.

However, only two papers responded very well to LC1100 original inks – and neither of those were Brother's BP71 – they were Ilford and Verbatim. Blemishes were evident with Brother original inks on BP71 paper but the sample could still be usable. However, serious blemishes were evident from Brother inks on Inkrite paper and the result was unusable.

Four major problems emerged from the water fastness testing:

- the mechanical condition of the paper while wet
- varying degrees of ink leaching in the paper
- a degree of image degradation:
    - image appearing dark and losing contrast
    - overall yellow colour cast
    - loss of image sharpness

The water has had a visible effect on all papers. While Brother BP71 and Ilford papers showed some minor distortion (curvature) across the whole sheet, Inkrite paper was buckled inconsistently and took on an eggshell appearance across its surface. Verbatim paper also buckled inconsistently and took on an eggshell appearance across its surface but, in addition, became very delicate from the moment of soaking – liable to break up very easily. Although also proving delicate while wet, the extra weight of the Inkrite paper prevents damage occurring too easily.

Many of the Yellow and Magenta inks displayed a tendency to leach out of areas of black or colour blocks. The severity varied enormously, from only just detectable to extensive, as seen in the images below. However, the paper most affected by a considerable margin was Ilford.

When freshly printed, it was found that most inks on Inkrite and Verbatim papers were significantly darker than those printed with Brother original supplies. When soaked, images on almost all of these samples were found to have darkened further. While some images are still just usable, having changed little from their pre-soaked condition, when compared to the samples printed on Brother paper, the difference is marked and the images would probably be rejected.

A number of samples display an overall yellow colour cast, mostly due to leaching of the Yellow ink in the paper. The only instance to affect Brother BP71 paper was Conzumo ink – which proved to be the worst ink in this test – where a very slight colour cast was noticed. The blemish affects Ilford paper most, followed closely by Inkrite and Verbatim.

Many sample prints suffered a minor loss of sharpness in the image, often as not proving to be minor enough in itself to be only noticeable with close inspection and not significantly affecting the overall appeal of the image. The only instance of severe loss of sharpness was with Cartridge World ink on Ilford paper.

Although Optical Density measurements were taken, there is little correlation between these readings and visual acceptability of the samples. What they show in particular is that Verbatim paper consistently intensifies the image under water soaking conditions, while in all but three instances (Brother, Geha and Prink inks) Brother paper loses a small amount of density.

Water Fastness – Office document

Highlights

- Brother BP60 inkjet plain paper holds all inks in place to a very high degree compared to generic plain paper
- Brother's pigment black ink makes it eminently suited to printing vulnerable material, such as addresses on envelopes. Geha and Pelikan also use a pigment black ink
- All other third party black inks are dye-based
- There is little difference between overall performance of colour inks, original or third party, on generic plain paper

Methodology

For detailed results, please refer to the accompanying spreadsheet data for UV fade and PDF files of scanned images.

Test specimens (CPL20DP) printed on the two office plain papers were immersed and soaked individually in deionised water for 24hrs. A total of 30 specimens were involved – one for each ink/paper combination.

Specimens were then laid between two sheets of the same paper and subjected to a load of approximately 7kPa (0.0714 Kg per square centimetre) for 10 minutes.

After 10 minutes under pressure, the load was removed and the specimens allowed to dry completely.

Optical Density measurements were taken for the printed colours fills, and the background media, to determine the degree to which inks have remained permanent on the media and the degree to which the media has absorbed non-permanent ink.

