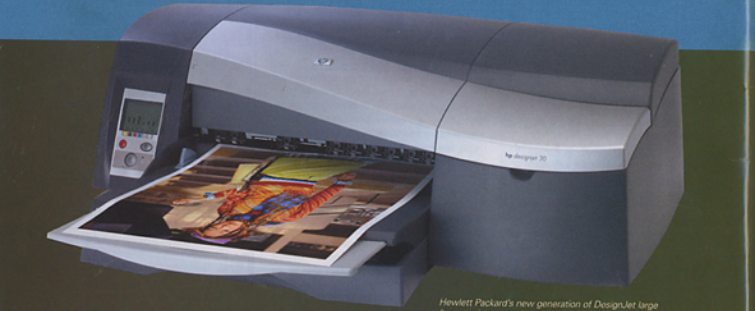
How Long Will An *Inkjet Print Last?*

Inkjet printing continues to improve in quality and affordability, but the questions over print life persist. Trevern Dawes examines the situation, outlines the current accelerated fade testing methods and summarises the practices recommended to promote maximum print life.



Hewlett Packard's new generation of DesignJet large format printers employ a six colour printing system which is claimed to give a print life of 70 years when using HP's No.85 dye-based inks.

IN 1826 A Frenchman called Joseph Nicéphore Niépce produced what is generally regarded as the world's first fixed photograph. It was a crude bitumen plate requiring an exposure of eight hours, but from this point on, imaging technology has made significant advances right up to the current era of digital photography. Some of the earliest photographs have survived in pristine condition because of the care taken in their production, the nature of the materials used and, most importantly, the way they have been stored.

When it comes to digital prints the same criteria of production processes, materials used and storage methods come into play. Longevity has become a key issue, not just because of the need for gallery patrons to be confident their purchases won't disappear overnight, but because we would all like to believe that what we create now in inkjet form is going to endure for a very long time.

When inkjet printing first arrived there was very little emphasis on print life. The prints faded quite rapidly so, even with all due care in display, some signs of degradation were evident within months, if not weeks. The technology has since made remarkable progress to the point where both pigment and some dye-based inkjet prints are claimed to have display life spans that match or exceed photographic colour prints.

In order to predict how long any particular combination of ink and paper will last, or any photographic production for that matter, you need to be aware of what causes deterioration and what methods are employed to fast track and measure fading.

Light Damage

Prints will fade by the action of light and humidity, chemical interaction within the

ink or substrate (i.e. the paper support) and chemical action from the atmosphere.

All forms of light emit heat and radiation to varying degrees. The light that allows you to make photographs is also the light that destroys the printed images. We all appreciate how rapidly any photograph can fade in sunlight and are sensible enough to avoid direct or reflected exposure, not just for permanent wall display, but also for casual print or album viewing.

While other light sources aren't nearly as damaging, they all have some detrimental effect so it useful to understand their characteristics. Incandescent tungsten lamps, as used in many domestic situations, have a low ultraviolet (UV) output, but still emit infrared radiation in the form of heat. Consequently, an optimum distance between print and light source needs to be established to avoid any heat-related problems. Tungsten halide bulbs are more efficient than incandescent bulbs, but also generate high UV levels. Fluorescent light sources are cold yet still emit higher than acceptable levels of UV radiation. However, because they last a long time and are relatively cheap to run they are very widely used.

The potential damage that any source of light may inflict upon a displayed print can be minimised by the use of glass.

Measuring Deterioration

You can, of course, attempt to run your own tests by comparing the outcome of simply placing one copy of a print in a sunny location while another copy is stored in a dark place. Any colour print from either a darkroom or an inkjet printer will fade quickly when exposed to direct sunlight.
This approach doesn't prove much at all and is certainly not a true indicator of print life.

Initially, the lightfastness of inks used in the general printing industry was evaluated by comparison with a permanent bright red pigment called 'crimson madder'. The 'Blue Wool Scale' was introduced later as an International Standard (ISO). This consisted of samples of blue wool dyes, with a value of '8' being regarded as permanent. The remaining seven dyes make up the scale. The longevity of any print might then be assessed against the scale, but there is much more to testing than the concept of exposing half the print to light for a specified time and noting the fade against the scale.

By introducing a powerful artificial light source under controlled conditions, the fading process can be accelerated and reasonably accurate long-term predictions made within a very short time. Xenon filled discharge lamps have a continuous light spectrum and these have completely replaced the original arc lamps used for fade testing.

