

## Fade Resistance of select HP photo, graphics and fine art printing systems:

HP Premium Plus Photo Paper, HP Advanced Photo Paper and HP Digital Fine Art Media

Hewlett-Packard Company,  
September 2006

The following charts provide fade resistance results<sup>(1)</sup> for HP Premium Plus, improved HP Advanced Photo Papers, and new HP Digital Fine Art Media when printed on select HP printers and inkjet print cartridges introduced since 2002. HP uses Wilhelm Imaging Research, Inc. (WIR), a leading independent test lab, to substantiate predicted fade resistance claims. HP participates in WIR's print permanence testing certification program. For more information on this program visit [www.wilhelm-research.com](http://www.wilhelm-research.com).

Note: for information about Premium Photo Paper refer to the bottom of the chart below

| Printer/Inkjet print cartridge <sup>2</sup>                                                                                              | Photo type & cartridges used | Glass-covered Display: Years<br>WIR <sup>3</sup> HP <sup>4</sup> |                                     |                        |
|------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|------------------------------------------------------------------|-------------------------------------|------------------------|
|                                                                                                                                          |                              | HP Premium Plus Photo Paper                                      | HP Advanced Photo Paper <b>New!</b> | HP Premium Photo Paper |
| HP 38 (Photosmart Pro B9180) or HP 70 pigment ink cartridges with HP Vivera Inks                                                         | Color or B&W printing        | Not compatible                                                   | 200+ (WIR)                          | Not compatible         |
|                                                                                                                                          |                              |                                                                  |                                     |                        |
| HP Photosmart A430, A510, A610, A710 series compact photo printers using the HP 110 Tri-color Inkjet Print Cartridge with HP Vivera Inks | Color or B&W printing        | Not Optimized                                                    | 50+ (WIR)                           | Not Optimized          |

| Printer/Inkjet print cartridge <sup>2</sup>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Photo type & cartridges used                                             | Glass-covered Display: Years WIR <sup>3</sup> HP <sup>4</sup> |                                     |                                              |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------|---------------------------------------------------------------|-------------------------------------|----------------------------------------------|
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                          | HP Premium Plus Photo Paper                                   | HP Advanced Photo Paper <b>New!</b> | HP Premium Photo Paper                       |
| Deskjets: 460, 5440, 5940, 5740, 6520, 6540, 6620, 6840, 9800 Officejets: 6210, 7210, 7310, 7410 and PSC 1510, 1610, 2355, 2575<br>Photosmart Printers: 7850, 8050, 8150, 8450, 8750<br>Photosmart 325, 335, 375, 385, 428, 475 , series printers using these inkjet print cartridges containing HP Vivera Inks (Note: some cartridges are optional or not operational with certain printers. Please check your printer manual):<br>Black : 336, 338, 339 or 337<br>Tri-color : 342, 343 or 344<br>Photo color : 348 or 101or 102<br>Photo gray :100 | Color printing with Tri-color only                                       | 82 (HP/WIR) <sup>∨</sup>                                      | Testing planned or in progress      | 50+ (HP)                                     |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Color printing with Tri-color and Photo color                            | 105+ (HP/WIR) <sup>∨</sup>                                    | Testing planned or in progress      | 50+ (HP)                                     |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Color printing with Tri-color, Photo color, or Photo blue and Photo gray | 105+ (HP/WIR) <sup>∨</sup>                                    | Testing planned or in progress      | 50+ (HP)                                     |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Color printing with Tri-color, Photo color, or Photo blue and Photo gray | 105+ (HP/WIR) <sup>∨</sup>                                    | Testing planned or in progress      | 50+ (HP)                                     |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | B&W/grayscale printing with Photo gray                                   | 115 (HP/WIR) <sup>∨</sup>                                     | Testing planned or in progress      | 50+ (HP)                                     |
| Photosmart Printers: 8253, Photosmart 3213, 3313 All-in-One using the HP 363 Ink Cartridges in the following Colours: yellow, cyan, magenta, light cyan, light magenta, black                                                                                                                                                                                                                                                                                                                                                                        | Color printing with all six cartridges in the 363 cartridge set          | 103 (WIR)                                                     | Testing planned or in progress      | 50+ (HP based on results for similar system) |