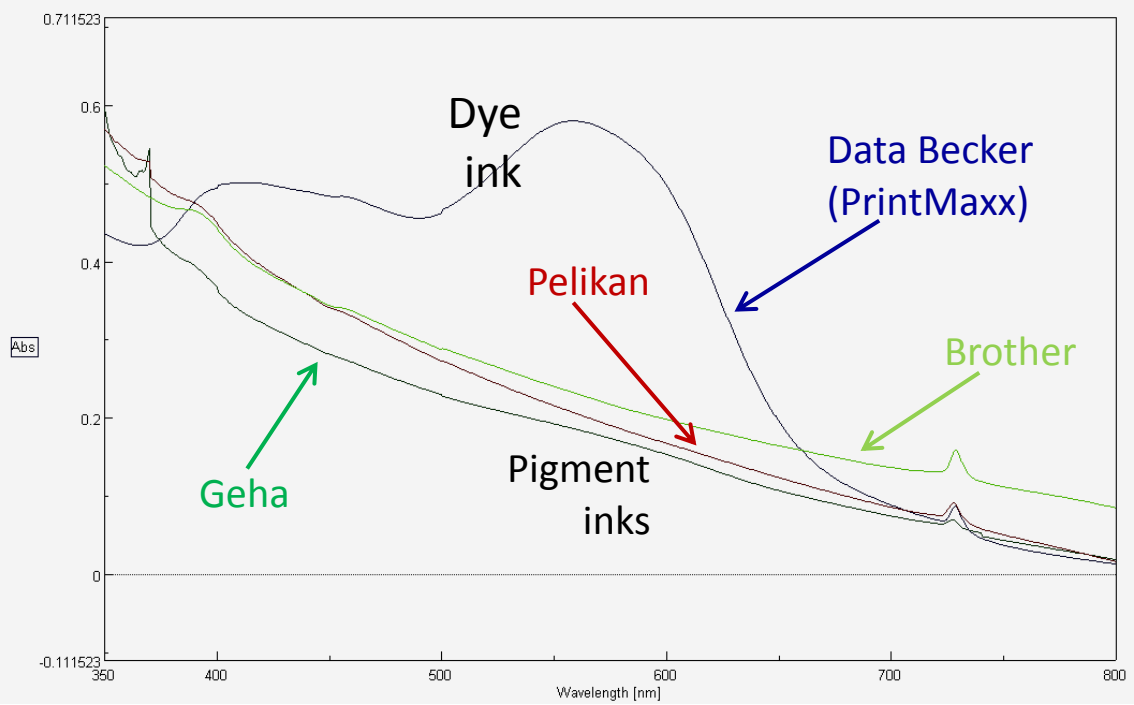
Test results

NB. Please see accompanying spreadsheet for detailed data and PDF files for scanned images.

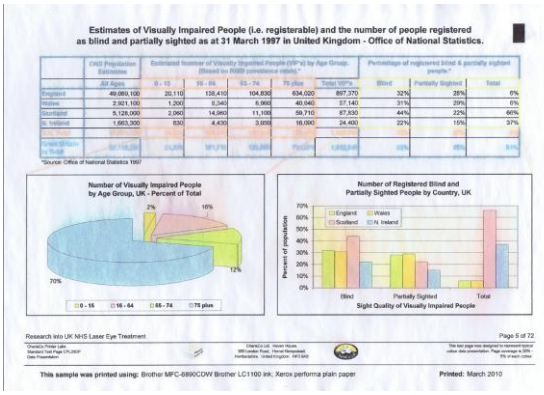
Note: all descriptions of subjective visual comparisons in the spreadsheet are comparisons with an original print of the same ink on the same paper, to determine the change due to soaking in water. They are not comparisons between a soaked print using third party supplies and a soaked print using Brother original supplies.

Undoubtedly, the most significant factor affecting water fastness capabilities of the inks is the fact that Brother original black ink is a pigment-based ink while all but two (Geha and Pelikan) of the third party black inks are dye-based.

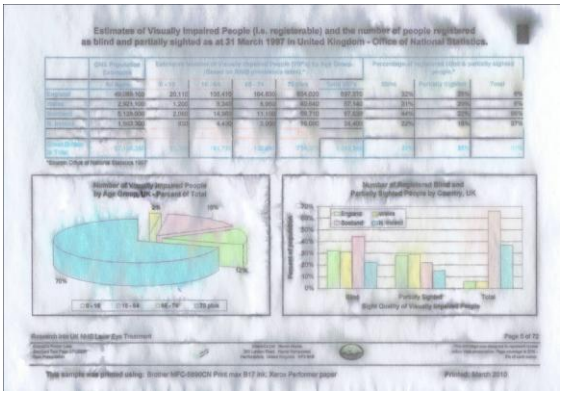
Therefore, all of the other third party Black inks run badly when printed on generic plain paper and immersed in water while Brother, Geha and Pelikan blacks hold fast and can, therefore, be used safely for printing addresses on envelopes.