The criteria used by one organisation to examine fading may not necessarily be the same as another, hence any comparisons made must be considered within the same testing conditions. For example, Wilhelm Imaging Research Inc. in the USA adopts white fluorescent light at 30,000 lux and assumes a one-day illumination to be 450 lux for 12 hours. Epson and Canon apply 70,000 lux and rate their one-day illumination as 500 lux for ten hours. In all cases testing is conducted in a controlled environment of 24 degrees Celsius and a relative humidity of 60 percent, and all printed colour patches are housed under 2.0 mm glass.

Fading is deemed to have occurred when density of a colour is under 70 percent of the original (i.e. the optical density is measured by densitometer to have fallen from 1.0 to 0.7). By using the outcomes of these tests, a projection can be made to predict the display life of the ink/paper combination. If, using one of Epson's tests, the print sample took 24 hours for 153 days before the OD reached 0.7, the total intensity would be 25,704 x 104 lux (i.e. 70,000 lux x 24 hours x 153 days). The 25,704 x 104 lux (500 lux x 10 hours x 365 days) delivers a result of 140.84 years to give a rounded prediction of 140 years.

Other Factors

The tests applied to evaluate print life tend to concentrate on lightfastness, yet other factors, not as easy to measure, such as heat, humidity and air quality also contribute to the life of a print. These factors take effect even when a print is stored in the dark and are general described as 'darkfastness' characteristics.

Some combinations of ink and paper may rate well yet can be highly sensitive to ambient levels of ozone. It's interesting to note that the deterioration caused by contact with airborne gases and contaminates such as ozone will generally not effect silver-halide prints because the sensitive emulsions reside under a protective layer. The type of coating applied to an inkjet print will determine how 'dark fade' takes effect. Research has shown that porous photo papers are more susceptible to air fade than swellable papers.

High levels of gelatine in silver-halide coatings are susceptible to the growth of micro organisms in the presence of high humidity, whereas colorants in inkjet prints tend to migrate, resulting in a shift in colour or reduced sharpness.

Chemicals or impurities in paper will yellow or stain when subjected to light or heat. This can be a problem for silver-halide because chemical traces remain in the paper after processing. There is less concern about inkjet prints, provided the paper used is pH neutral, or, better still, acid-free.

Organisations like Wilhelm Research adopt uniform standards and consider the 'dark fade' factors as well as the light fade factors. If 'dark fade' testing cannot be readily achieved, at least footnotes are included with assessments to explain that print deterioration can occur other than by the direct action of light.

There is reason to be cautious about some claims derived by accelerated lightfast testing because of the phenomenon known as the Law of Reciprocity. Essentially this infers that relatively short exposures to very powerful lighting will not be the same as very long exposure to normal lighting. If a test print is deemed to have faded in lighting 100 times as intense as normal lighting can it then be assumed the same print will fade equally in 1/100th of the time under normal lighting?

The assumed level of ambient lighting also comes into play. If an average home has a light intensity of about 100 to 200 lux and most commercial premises of 450 lux, what ought to be accepted as being a 'typical' day for evaluation purposes? The intensity of the light therefore has a profound effect. In endeavouring to make your own assessments you need to consider your type of 'standard day' and take into account that some home or private galleries may only be illuminated for short periods.

As a general guide it can be assumed you will maximise the life of your prints if

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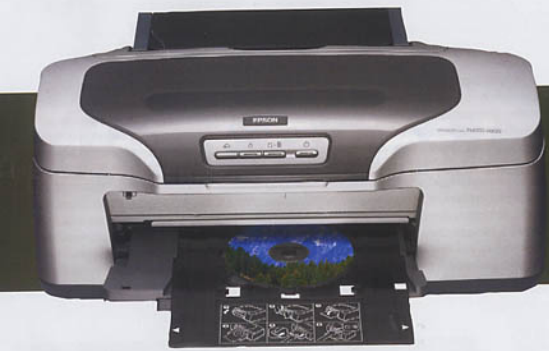

Epson's Stylus Photo R800 has an eight channel print head which uses the company's archival UltraChrome pigment based inkset. The eight colours are CMYK, plus light cyan, light magenta, red and blue. Print longevity is quoted at "more than 100 years" for prints made on Epson's Archival Matte paper.

you choose pigment-based inks and non-acid papers, but in doing so you may not be pursing the best way of making prints. Dyes do provide better colour gamut and brightness than pigments or pigmented inks, but don't have the same longevity characteristics.