| Printer/Inkjet print cartridge <sup>2</sup>                                                                                                                                                                                                                                                                                                                                                                                                           | Photo type & cartridges used                              | Glass-covered Display: Years WIR <sup>3</sup> HP <sup>4</sup> |                                                         |                                                                              |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------|---------------------------------------------------------------|---------------------------------------------------------|------------------------------------------------------------------------------|
|                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                           | HP Premium Plus Photo Paper                                   | HP Advanced Photo Paper <b>New!</b>                     | HP Premium Photo Paper                                                       |
| Photosmart 100, 130, 230 145, 245, 7600, 7700, 7900, 7150, 7200, 7350, 7450, 7500 series; and Deskjet 450C, 3600, 3800, 5100, 5550, 5600, 5800 and 9600 series; PSC 1350, 2100, 2200, 2300, 2400 2500series; and Officejet 6110, 4110, 5510 series (Note: some cartridges are optional or not operational with certain printers. Please check your printer manual):<br>Black : 56 or 21<br>Tri-color : 57 or 22<br>Photo color : 58<br>Photo gray :59 | Color printing with Tri-color only                        | 10+ (HP)                                                      | Not tested. Recommend using HP Premium Plus Photo Paper | 20+ (HP)                                                                     |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Color printing with Tri-color and Photo color             | 50+ (HP, based on results for similar system)                 | Not tested. Recommend using HP Premium Plus Photo Paper | 50+ (HP, based on results for similar system) – submitted to WIR for testing |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Color printing with Tri-color, Photo color and Photo gray | 50+ (HP, based on results for similar system)                 | Not tested. Recommend using HP Premium Plus Photo Paper | 50+ (HP based on results for similar system)                                 |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                       | B&W/grayscale printing with Photo gray                    | 50+ (HP, based on results for similar system)                 | Not tested. Recommend using HP Premium Plus Photo Paper | 50+ (HP, based on results for similar system)                                |
| Same printers as listed above for 57 Tri-color cartridges.<br>Tricolor: 57+ Vivera                                                                                                                                                                                                                                                                                                                                                                    | Color printing with Tri-color only                        | 68 (WIR)                                                      | Not tested. Recommend using HP Premium Plus Photo Paper | 50+ (HP, based on results for similar system)                                |
| Compatible with printers using the 78 cartridge.<br>Tricolor: 78+ Vivera                                                                                                                                                                                                                                                                                                                                                                              | Color printing with Tri-color only                        | 88 (WIR)                                                      | Not tested. Recommend using HP Premium Plus Photo Paper | 50+ (HP, based on results for similar system)                                |
| Compatible with printers using the 78 cartridge.<br>Tricolor: 78                                                                                                                                                                                                                                                                                                                                                                                      | Color printing with Tri-color only                        | ~5 (WIR)                                                      | Not tested.                                             | ~5 (HP, based on results for similar system)                                 |

|                                                                                                                                                         |                                                                          |                                                    |                                |                                                 |
|---------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------|----------------------------------------------------|--------------------------------|-------------------------------------------------|
| Designjet 30, 90, 130 Ink cartridges featuring HP Vivera Inks including these colors: Black: 84<br>Yellow, cyan, light cyan, light magenta, magenta: 85 | Color printing with all colors cartridges in the 85 cartridge set and 84 | 82<br>(HP based on WIR results for similar system) | Testing planned or in progress | 50+<br>(HP based on results for similar system) |
|---------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------|----------------------------------------------------|--------------------------------|-------------------------------------------------|

| Printer/Inkjet print cartridge <sup>2</sup>                                      | Photo type & cartridges used | Glass-covered Display: Years WIR <sup>3</sup> HP <sup>4</sup> |                                |                        |                        |
|----------------------------------------------------------------------------------|------------------------------|---------------------------------------------------------------|--------------------------------|------------------------|------------------------|
|                                                                                  |                              | HP Digital Fine Art Media (B+/A3+/13x19") <b>New!</b>         |                                |                        |                        |
|                                                                                  |                              | HP Hahnemühle Smooth Fine Art Paper                           | HP Hahnemühle Watercolor Paper | HP Aquarella Art Paper | HP Artist Matte Canvas |
| HP 38 (Photosmart Pro B9180) or HP 70 pigment ink cartridges with HP Vivera Inks | Color or B&W printing        | 200+ (WIR)                                                    | 200+ (WIR)                     | 200+ (HP)              | 200+ (HP)              |

