HP's Commitment to Rigorous Permanence & Durability Testing

Overview

To help customers make informed decisions when buying large format printers and printing supplies, HP is committed to providing rigorous testing of those specifications associated with the customer's need for prints that withstand the demands of handling, display and storage.

Image permanence

This term essentially describes how long a print will last and is determined by how well the print resists relevant degradation factors. For example, a displayed print may experience noticeable changes such as fading due to exposure to light (lightfade), air pollutants (air pollution), or high temperatures. Other degradation factors include thermal or dark fade, which refers to image degradation due to the absence of light, and humid-fastness, defined as the migration of colorant when an image is exposed to elevated levels of humidity. A 'Display Permanence Rating' (DPR) is generated by examining the relevant degradation factors from the above list, and determining the limiting factor. For example, a framed photograph DPR will be a function of the light fade resistance and the thermal degradation resistance (whichever is lesser). Air pollutant (i.e. ozone) fading would be an additional factor to include for photographs displayed with no protection from contact with air.

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HP messages permanence results on a wide variety of printers, inks, and substrates. You can find them at www.hp.com/go/supplies/printpermanence. The methods outlined below apply to both rigid and flexible substrates.

Indoor Light Fade – General Method

The basic method for estimating resistance to the effects of exposure to light uses high-intensity light fading tests under controlled temperature and humidity conditions. Data obtained from the accelerated tests are then used to calculate a display permanence rating (in years) which is based on the time of light exposure required to reach the first of a set of "endpoint criteria" for fading and changes in color balance of an image, and for yellowish stain formation in the print paper itself.

A. Indoor Light Fade – Nominal Home & Office

There are two main types of high-intensity illumination commonly used today for such tests: fluorescent, and xenon arc. Fluorescent accelerated fading chambers have the advantage of demonstrated ability to operate over a wide range of lux levels (100 lux to 100 klux) at a relevant temperature and humidity (75°F [24°C] and 60% RH), which

enables linearity (reciprocity) tests to increase the confidence in predictions based on highly-accelerated tests. 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 of indirect daylight through window glass, and in recent years equipment advances have enabled improved control of temperature and humidity; as these issues are resolved, filtered xenon arc will likely emerge as the new standard in the future for all accelerated display simulations. Leading labs, such as HP's Image Permanence Lab (HP's IPL) and Wilhelm Imaging Research, operate both types of equipment but currently base nominal Home & Office Indoor Display Permanence Ratings on the well-established technique of fluorescent illumination. 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 on a average. Tests include accelerated glass-filtered, UV filtered, and bare-bulb fluorescent light fading tests conducted at 75°F (24°C) 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.

B. Indoor Light Fade – Commercial In-window

Successful simulation of in-window display requires an acceleration illuminant that creates a spectrum similar to that of sunlight filtered through window glass. Xenon-arc lamps best match the desired spectrum, but controlling temperature and humidity in these devices requires state-of-the-art equipment and operation. HP currently uses data from Xenon-arc devices in HP's Image Permanence Lab as well as data from leading independent test labs. HP claims published starting in 2007 for prints made with printing systems such as HP Designjet Z6100 use the following test conditions and calculation assumptions. Xenon-arc lamp, glass filtered (Boro-Silicate 300 nm UV cut-off), cycled temperature and humidity (3.8 hours per light cycle – air held at 40°C & 40%rH, 65°C Black Panel Temperature, 1.0 hour per dark cycle – air held at *25°C* & 70%rH,. Key calculation assumptions include 6,000 lux for 12 hours per simulated day, and Wilhelm Imaging Research v3.0 failure criteria.

Outdoor Permanence - General Method

A selection of HP substrates and inks are designed to withstand outdoor elements, such as direct sunlight, rain, high temperatures, and various humidity. The most accurate way to simulate these is through the use of xenon-arc environmental chambers, much like the In-Window method described above. Our outdoor test procedure follows the rigorous cycles of SAE J2527, in which samples are exposed to different combinations and intensities of the elements at one time. It even includes a dark-cycle to represent night time. To calculate a life-time prediction we compare data from the simulated experiment and real-time data of samples exposed outdoors. Also, to better fulfill HP customer demands, we continually invest time & money into ISO Standard Committees.

Thermal Degradation
(also known as album/dark storage stability or dark fade, since it is a function of temperature and relative humidity and does not require exposure light to occur)

Thermal Degradation is determined using accelerated dark storage tests in which samples are incubated in precisely-controlled ovens at a series of elevated temperatures, at a constant relative humidity. Fade and paper yellowing data obtained from each temperature are used to calculate what would be expected to occur after many years when prints are kept in the dark under normal temperature and humidity conditions. HP inkjet colorants are very stable at room temperature – in fact, even after 200 years of simulated storage at 23°C (73°F) and 50% RH, there is not an objectionable change in the white (d-min) areas of a print. The limiting factor is the rate of yellowing of the paper itself – and not of the ink color. In tests conducted by Wilhelm Imaging Research, Inc. (WIR) with HP 70 and 91 Vivera pigment inks on a range of HP media, the Album/Dark Storage Ratings were found to be over 200 years. HP expects that this 200+ year rating will apply to prints made with all current Original HP pigment inks on a range of HP media tested by WIR such as HP Hahnemühle Smooth Fine Art Paper, HP Hahnemühle Watercolor, and HP Super Heavyweight Plus Matte Paper.

Air Pollution Fade
(Or fade caused by airborne pollutant).

HP employs several technological innovations to minimize fade caused by airborne pollutants such as ozone. HP designs special colorants used in pigment inks that, when printed on a range of HP media, are resistant to air pollution fade. There currently are no officially-sanctioned standard methods for estimating and accelerating pollutant-induced fade, but general industry practice used by several major manufacturers allows estimates to be made based on elevated ozone exposure and assumption of 40 ppm-hours of ozone equivalent to approximately 1 year of real world exposure. To determine potential susceptibility to pollutant fade, HP tests products under concentrated ozone conditions. In unprotected display in direct contact with indoor air, HP Vivera pigment inks offer several decades of ozone fade resistance on recommended papers. For more information, see www.hp.com/go/supplies/printpermanence.

Water Resistance
In addition to delivering outstanding image quality and exceptional fade resistance, HP Vivera pigment inks are carefully formulated for water resistance and produce results that can be counted on across a range of HP media.
During the development of HP Vivera pigment inks, HP tests water resistance performance characteristics most important to customers. HP uses ISO and internally developed tests and considers prints which pass the following tests to be water resistant: *ISO Standing Water, Water Spray, Water Drip, and Wet Smudge.*

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