Inkjet printers operate with either dyes or pigments. Some larger format printers will function with either, provided clean out cycles are used when changing from one type of ink to another. The six, seven or eight colour systems offer advantages over four colour printing because they allow more subtle tones to be reproduced. The seventh or eighth 'colour' is a light black or a 'grey component replacement' which is designed to minimise metamerism. It is particularly helpful in the printing of black and white images.

Testing Times

Should you be looking for highly detailed scientific explanations of fade testing, visit www.wilhelm-research.com and download the report entitled "The Permanence and Care of Color Photographs, Traditional and Digital Color Prints, Color Negatives, Slides and Motion Pictures". The entire document runs to 758 pages!

From among all this technical wizardry what can be assumed? You may be sceptical or you may be encouraged, but whatever your reaction, you can benefit from the assumption that the predicted values are relative to each other. All things being equal in the testing department, and what transpires thereafter in terms of display or storage, we might then observe that one particular combination of paper and ink has a potentially better life span than another combination. However, whether that 'better combination' has the right look or feel about it is another matter.

All manner of discussion and laboratory testing are going to be of little consequence unless some real figures are offered. In presenting any ratings it's important to appreciate that, as research continues, more accurate assessments might be forthcoming. All findings come with a convenient disclaimer indicating that display and storage conditions employed in the 'real world' are too variable to have ratings backed with guarantees.

For the products readily available in Australia here is a short listing for prints displayed under glass. Take this as a guide and not as gospel. Most of these ratings are provided by the Wilhelm Research Institute.

Epson Ultrachrome pigmented inks March 2004 (Wilhelm)

• Epson Premium Gloss	85 years
• Epson Premier Lustre	71 years
• Epson Premier Semi-Matte	67 years
• Epson Ultrasmooth Fine Art	108 years

Epson pigment inks (on an Epson 2000P printer)

• Epson Premium Semi-Gloss	140 years
• Glossy Photo Weight	180 years
• Watercolour Radiant White	200 years
• Archival Matte	200 years

Epson six colour dyes (on 780/870/890/1270/1290 printers)

• Epson Heavyweight Matte	26 years
• Epson Glossy Photo	10 years

HP Designjet 5550 and Designjet 130 (six colour dyes)

• HP Premium	73 years

Canon dye ink April 2004 (Canon)

• No paper given	25 years

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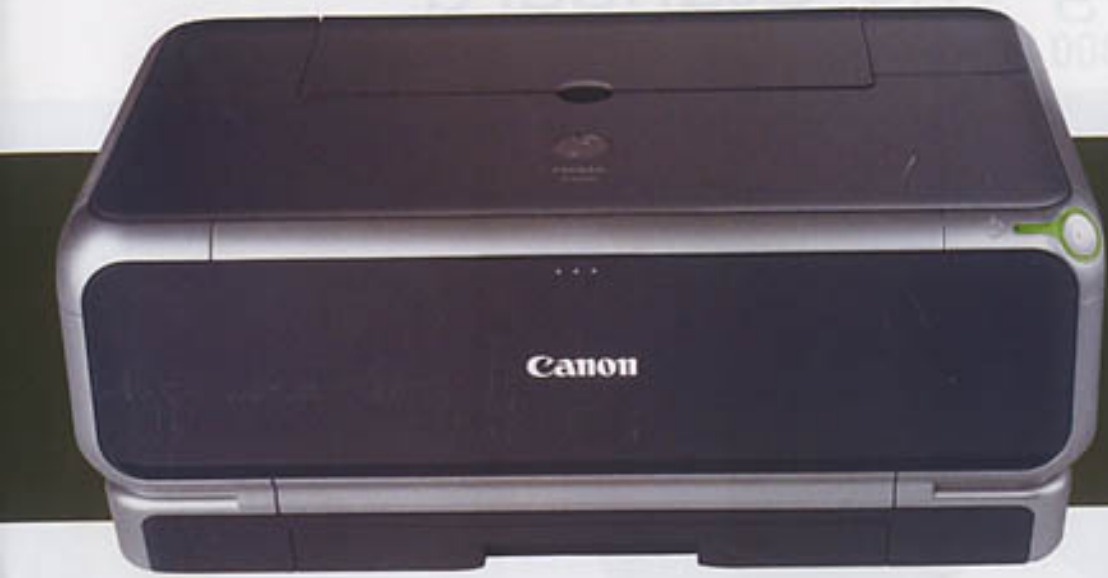

Canon's ChromaPLUS eight colour printing process, as used in the new Pixma iP8500 printer, adds light cyan (called 'photo cyan' by Canon), light magenta, red and green to the standard CMYK inkset. In conjunction with Canon's own Photo Paper Pro, a print life of "up to 100 years" is claimed.