Spectrophotometer readings from Brother, Data Becker (PrintMaxx), Geha and Pelikan black inks.



Scan of Brother inks on Xerox Performer paper after soaking

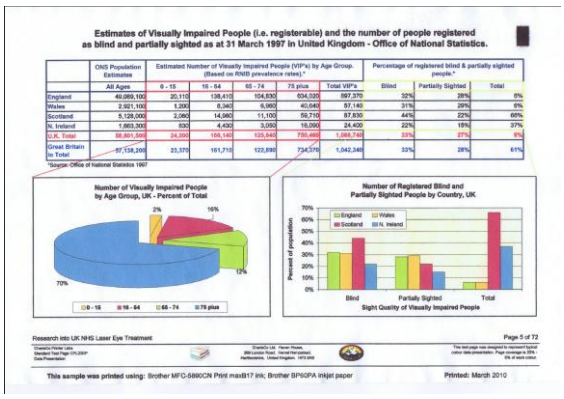


Scan of Data Becker PrintMaxx inks on Xerox Performer paper after soaking

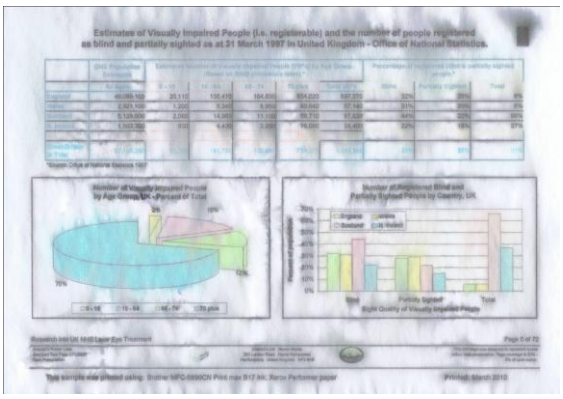
Soaked samples (on Xerox Performer paper) displayed a wide range of effects, from those where inks had bled into the paper so severely that the paper has taken on a blue/grey hue and the printed image is not far from undecipherable to those printed with pigment black ink where the individual colours have bled into the paper in bright plumes around the printed image.

Brother's inks perform neither better nor worse than other inks on this paper, except insofar as the pigment black ink ensures that black text is fully readable.

Secondly, Brother's BP60 inkjet plain paper holds ink in place very tightly during and after soaking, whether dye or pigment.



Scan of Data Becker PrintMaxx inks on Brother BP60 inkjet paper after soaking



Scan of Data Becker PrintMaxx inks on Xerox Performer paper after soaking

All samples printed on Brother BP60 paper are perfectly readable and could continue to be used for general purpose (in-house) collaboration, analysis or even archiving.

By contrast, none of the samples printed on Xerox Performer paper could be considered to be fully usable. Two of the samples (Geha and Pelikan) could be considered to be usable for recovery of information – but only because all text is readable (red text barely readable but just discernable).

