Epson Stylus Pro 9600 – Print Permanence Ratings

Los Angeles photographer Greg Gorman with a print of the Academy Award winning actress Jodie Foster printed with his Epson 9600 and UltraChrome pigmented inks. Gorman is internationally known for his photographs of movie stars and other celebrities. <www.greggormanphotography.com>

Description: Introduced in May 2002, the Epson Stylus Pro 9600 is a 7-ink printer designed for high-quality photographic applications and handles roll paper in widths up to 44-inches (and virtually any length) and sheet paper in sizes up to 44 x 60 inches. With a straight-through paper path easily accessible from the front, the printer can accommodate very heavy sheet paper, such as the 505 gsm Somerset Velvet Fine Art Paper, and rigid cardboard up to 1.5 mm thick. The new Epson UltraChrome inkset can be thought of as the first pigmented inkset designed primarily for indoor use. Although the Display Permanence Ratings are lower than those of the extremely stable Epson Archival pigmented inkset available with the 6-ink Epson Stylus Pro 10000 and 10600 printers, which is suitable for 1–2 year outdoor display applications, the UltraChrome inkset produces more brilliant prints with a larger color gamut, higher d-max, and less metamerism. The UltraChrome inkset used with the 9600 and the smaller 24-inch 7600 (as well as the desktop Epson Stylus Photo 2200 and 2100) also features a dilute "Light Black" (the "7th ink"), which helps smooth tonal transitions, reduces metamerism, and makes it possible to print high quality black-and-white images using the full 7-ink inkset. In order to obtain the highest d-max, a "Photo Black" full-concentration black ink is available for high gloss and semi-gloss papers, and a separate full-concentration "Matte Black" is supplied for matte papers. Price in the United States for the 9600 is $4995.00. The Epson Stylus Pro 7600, a smaller 24-inch printer which is otherwise almost identical in design to the 44-inch 9600, is available for $2,995.

The Epson 9600 is available with a choice of either the pigmented UltraChrome inks or Epson Photographic Dye inks. The pigmented inks provide not only better display permanence than the dye-based inks, but also have better water-fastness and humidity-fastness, superior resistance to gas fading, and have much less "short-term color drift" during the days and weeks after printing.

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 UltraChrome Pigmented Inks	Displayed Prints Framed Under Glass[2]	Displayed Prints Framed With UV Filter[3]	Displayed Prints Not Framed (Bare-Bulb)[4]	Dark Storage Stability Rating at 73°F & 50% RH (incl. Paper Yellowing)[5]	The > symbol indicates "more years" than the number listed and that the tests are continuing. Paper/Canvas Description
Epson Premium Glossy Photo Paper (250)	**85 years**	>100 years	60 years	>200 years	Rapid-dry microporous glossy RC-base paper
Epson Premium Semigloss Photo Paper (250)	**77 years**	>100 years	55 years	>200 years	Rapid-dry microporous semigloss RC-base paper
Epson Premium Luster Photo Paper (roll)	**71 years**	>100 years	48 years	>200 years	Rapid-dry microporous luster surface RC-base paper
Epson Premium Semimatte Photo Paper (250)	**67 years**	>100 years	47 years	>200 years	Rapid-dry microporous semimatte RC-base paper
UltraSmooth Fine Art Paper for Epson[6]	**>75 years**	>100 years	55 years	>200 years	100% cotton base matte paper free of UV brighteners[7]
Somerset Velvet for Epson (255 and 505 gsm)	**62 years**	>100 years	37 years	>200 years	100% cotton base matte paper
Somerset Velvet for Epson w/ PremierArt™ Spray[6]	**>145 years**	>145 years	75 years	>200 years	100% cotton base matte paper (sprayed after printing)
Epson Velvet Fine Art Paper (sheet)	**61 years**	>100 years	34 years	>200 years	100% cotton base matte paper
Epson Velvet Fine Art Paper w/ PremierArt™ Spray[6]	**82 years**	>100 years	55 years	>200 years	100% cotton base matte paper (sprayed after printing)
Epson Smooth Fine Art Paper	**72 years**	>100 years	57 years	>200 years	100% cotton base matte paper free of UV brighteners[7]

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Epson Stylus Pro 9600 – Print Permanence Ratings