Quality Questions

The ratings for pigment and pigmented inks are appreciably higher than those of dyes. What is not mentioned in all these assessments is quality. That is to say that dyes have noticeably higher colour gamut, brightness and richer blacks than pigments. What dyes may lack in longevity they make up for with that highly subjective characteristic called 'quality' and much of this can be attributed to the depths of the dye blacks.

A high level of light stability has been achieved in the new six colour set and papers incorporated in the HP Designjet 5550 and now the Designjet 130/130NR models. These ratings are highly significant because it means pigments are no longer alone in the high rating charts.

As a matter of comparison for the darkroom produced colour prints, the ratings for Ilfochrome is 29 years and for Fujifilm's Archival Crystal paper it's 70 years. Most of the RA-4 process colour photographic papers range from 14 to 18 years.

Preservation Methods

For most of us there are differences between what can be classified as 'ideal' conditions of storage and display, and what is actually practical. The 'ideals' declare the rate of deterioration in a print can be limited or slowed down by exposing prints to light only when necessary or by ensuring the light is not too bright and that UV radiation is removed.

High temperatures and high humidity play significant roles in print degradation, but unfortunately we cannot always constantly apply air conditioning and de-humidifiers to our environments, let alone do a 'Bill Gates' and consign all our work to sub-zero storage deep inside mountains. The family deep freeze may well be the answer, but because refrigerators produce moisture all print/film packages would need to be sealed in airtight containers.

By displaying prints under glass and well away from direct sunlight you will at least provide the best conditions for display. If you want to preserve the same image then you should probably simply make a second copy and lock it away from light, heat, humidity and air movement as best you can.

Avoid storing prints near chemicals (especially in a darkroom) and keep them well away from ozone sources such as television, computer monitors, air conditioners or any source of high voltage.

Ordinary glass, in windows and pictures frames, will block the most damaging high-frequency, longer wavelength ultraviolet radiation associated with daylight. Lower frequency ranges are not blocked. Artificial light, particularly tungsten incandescent bulbs or low-UV emitting fluorescent tubes, is much preferred to daylight. The exclusion of sunlight is the most critical factor.

Lamination of a print via UV-absorbing film, acrylic sheets or lacquers may enhance longevity but care must be exercised because some laminates can cause more harm than good. Adhesives used in the mounting and presentation of prints can also have adverse effects in the long term.

Display prints are best presented under glass in a properly sealed frame. The glass is an UV inhibitor and acts as a barrier against contaminates in the air. Avoid print framing in high humidity conditions and always allow prints at least a day to dry before framing.

Prints intended for storage need to be housed in acid-free containers. If an album is preferred avoid adhesives via the use of acid-free sleeves or old-fashioned invisible corners and ensure the album is rated as being made of archival materials.

Real World Values

So much for all the technicalities, but where do we stand? We can look at the ratings supplied by various organisations and try to reach some sort of conclusion, even if we choose to adopt a very conservative approach and decide to cut the values in half.

Apart from galleries and museums, few of us will have ideal conditions for storage and display, so the predictions available can only be taken as guidelines. This is to say our prints may have quite different 'lifestyles' so, if display prints are not subjected to ten hours of light per day, they may indeed endure far longer than predicted.

Those other factors of variable temperatures and humidity levels, plus unknown responses to ozone contamination may indeed shorten print life.

As you are now aware of all the factors that contribute to print degradation you can, at least, take all due diligence in display and storage conditions. The life of a display print will therefore be enhanced by placing it behind glass using neutral pH framing materials in a relatively cool, dry area with low levels of UV illumination. Otherwise prints belong in albums and archival storage containers, once again in a cool, dry area.

How long will these prints last? How long is a piece of string? Who knows, but you can be assured there will be no need for re-prints for many years if you select the appropriate materials and take the necessary precautions for display and storage.

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FEATURES

ON TRIAL

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This month's wild image is courtesy of Tony Martorano. He describes the advantages of going digital on safari on page 76.

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