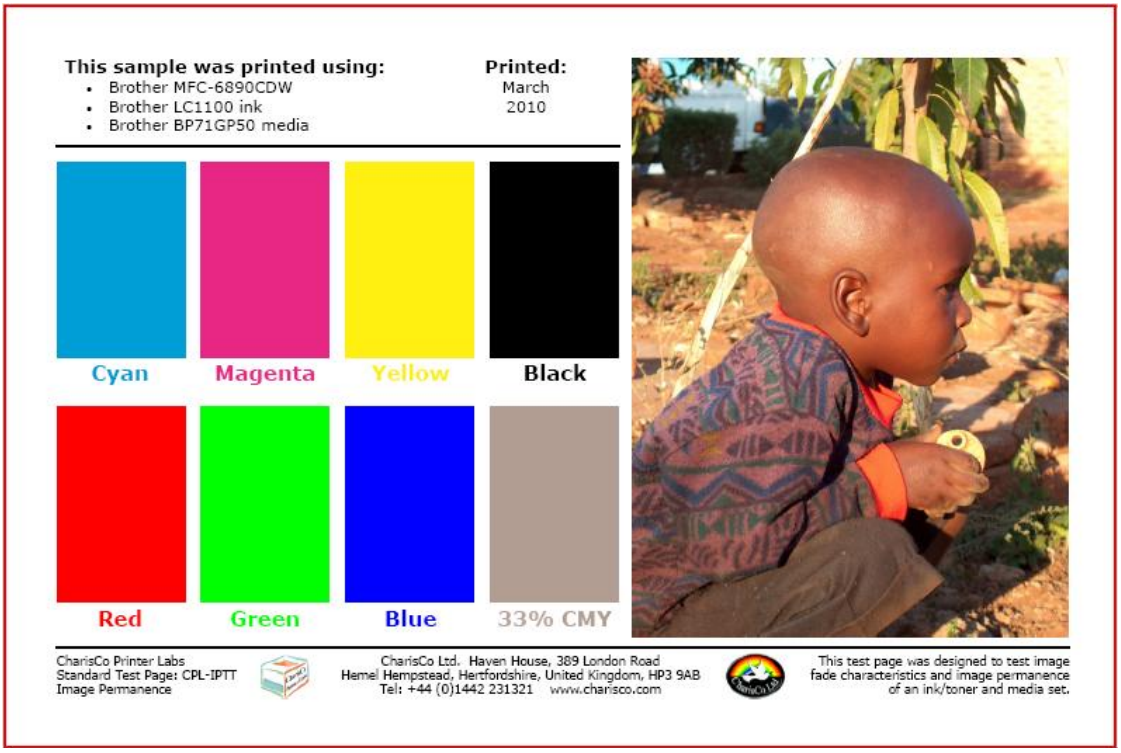
Conzumo was the one third party ink to affect the paper adversely to a serious degree, where a quantity of Yellow ink bled throughout the paper to produce an overall Yellow colour cast. Most of the third party inks were noted to have bled into the paper to varying degrees – particularly the dye-based black inks, which had bled from the solid black rectangle in the upper right hand corner.

Brother inks clearly perform better than any of the third party inks on the Brother BP60 paper but challenged closely by EcoStore ink despite the fact that the black is dye-based.

