Light fade testing methods: HP Image Permanence Labs & Wilhelm Imaging Research

The permanence of digital photo output is an important concern for most consumers who print their own photos. Developing innovative, high-quality hardware, ink and paper that produces professional-quality, highly fade -resistant photos is a priority for HP and is an important feature that differentiates the quality of HP photo printing systems from those of most of its competitors.

HP Image Permanence Labs

HP has two state-of-the-art image permanence labs in San Diego, California and Corvallis, Oregon with custom image permanence testing equipment. These labs develop new test procedures to better predict image permanence across a wide range of degradation mechanisms including light fade, ozone fade, humidity-fastness, and dark storage (thermal) fade.

HP's image permanence testing equipment covers a wide range of acceleration factors, and is temperature- and humidity-controlled in order to replicate and predict image permanence under conditions that are representative of how customers actually store and display prints. For fluorescent light fade, the permanence predictions in HP's labs correlate very well to published Wilhelm Imaging Research, Inc.'s permanence test results.

HP's image permanence testing equipment is highly specialized and cannot be readily duplicated without substantial investment. For example, typical light fade tests are performed at 23ºC and 50% relative humidity even in the presence of extremely bright illumination (up to 350 times brighter than typical room), which is difficult for equipment to achieve and maintain. Significant human training and resources are needed to appropriately generate samples, take periodic measurements, and check and calibrate the equipment operating conditions. Acceleration factors between 2.5X to 350X the normal assumed daily light levels are used to span the range between" real world but very slow" and" highly accelerated" test conditions. Depending on the test model, both fluorescent and xenon arc light sources are also used to simulate residential indoor and commercial application daylight window fade conditions.

Wilhelm Imaging Research, Inc.

HP follows the general testing method developed and used by Wilhelm Imaging Research, Inc. (WIR), a leading image permanence test lab. The WIR method has also been used by many other photo solution manufacturers, including Epson, Canon, Lexmark, and Fuji.

As a best-practice, HP regularly submits its photo papers, inks and printers to the WIR labs for light fade and dark storage stability testing. When available, HP uses WIR results as its primary substantiation for fade resistance claims on prints produced with HP photo systems.

Find out more about Wilhelm Imaging Research test methods and test results at www.wilhelm-research.com.

The table below provides a comparison of the test methods and conditions used by HP and Wilhelm Imaging Research.

Test Specification	Wilhelm Imaging Research[i]	HP
Environment: Refers to temperature and relative (RH) humidity in the test chamber.	24º C, 60% RH	23º C, 50% RH
Typical display estimate: This is the calculation assumption that is necessary to predict display life. It represents an assumption based on research of the amount of light that a typical photo is exposed to per day. Actual photo samples are tested at Lux levels 35X to 200X greater than this to accelerate test results. Otherwise we would have to wait decades for results.	450 lux per 12 hr day	Same as WIR
Sample cover: This refers to whether test photos are covered with glass in the test chamber. Covered photos can resist noticeable light fade considerably longer and simulate the manner in which many photos are displayed.	Uncovered, glass-covered, and UV-filter covered samples are tested	Uncovered and glass-covered samples are tested
Initial density: This refers to color density of the test sample colors after printing and before fading has begun. For black, cyan, magenta and yellow, color squares with these two densities are identified. Generally, higher densities contain more ink and less white space. A density of 1.0 would appear as dark yellow, dark blue, black etc., 0.6 would be lighter blue, light yellow, light gray etc. Testing only 1.0 densities would not be simulating the reality of most photos as photos contain many subtle shades and are not printed with purely dark colors.	0.6 and 1.0	Same as WIR
Dry down time: Photos are allowed to dry before testing begins. A long dry down time (in dark) is important to stabilize the colors and completely eliminate any effects the residual ink solvent may have on the test. This is to model more accurately true photo display behavior. A typical print has a long time to dry before light exposure is significant.	2 weeks 24º C, 60% RH	2 weeks 23º C, 50% RH
Failure point (Optical Density loss): These are pre-determined color optical density loss criteria that when reached, indicate a color has faded noticeably to the naked eye. As soon as one color is seen to have noticeable fade, it has reached the "failure point", and the test is over. Calculations using the Typical Display Estimate correlate results to an estimated number of years a photo can expect to resist fading in typical real-world display conditions.	17 failure modes measuring pure color loss, color imbalance due to color loss, and white point changes	Same as WIR
Faded to failure: During a test photos are removed from the chamber periodically to test for color optical density loss. With enough data points photo life could be estimated even if photos are not tested to failure (noticeable color fade or color shift). However, as these non-failure estimates are not as accurate as predictions made from photos tested to failure.	yes	yes

Comparing results of different manufacturers

Note: Caution is advised when comparing fade resistance of photo papers from failure criteria; however, some manufacturers use their own methods, including Eastman Kodak. Fade performance predictions using Kodak's light fade test methods will always be significantly longer than those using the Wilhelm test method. There are several test method differences between WIR and Kodak that significantly affect fade resistance test results:

Kodak uses a typical display condition of 120 lux for a 12-hour a day, while WIR uses 450 lux for a 12-hour day. This factor alone in Kodak's method results in a 3.75 increase in predictions for the life of displayed prints. As an example, photos printed with HP Premium Plus Photo Paper using the HP 57 & 58 inkjet print cartridges are predicted to resist fading for 73-years by WIR; in Kodak terms, using 120 lux for 12 hours per day, that figure increases to approximately 274-years). 450 lux for a 12-hour day represents a brightly lit room such as a living room or kitchen.

Other factors of the Kodak test methodology that may further elevate predicted fade performance include the use of a plastic cover that, unlike the glass print cover used by WIR and HP, filters essentially all UV radiation, the most damaging component of light. In addition, the Kodak method tracks only the single optical density of 1.0 per color, while WIR and HP track both 0.6 and 1.0. Tracking more than one density provides a better idea of fade resistance performance across a wider range of color intensities – more like a three-dimensional view – and is less likely to overlook fade problems that may exist at other densities, especially in the important lighter hair and skin tones found in pictures of people. Taken together, these differences in test methodology typically result in Kodak's display life predictions being 4 to 8 times *greater* than the more realistic, consumer-oriented print display life predictions from WIR, HP, Epson, Canon, Lexmark, and most other companies.

Glossary

Fade Destruction of the color-generating characteristics of colorants.

Inkjet Printer technology in which droplets of ink are projected onto paper.

Lightfastness Prediction of how long a photo image can be subjected to light before noticeable fade occurs (also called light fade resistance).

Lux Unit of illumination equal to one lumen per square meter.

Optical density (OD) Measure of transmitted or reflected light.

---

i. Test method is specified in Wilhelm Imaging Research's v3.0 Endpoint Criteria Set and is available on www.wilhelm-research.com.

August 2017