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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 UltraChrome Pigmented Inks	**Displayed Prints Framed Under Glass[2]**	Displayed Prints Framed With UV Filter[3]	Displayed Prints Not Framed (Bare-Bulb)[4]	**Dark Storage Stability Rating at 73°F & 50% RH (incl. Paper Yellowing)[5]**	The > symbol indicates "more years" than the number listed and that the tests are continuing. **Paper/Canvas Description**
Epson Textured Fine Art Paper	**82 years**	>100 years	68 years	>200 years	100% cotton base matte paper free of UV brighteners[7]
Epson Watercolor Paper Radiant White (sheet)	**>90 years**	>100 years	66 years	>200 years	Matte surface paper
Epson Enhanced Matte Paper	**64 years**	>100 years	41 years	110 years	Matte surface paper (formerly Archival Matte Paper)
Epson Canvas	**69 years**	>85 years	37 years	>200 years	Coated 100% cotton fine art canvas
Epson Canvas w/ PremierArt™ Spray[6]	**82 years**	>100 years	65 years	>200 years	Coated 100% cotton fine art canvas (sprayed)

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Epson Stylus Pro 9600 – Print Permanence Ratings

(Black-and-white prints made with the full-color Epson UltraChrome inkset)

Long favoring black-and-white photography for his personal work, Greg Gorman is shown here at a November 1, 2002 reception for his exhibition ***Just Between Us*** at the Colin De Land Fine Art Gallery on West 22nd Street in New York. Gorman printed everything in the show with his Epson 9600 using heavy 44 x 60-inch sheets of 505 gsm Somerset Velvet for Epson, a matte surface 100% cotton base fine art paper. Epson large-format printers feature a top-loading straight-through paper path that is able to handle sheet paper and cardboard of up to 1.5 mm in thickness as well as roll-paper.

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 UltraChrome Pigmented Inks	Displayed Prints Framed Under Glass[2]	Displayed Prints Framed With UV Filter[3]	Displayed Prints Not Framed (Bare-Bulb)[4]	Dark Storage Stability Rating at 73°F & 50% RH (incl. Paper Yellowing)[5]	The > symbol indicates "more years" than the number listed and that the tests are continuing. Paper/Canvas Description
Epson Premium Glossy Photo Paper (250)	**135 years**	>150 years	76 years	>200 years	Rapid-dry microporous glossy RC-base paper
Epson Premium Semigloss Photo Paper (250)	**118 years**	>150 years	74 years	>200 years	Rapid-dry microporous semigloss RC-base paper
Epson Premium Luster Photo Paper (roll)	**80 years**	>100 years	58 years	>200 years	Rapid-dry microporous luster surface RC-base paper
Epson Premium Semimatte Photo Paper (250)	**76 years**	>100 years	57 years	>200 years	Rapid-dry microporous semimatte RC-base paper
UltraSmooth Fine Art Paper for Epson[6]	**>100 years**	>100 years	>80 years	>200 years	100% cotton base matte paper free of UV brighteners[7]
Somerset Velvet for Epson (255 and 505 gsm)	**90 years**	>100 years	60 years	>200 years	100% cotton base matte paper
Somerset Velvet for Epson w/ PremierArt™ Spray[6]	**>150 years**	>150 years	135 years	>200 years	100% cotton base matte paper (sprayed after printing)
Epson Velvet Fine Art Paper (sheet)	**115 years**	125 years	112 years	>200 years	100% cotton base matte paper
Epson Velvet Fine Art Paper w/ PremierArt™ Spray[6]	**>140 years**	>145 years	118 years	>200 years	100% cotton base matte paper (sprayed after printing)
Epson Textured Fine Art Paper	**150 years**	>150 years	150 years	>200 years	100% cotton base matte paper free of UV brighteners[7]
Epson Smooth Fine Art Paper	**140 years**	>150 years	120 years	>200 years	100% cotton base matte paper free of UV brighteners[7]
Epson Watercolor Paper Radiant White (sheet)	**>100 years**	>100 years	>100 years	>200 years	Matte surface paper
Epson Enhanced Matte Paper	**>150 years**	>150 years	>150 years	110 years	Matte surface paper (formerly Archival Matte Paper)
Epson Canvas	**>100 years**	>100 years	>85 years	>200 years	Coated 100% cotton fine art canvas
Epson Canvas w/ PremierArt™ Spray[6]	**>130 years**	>130 years	120 years	>200 years	Coated 100% cotton fine art canvas (sprayed)

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Epson Stylus Pro 9600 – Print Permanence Ratings

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 a display condition 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 "more than 100 years" until such time as meaningful dark stability 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) 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 and the spectral composition of the illuminate, with some ink/paper combinations 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.