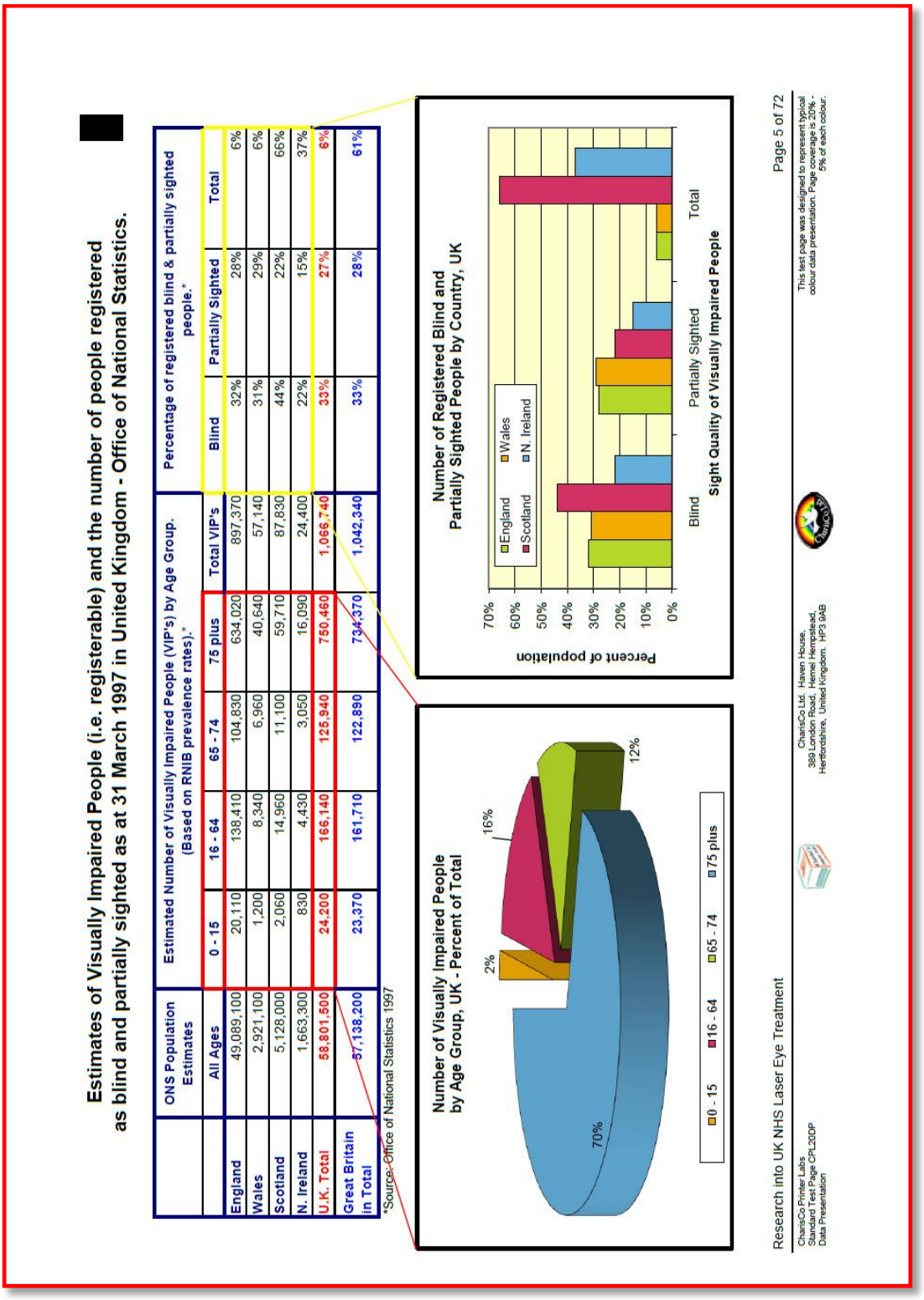
Optical density readings for this test are fully representative of the subjective assessment.

Appendix A – Test Targets, image permanence

CPL-IPTT – (Light / UV / Water)



CPL20DP – (Light / UV / Water)



Estimates of Visually Impaired People (i.e. registerable) and the number of people registered as blind and partially sighted as at 31 March 1997 in United Kingdom - Office of National Statistics.

	ONS Population Estimates	Estimated Number of Visually Impaired People (VIP's) by Age Group. (Based on RNIB prevalence rates).*					Percentage of registered blind & partially sighted people.*		
	All Ages	0 - 15	16 - 64	65 - 74	75 plus	Total VIP's	Blind	Partially Sighted	Total
England	49,089,100	20,110	138,410	104,830	634,020	897,370	32%	28%	6%
Wales	2,921,100	1,200	8,340	6,960	40,640	57,140	31%	29%	6%
Scotland	5,128,000	2,060	14,960	11,100	59,710	87,830	44%	22%	66%
N. Ireland	1,663,300	830	4,430	3,050	16,090	24,400	22%	15%	37%
U.K. Total	58,801,500	24,200	166,140	125,940	750,460	1,066,740	33%	27%	6%
Great Britain in Total	57,138,200	23,370	161,710	122,890	734,370	1,042,340	33%	28%	61%

