Hewlett-Packard Deskjet 5550 – Print Permanence Ratings

To switch the HP 5550 printer from the 4-ink plain paper mode to the 6-ink photo mode to print high quality, long-lasting photographs, the HP #56 Black ink cartridge is removed from the right-hand cartridge slot and replaced with the optional high-stability HP #58 Photo cartridge. The two cartridges can be easily changed back and forth.

Description: Introduced in June 2002, the HP Deskjet 5550 is the world's first desktop inkjet printer capable of switching between the "standard" 4-ink plain paper document printing mode and, with the purchase of an optional photo ink cartridge, printing in a high-quality and high-stability 6-ink photo mode. When used in the photo mode with the new and completely reformulated HP Premium Plus Photo Paper also introduced in June 2002 (called "Improved" HP Colourfast Photo Paper in Asia and some other markets), the prints have a Wilhelm Display Permanence Rating (DPR) of more than 70 years when prints are framed under glass. This is the highest DPR of any dye-based desktop inkjet printer ever tested by Wilhelm Imaging Research. In another first for a dye-based inkjet photo printer, the DPR of the HP prints is also superior to that of any traditional photographic color paper. As with all inkjet printers, the choice of paper can have a significant impact on overall image permanence. Display Permanence Ratings, humidity-fastness, resistance to fading caused by ozone and other atmospheric pollutants (gas fading), and paper yellowing properties all can be affected by the selection of paper. For example, as listed below, the Display Permanence Rating of Kodak Ultima Picture Paper used with the HP 5550 in the 6-ink photo mode is less than *one-quarter* of that achieved with HP Premium Plus Photo Paper. U.S. retail price of the HP 5550 is $149.00. Paper sizes up to 8.5 x 11 inches or A4. Printer resolution is stated by HP to be "up to 4,800 x 1,200 optimized dpi on photo papers with 1,200 x 1,200-input dpi." The HP Photosmart 7150, 7350, and 7550 printers introduced in July 2002 are sold equipped with HP #57 and HP #58 ink cartridges for printing in the 6-ink photo mode. With an optional HP #56 ink cartridge, these Photosmart printers can also print in the 4-ink document mode (the Photosmart 7550 is supplied with all three cartridges and it chooses the proper mode depending on the paper type selected).

New HP Premium Plus Photo Paper with enhanced image stability introduced in July 2002.

Display Permanence Ratings and Dark Storage Ratings (Years Before Noticeable Fading and/or Changes in Color Balance Occur)[1]

Paper, Canvas, or Film Media Printed with HP Dye-Based Inks	Displayed Prints Framed Under Glass[2]	Displayed Prints Not Framed (Bare-Bulb)[3]	Displayed Prints Framed With UV Filter[4]	Dark/Album Storage Stability Rating (incl. Paper Yellowing)[5]	Comments
Printed in 4-Ink Standard Mode (#56 and #57 inks)					
HP Premium Plus Photo Paper – Glossy	**15 years**	11 years	21 years	now in test	Glossy RC-base paper (swellable polymer)
HP Premium Plus Photo Paper – Matte	**now in test**	now in test	now in test	now in test	Glossy RC-base paper (swellable polymer)
HP Premium High-Gloss Film	**now in test**	NR[3]	now in test	now in test	Glossy polyster-base media (microporous)
Kodak Ultima Picture Paper – Glossy	**4 years**	3 years	5 years	now in test	Glossy RC-base paper (swellable polymer)
Printed in 6-Ink Photo Mode (#57 and #58 inks)					
HP Premium Plus Photo Paper – Glossy	**73 years**	49 years	now in test	now in test	Glossy RC-base paper (swellable polymer)
HP Premium Plus Photo Paper – Matte	**now in test**	now in test	now in test	now in test	Glossy RC-base paper (swellable polymer)
HP Premium High-Gloss Film	**23 years**	NR[3]	now in test	now in test	Glossy polyster-base media (microporous)
Kodak Ultima Picture Paper – Glossy	**17 years**	17 years	11 years	now in test	Glossy RC-base paper (swellable polymer)

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Notes on These Tests:

1) 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 plane 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. (See: Henry Wilhelm, "How Long Will They Last? An Overview of the Light-Fading Stability of Inkjet Prints and Traditional Color Photographs," *IS&T's 12th International Symposium on Photofinishing Technology,* sponsored by the Society for Imaging Science and Technology, Orlando, Florida, February 2002: *<http://www.wilhelm-research.com/articles_ist_02_2002.html>.)* High-intensity light fading reciprocity failures in these tests are assumed to be zero. Illumination conditions in homes, offices, and galleries do vary, however, and color images will last longer when displayed under lower light levels; likewise, the life of prints will be shortened when displayed under illumination that is more intense than 450 lux. Ink and paper combinations that have not reached a fading or color balance failure point after the equivalent of 100 years of display are given a rating of "greater than 100 years" until such time as meaningful Arrhenius thermal aging data are available (see discussion in No. 5 below).