4) 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 (which absorbs UV radiation with wavelengths below about 330nm). Some print materials are affected greatly by UV radiation in the 313–365nm region, 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.

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., 57°C, 64°C, 71°C, 78°C, and 85°C)

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Epson Stylus Pro 9600 – Print Permanence Ratings

Notes on These Tests (continued from previous page):

at a constant relative humidity of 50% RH to permit extrapolation to ambient room temperatures (or other conditions such those found in sub-zero, humidity-controlled cold storage preservation facilities). Because 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. Due to this concern, as a matter of policy, Wilhelm Imaging Research does not provide a Display Permanence Rating of greater than 100 years for any inkjet or other photographic 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 73°F (23°C) and 50% RH. Arrhenius dark storage 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 place. The Arrhenius data given here are only applicable when prints are protected from the open atmosphere; that is, they are stored in closed boxes, placed in albums within protective plastic sleeves, or framed under glass or high-quality acrylic sheet. If prints are stored, displayed without glass or plastic, or otherwise exposed to the open atmosphere, low-level air pollutants may cause significant paper yellowing within a relatively short period of time. Note that these Arrhenius dark storage data are for storage at 50% RH; depending on the specific type of paper and ink, storage at higher relative humidities (e.g., 70% RH) could produce significantly higher rates of paper yellowing and/or other types of physical deterioration.

6) PremierArt™ Print Shield, an easy-to-apply spray for protecting inkjet prints (supplied in aerosol spray cans) is available from Premier Imaging Products, Inc. <www.Premierimagingproducts.com>, 121 Lombard Street, Oxnard, California 93030; tel: 805-983-1472; fax: 805-988-0213. UltraSmooth Fine Art Paper for Epson is supplied by Epson and its authorized dealers in the U.S., Canada, and Latin America. PremierArt™ UltraSmooth Fine Art Paper is available from Premier Imaging Products, Inc.

7) Fluorescent brighteners (also called "UV brighteners," "optical brighteners," or "optical brightening agents" [OBA's]) are white or colorless compounds added to most inkjet and other papers in order to make them appear whiter and "brighter" than they really are. Fluorescent brighteners absorb ultraviolet (UV) radiation, causing the brighteners to fluoresce (emit light) in the visible region, especially in the blue and green portions of the spectrum. Fluorescent brighteners can lose activity – partially or completely – as a result of exposure to light. Brighteners may also lose activity when subjected to high temperatures in accelerated thermal aging tests and, it may be assumed, in long-term storage in albums or other dark places under normal room temperature conditions. With loss of brightener activity, papers will appear to have yellowed and to be "less bright" and "less white." In recent years, traditional chromogenic ("silver-halide") color photographic papers have been made with UV-absorbing interlayers and overcoats and this prevents brighteners that might be present in the base paper from being activated by UV radiation. It is the relative UV component in the viewing illumination that determines the perceived "brightening effect" produced by fluorescent brighteners. If the illumination contains no UV radiation (for example, if a UV filter is used in framing a print), fluorescent brighteners are not activated and, comparatively speaking, the paper appears to be somewhat yellowed – and not as "white." This spectral dependency of fluorescent brighteners makes papers containing such brighteners look different depending on the illumination conditions. For example, prints displayed near windows are illuminated with direct or indirect daylight which contains a relatively high UV component and, if an inkjet paper contains brighteners, this causes the brighteners to strongly fluoresce. When the same print is displayed under incandescent tungsten illumination, which has a low UV component, the brighteners have little effect. Another potential drawback of brighteners is that brightener degradation products may themselves be a source of yellowish stain. These problems can be avoided simply by not adding fluorescent brighteners to inkjet photographic papers during manufacture. When long-term image permanence is an important consideration – or may eventually become an important consideration – fluorescent brighteners should be avoided.