*Source: Office of National Statistics 1997

Research into UK NHS Laser Eye Treatment

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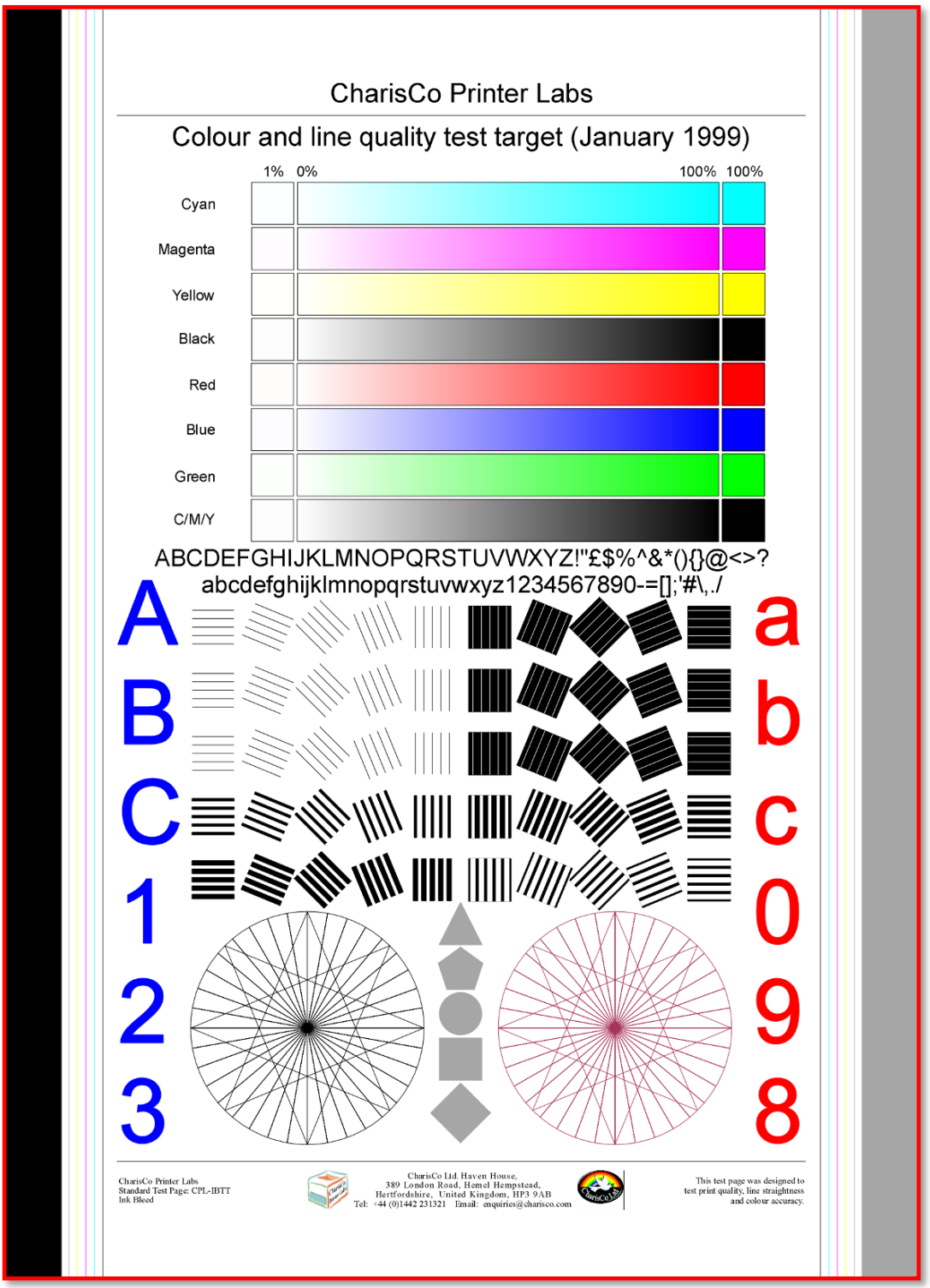
CharisCo Printer Labs
Standard Test Page CPL20DP
Data Presentation

CharisCo Ltd. Haven House,
389 London Road, Hemel Hempstead,
Hertfordshire, United Kingdom. HP3 9AB

This test page was designed to represent typical colour data presentation. Page coverage is 20% - 5% of each colour.

Appendix B – Test Targets, print quality

CPL-PQTT – Print Quality Test Target



CPL-IBTT – Ink Bleed (and colour registration) Test Target