2) In typical indoor situations, the "Displayed Prints Framed Under Glass" test condition is considered the single most important of the three display conditions listed. All prints intended for long-term display should be framed under glass or plastic to protect them from staining, image discoloration, and other deterioration caused by prolonged exposure to cigarette smoke, cooking fumes, insect residues, and other airborne contaminants; this precaution applies to traditional black-and-white and color photographs as well as inkjet and other types of digital prints.

3) Illumination from bare-bulb fluorescent lamps (with no glass or plastic sheet between the lamps and prints) contains significant UV emissions at 313nm and 365nm which, with most print materials, increases the rate of fading compared with fluorescent illumination filtered by ordinary glass. Some print materials are affected greatly by the UV radiation, and others very little. "Gas fading" is another potential problem when prints are displayed unframed, such as when they are attached to kitchen refrigerator doors with magnets, pinned to office walls, or displayed inside of fluorescent illuminated glass display cases in schools, stores, and offices. Field experience has shown that, as a class of media, microporous "instant dry" papers used with dye-based inkjet inks can be very vulnerable to gas fading when displayed unframed and/or stored exposed to the open atmosphere where even very low levels of ozone and certain other air pollutants are present. In some locations, displayed unframed prints made with microporous papers and dye-based inks have suffered from extremely rapid image deterioration. This type of premature ink fading is not caused by exposure to light. Polluted outdoor air is the source of most ozone found indoors in homes, offices and public buildings. Ozone can also be generated indoors by electrical equipment such as electrostatic air filters ("electronic dust precipitators") that may be part of heating and air conditioning systems in homes, office buildings, restaurants, and other public buildings to remove dust, tobacco smoke, etc. Electrostatic air filtration units are also supplied as small "tabletop" devices. Potentially harmful pollutants may be found in combustion products from gas stoves; in addition, microscopic droplets of cooking oil and grease in cooking fumes can damage unframed prints. Because of the wide range of environmental conditions in which prints may be displayed or stored, Display Permanence Ratings for the bare-bulb illumination condition will not be listed for paper/ink combinations of known susceptibility to gas fading. Therefore, prints made with microporous papers and dye-based inks should always be displayed framed under glass or plastic.

4) Displayed prints framed with ultraviolet filtering glass or ultraviolet filtering plastic sheet generally last longer than those framed under ordinary glass. How much longer depends upon the specific print material, with some benefitting a great deal more than others. A few products even show reduced life when framed under a UV filter because one or more of the image dyes or pigments is disproportionately vulnerable to fading caused by UV radiation, resulting in more rapid changes in color balance than occur with the glass-filtered and/or the bare-bulb illumination conditions. For these tests, Acrylite OP-3 acrylic sheet, a "museum quality" UV filter supplied by Cyro Industries, is used. Keep in mind that the major cause of fading with most digital and traditional color prints in indoor display conditions is visible light and although a UV filter may slow fading, it will not stop it.

5) Prints stored in the dark may suffer slow deterioration that is manifested in yellowing of the print paper, image fading, changes in color balance, and physical embrittlement, cracking, and/or delamination of the image layer. These types of deterioration may affect the paper support, the image layer, or both. Each type of print material (ink/paper combination) has its own intrinsic dark storage stability characteristics; some are far more stable than others. Rates of deterioration are influenced by temperature and relative humidity; high temperatures and/or high relative humidity exacerbate the problems. Long-term dark storage stability is determined using Arrhenius accelerated dark storage stability tests that employ a series of elevated temperatures (e.g., 50°C, 60°C, 70°C, and 80°C) at a constant relative humidity to permit extrapolation to ambient room temperatures (or other conditions such those found in sub-zero, humidity-controlled cold storage preservation facilities). Many types of inkjet inks, especially those employing pigments instead of dyes, are exceedingly stable when stored in the dark; the eventual life of prints made with these inks may be limited by the instability of the paper support, and not by the inks themselves. Because of this concern, as a matter of policy, Wilhelm Imaging Research does not provide a Display Permanence Rating of greater than 100 years for any print material unless it has also been evaluated with Arrhenius dark storage tests and the data indicate that the print can indeed last longer than 100 years without noticeable deterioration when stored at 75°F (24°C) and 50% RH. Arrhenius data are also necessary to assess the physical and image stability of a print material when it is stored in an album, portfolio box, or other dark location.

6) Some inkjet prints made with dye-based inks have poor humidity-fastness when stored or displayed in commonly encountered conditions of high relative humidity (e.g., 70% RH and higher). With some materials, humidity-induced deterioration can occur very quickly when the prints are in a warm and humid environment – sometimes within only a few days after printing. These problems may include one or more of the following:

   a) Ink bleeding (gradual lateral ink diffusion)
   b) Density changes (increases or decreases)
   c) Color balance changes
   d) "Bronzing" in high-density areas
   e) Sticking and ink transfer