**Chart Notes:**

1. Fade resistance results in “covered display” column refer to light fade test results of photos under glass. Degradation by light is not the only factor than can cause photos to fade or distort over time. Clearly specified test standards for the two other factors – humidity and ozone – are currently not defined. However HP Image Permanence Lab and WIR use existing general methods to test for resistance to humidity and ozone. In general, according to tests conducted by HP IPL, the HP products listed in the table show good humidity and ozone resistance. For best results with any photo product, display and store photos in a cool, dry location. For more information on factors that may cause fading refer to “Inkjet Photo Prints: Here to Stay” at [www.hp.com/go/printpermanence](http://www.hp.com/go/printpermanence)

The basic method for estimating lightfade resistance accelerates light exposure and calculates years of image resistance to fade based on the accelerated light exposure. There are two main types of high-intensity illuminant commonly used today: fluorescent, and Xenon arc. Fluorescent accelerated fade chambers have the advantage of demonstrated ability to operate over a wide range of lux level (100 Lux to 100 kLux) at a relevant temperature and humidity (approx. 75 F / 60 % RH), which enables linearity tests that greatly increase the confidence in the highly-

accelerated predictions. There is some UV content with fluorescent illuminants. Xenon arc devices have the advantage of providing, with appropriate filtering, an even better simulation of typical indoor lighting spectra, and in recent years equipment advances have enabled improved control of temperature and humidity; as these issues are resolved, Xenon arc will likely emerge as the new standard in the future. Leading labs, such as HP's IPL and Wilhelm Imaging Research, operate both types of equipment but currently base indoor Display Permanence Ratings on the well-established technique of fluorescent illumination. The spectral power distribution of the fluorescent lamps used in these tests meets the requirements set forth in ANSI Standard IT9.9 and ISO Standard 18909. Nominal illumination for calculating indoor display life is generally taken as 450 lux averaged over a 12 h day. Due to variability in illumination conditions in homes and offices, images will last longer when displayed under lower light levels (on average over a 12-hr day) and likewise, display life will be shortened when displayed under illumination that is more intense than the 450 lux average. Tests include accelerated glass-filtered, UV filtered, and bare-bulb fluorescent light fading tests conducted at 75 degrees Fahrenheit and 60 percent relative humidity, based on a standard indoor display condition of 450 lux for 12 hours per day. HP and Wilhelm Imaging Research Display Permanence Ratings for indoor display focus on the glass-filtered results, but the full data summary on Wilhelm-Research.com includes the bare-bulb and UV-filtered results as additional points of comparison.

2. Printer and inkjet print cartridges listed may not reflect all of the printers available with the inkjet print cartridge configuration listed. Some printer and inkjet print cartridge product numbers vary by region. Some photo cartridges may be optional with certain printers.
3. WIR refers to Wilhelm Imaging Research. WIR Display Permanence Ratings (DPR) are based on accelerated light stability tests conducted at 35 Klux with glass-filtered cool white fluorescent illumination with the sample plain air temperature maintained at 24°C and 60% relative humidity. Data were extrapolated to display conditions of 450 lux for 12 hours per day using the Wilhelm Imaging Research, Inc. "Visually-Weighted Endpoint Criteria Set v3.0." and represent the years of display for easily noticeable fading, changes in color balance, and/or staining to occur. For more information regarding Wilhelm Imaging Research test methods and conditions please refer to [www.wilhelm-research.com/](http://www.wilhelm-research.com/)
4. HP IPL refers to HP's Image Permanence Laboratory. HP IPL light fade, ozone fade, and thermal degradation test methods are similar to WIR methods; differences include lower humidity in light fade testing (50 %RH), and higher accelerated light intensity (90 Klux).
5. Results obtained by WIR for previous version of HP Premium Plus Photo Paper; HP IPL test results demonstrate equal or greater fade resistance performance with current version of HP Premium Plus Photo Paper. WIR is currently conducting confirmation tests with the current version of HP Premium Plus Photo Paper.

