**Fade resistance of select HP photo printing systems:**

**HP Premium Plus Photo Paper and HP Advanced Photo Paper**

**Hewlett-Packard Company**

**August 2015**

The following charts provide fade resistance results1 for color photos on HP Premium Plus and HP Advanced Photo Papers, when printed on select HP printers and using Original HP inkjet print cartridges. HP performs fade resistance testing in HP’s Image Permanence Labs.4 Additional testing has been done on some cartridges by Wilhelm Imaging Research, Inc. (WIR), a leading independent test lab. For more information on Wilhelm Imaging Research, visit [www.wilhelm-research.com](http://www.wilhelm-research.com).

**Fade resistance when displayed under glass:**

The glass-covered display years in the table below is for Original HP inkjet print cartridges. The fade resistance criteria are explained in <http://www.hp.com/products1/printpermanence/pdfs/light_fade_testing_methods_Aug242004_final.pdf>.

These fade resistance ratings are based on Original HP inks. In most cases refilled or bargain ink cartridges will have different and usually significantly less image permanence performance. 6

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| **HP Cartridges Display Ratings:** |  | **Photos under glass, fade resistance simulation** |
| **Inkjet print cartridge2** | **Photo type & cartridges** | **Glass-covered display years****HP Premium Plus and** **Advanced Photo Papers** |
|   |  |  |
| HP 02/363 Ink Cartridges (yellow, cyan, light cyan, magenta, light magenta, black) | Color printing with all six cartridges in the 02 cartridge set | 45 |
| HP 564/364/178 Ink Cartridges  | Color printing with Cyan, Magenta, Yellow, Photo Black ink cartridges | 100 |
| Color printing with Cyan, Magenta, Yellow ink cartridges | 80 |
| HP 46 Ink Cartridges | Color printing with Tri-color |  55+ |
| HP 60/300/121/818 Ink Cartridges | Color printing with Tri-color | 80 |
| HP 61/301/122/802 Ink Cartridges | Color printing with Tri-color |  50+ |
| HP 62 Ink Cartridges | Color printing with Tri-color |  55+ |
| HP 650/662/678 Ink Cartridges | Color printing with Tri-color | 50+ |
| HP 651Ink Cartridges | Color printing with Tri-color | 55+ |
| HP 655/670/685 Ink Cartridges | Color printing with Tri-color | 100 |
| HP 110 Ink Cartridge  | Color or B&W printing | 51 (WIR test) |
| HP 675 OfficeJet Ink Cartridges | Color printing with Tri-color | 80 |
| HP 703 Ink Cartridges | Color printing with Tri-color | 80 |
| HP 704 Ink Cartridges  | Color printing with Tri-color |   50+ |
| HP 920 OfficeJet Ink Cartridges | Color printing with Cyan, Magenta, Yellow ink cartridges | 75 |
|  |  |  |
| HP 940 OfficeJet Ink Cartridges | Color printing with Cyan, Magenta, Yellow ink cartridges |  65+ |
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Additionally, HP inks and paper provide better fade resistance than other established photo printing technologies such as dye-sublimation or silver halide, as shown in the second table.

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| **Wilhelm Imaging Research Display Permanence Ratings (glass covered): Common lab, retail and online photo printing process including dye-sublimation and traditional silver-halide** Color prints printed from a digital file |
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| Silver halide (traditional lab processing for photos) such as: |  |
| Fujicolor Crystal Archive paper  | **40 years** |
| Kodak Ektacolor Edge Generations paper – (silver halide) | **19** |
|  |
|  |  |
| Retail kiosks such as: |  |
| Fuji Xerox 7/11 (xerographic photo printer) | **23** |
| Kodak PictureMaker (dye-sublimation photo printer) | **26** |
| Dye-sublimation such as: |  |
| Kodak Easy Share printer dock | **26** |
| Sony DPP-FP55 Picture Station | **10** |
| Olympus P-10 Printer | **8** |
| Canon CP-200 | **7** |
| Fade resistance of other brands’ inkjet systems varies widely – visit [www.wilhelm-research.com](http://www.wilhelm-research.com) for more information and results of other inkjet systems |

**Other factors**

HP carefully considers all factors related to permanence -- not just fade resistance. 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 25ºC (77º 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 HP Image Permanence Labs and/or WIR on HP inks listed in the charts above resulted in dark fade resistance of approximately 200 years. HP expects that this 200+ yr. value applies to HP photos made with all current HP inks on either HP Premium Plus or HP Advanced Photo Papers.

**Ozone Fading** (or fade caused by airborne pollutant)

HP employs several technological innovations to minimize fade caused by airborne pollutants such as ozone including special colorants used in pigment inks and new generation dye inks that when printed on improved HP Premium Plus and HP Advanced Photo Papers are resistant to ozone fade. Currently there is no official standard for calculating equivalent years of ozone fade resistance, but general industry practice used by several major manufacturers allows approximate estimates to be made based on elevated ozone exposure. 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.).

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| **Ozone Fade of HP Photo Papers** |
| **Ink technology** | **HP Premium Plus Photo Paper and HP Advanced Photo Paper** |
| HP pigment-based inks | 30 - 60 years\*  |
| HP dye-based inks introduced before 2006 | 0.7 years\* |
| Porous-optimized Chromophore dye-based inks (e.g. 110, 564, 60, 61,62, ,920 ink cartridge) | 9 - 12 years\*  |
|  | \*estimated years before noticeable fading. |

Image permanence estimates based on Original HP inks printed on HP Photo Papers in HP Permanence Labs.

**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 and new generation dye 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**

Print high quality vivid photos that you can share proudly for years by choosing HP inks and papers. In fact, HP outperforms 3rd party refilled ink cartridges. On average, HP was shown to have up to 50 times the display permanence of common refilled ink cartridges.6 A simulator showing light fade resistance using HP inks and non-HP inks is available through this webpage, http://www.hp.com/go/printpermanence.

HP hopes you will enjoy your photos for many years to come. HP printers, HP original inkjet cartridges, and HP photo papers are designed together for outstanding print quality and value.

Regardless of whether photo prints are inkjet, silver-halide, or based on any other technology, it is always advisable to…

* Store them in a cool and dry place.
* Avoid constant exposure to conditions above 80% relative humidity.
* Place them behind glass, in a plastic sleeve or laminate them for display. Avoid direct sunlight.

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.

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 that 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 Wilhelm Imaging Research use existing general methods to test for resistance to humidity and ozone. In general, according to tests conducted by HP Image Permanence Lab (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)
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. 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.. 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 to simulate home use of framed photos, but the full data summary on Wilhelm-Research.com includes the bare-bulb and UV-filtered results as additional points of comparison.
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. Wilhelm Imaging Research, Inc. testing with glass in contact with photo; all other tests are testing with 5mm gap between glass and photos. See these fade resistance ratings in Henry Wilhelm’s paper, “A Survey of Print Permanence in the 4x6 inch Consumer Digital Print Market in 2004-2007” at <http://www.wilhelm-imaging.com/ist/WIR_IST_2007_03_HW.pdf>
6. Based on Wilhelm Imaging Research, 2012. For more details, <http://www.wilhelm-research.com/hp/NonGenuine-3rdPartyInkRefills.html> . As compared to print permanence ratings of Original HP Inks and papers on this page.