## WIR Display Permanence Ratings – Dye-sublimation and traditional silver-halide

Color prints printed from a digital file.

|                                                                                                                                                                                                       |          |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|
| Fujicolor Crystal Archive paper – (silver halide)                                                                                                                                                     | 40 (WIR) |
| Kodak Easy Share printer dock (dye-sublimation)                                                                                                                                                       | 26 (WIR) |
| Kodak Ektacolor Edge Generations paper – (silver halide)                                                                                                                                              | 19 (WIR) |
| Canon CP-200 (dye-sublimation)                                                                                                                                                                        | 7 (WIR)  |
| Sony DPP EX5 (dye-sublimation)                                                                                                                                                                        | 4 (WIR)  |
| Fade resistance of other brands' inkjet systems varies widely – visit <a href="http://www.wilhelm-research.com">www.wilhelm-research.com</a> for more information and results of other inkjet systems |          |

### Other factors

HP carefully considers all factors related to permanence--not just lightfastness. Other permanence factors include:

**Thermal Degradation** (also known as dark fade, since it does not require light to occur). HP inkjet colorants are very stable at room temperature--in fact, even after 200 years of simulated storage at 25°C (77° F), there is no noticeable change in the colored areas. The limiting factor is the rate of yellowing of the paper itself. In tests conducted by WIR with HP 57/58 and HP 342 ( or 343/344)/348 inkjet print cartridges on HP Premium Plus, the dark fade resistance was found to be over 200 years. Printing with HP Viverra pigment inks such as the HP 38 inkjet print cartridges on most papers yields 200+ years of thermal fade resistance. HP expects that this 200+ yr. value applies to HP photos made with all current HP Viverra inks on either HP Premium or HP Premium Plus photo papers, the newer version of HP Advanced Photo Paper, and HP Hahnemühle Smooth Fine Art Paper, HP Hahnemühle Watercolor Paper, HP Aquarella Art Paper, HP Artist Matte Canvas. Confirmation tests are underway at WIR.

**Ozone Fading** (or fade caused by airborne pollutant). HP employs several technological innovations to minimize fade caused by airborne pollutants such as ozone. HP has chosen to use a special, self-sealing inkjet coating on HP Premium and HP Premium Plus photo papers. This coating encapsulates the colors,

thereby preventing significant air fade when prints are displayed in regular contact with air. HP also designs special colorants used in pigment inks that when printed on HP Advanced Photo Paper are resistant to air fade. Currently there is no official standard for calculating equivalent years of air fade resistance, but general industry practice used by several major manufacturers allows approximate estimates to be made based on elevated ozone exposure. Based on these tests, all current HP inks with HP Premium Plus or HP Premium should have several decades of air fade resistance when displayed in regular contact with air. Photo printed with HP Vivera pigment inks, such as the HP 38, should have decades of air fade. However, for long-term display it is still preferable to use glass or other protection, since it helps protect the print from various types of damage (scratches, smoke particles, etc.).

| Air Fade of HP Photo Papers               |                                                                      |                                                  |
|-------------------------------------------|----------------------------------------------------------------------|--------------------------------------------------|
| Paper technology<br>Ink technology        | HP Premium Plus or<br>HP Premium photo papers<br>(swellable coating) | HP Advanced Photo Paper<br>(nano-porous coating) |
| Pigment                                   | Not compatible                                                       | (30 - 60 years*) – Still in test                 |
| Current dyes                              | (30+ years*)                                                         | (0.5+ years*)                                    |
| Modified dye (e.g. 110<br>cartridge)      | Not recommended                                                      | (8+ years*)                                      |
| *estimated years before noticeable fading |                                                                      |                                                  |

**Humidity-fastness.** Currently, there is no official standard for calculating equivalent years of display as a function of humidity exposure. However, general industry practice enables identification of products that have poor vs. good resistance to humidity-induced color changes. HP has tested the HP inks listed above on compatible papers, and has found the resistance to humidity-induced color changes to be good. Photos printed with pigment inks are particularly resistant to the effects of humidity. However, with all photos--not just inkjet--frequent exposure to high humidity (e.g. above 80 % RH) should be avoided if possible.

### General Tips for Better Permanence

Regardless of whether a photo print is inkjet, silver-halide, or based on any other technology, it is always advisable to ...

- Store it in a cool and dry place.
- Avoid constant exposure to conditions above 80% relative humidity.

- Place it behind glass, in a plastic sleeve or laminate it for display.

And especially for inkjet photo prints to ...

- Dry them for at least one day at conditions below 70% humidity before storing or displaying behind glass or plastic.
-