

Kodak AiO Ink Technology Deep Dive

2011-
2013

ESP 1.2 / 3.2



Hero 9.1



Hero 7.1



Office Hero 6.1



Hero 5.1



Hero 3.1



2010-
2011

ESP C110, C310,
C315



ESP Office
2150/2170



ESP Office 6150



ESP 7250



ESP 9250



2008-
2009

ESP 3250



ESP 5250



ESP3



ESP5



ESP7



ESP9



2007-
2008

Easyshare 5100



Easyshare 5300



Easyshare 5500

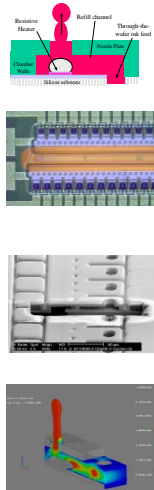


September 2012

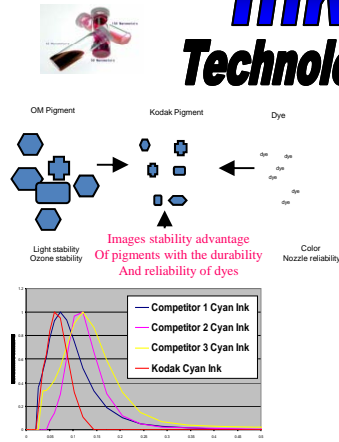
Kodak

Kodak Ejector Technology

- State-of-the-art MEMS and CMOS technology for high-performance drop ejection
- Monolithic nozzle plate, heater, and microelectronics provides submicron alignment precision
- Inorganic nozzle plate (silicon oxide) is plasma etched for exceptional nozzle uniformity
- Clear-Mode to reduce cavitation and robust materials extend resistor life
- Dual drop weight on single die
- World-class simulation capability for fast design cycles

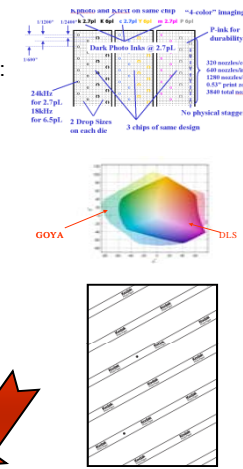


Kodak Ink Technology



- Proprietary milling technology delivers nanoparticulate pigments:
- ✓ Optimized Color and Image Quality
- ✓ High Reliability
- Proprietary binder technology
- ✓ Improved durability
- ✓ Maintainable
- ✓ Stick to the paper, not to the printer!
- Unique Colorless Ink for gloss optimization and improved durability

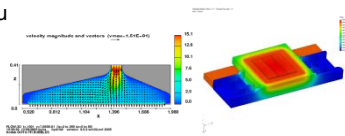
Kodak Systems & Image Science Technology



- Highly Optimized Writing System Architecture
- ✓ No need to change ink tanks for documents or photos
- ✓ 3840 nozzles for high speed photo and document printing
- ✓ Optimized drop volumes to maximize performance across all uses
- Leverage decades of Kodak digital imaging science and knowledge of customer preference
- Proprietary color mapping to maximize usage of color gamut
- Proprietary rendering algorithms to yield a Kodak print every time
- One photo mode, automatically selected and optimized for each media

Kodak Print Head & Ink Tank Technology

- 6 or 4 colors bundled into two tanks for customer ease-of-use.
- Capillary media to maintain back pressure and minimize cost
- Permanent print head – you don't replace expensive Si with every tank change
- Precision aligned components to maximize image quality
- Optimized design through leverage of fluidic and thermal modeling



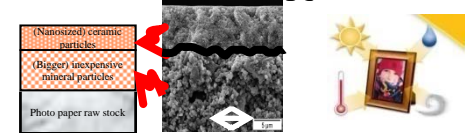
Kodak

A Kodak Print with no compromises!!

- Great Image Quality
- Fast Print Times, 28 second 4x6
- Prints that last a life time
- PLUS:**
- Leading ease-of-use features
- And Exceptional Value

	PHOTO MEDIA							PLAIN PAPER	
	Print Quality	Print Speed	Print Cost	Print Life	Print Size	Print Resolution	Print Durability	Print Ease	Print Value
Print Quality	+	+	+	+	+	+	+	+	+
Print Speed	+	+	+	+	+	+	+	+	+
Print Cost	+	+	+	+	+	+	+	+	+
Print Life	+	+	+	+	+	+	+	+	+
Print Size	+	+	+	+	+	+	+	+	+
Print Resolution	+	+	+	+	+	+	+	+	+
Print Durability	+	+	+	+	+	+	+	+	+
Print Ease	+	+	+	+	+	+	+	+	+
Print Value	+	+	+	+	+	+	+	+	+

Kodak Media Technology



- Microporous media for micro-second ink absorption times → fast print times!
- Smudge and water resistant
- Excellent value → 10cents/print on Photo Paper
- Full Media Portfolio spanning Lab-Quality to Plain Paper



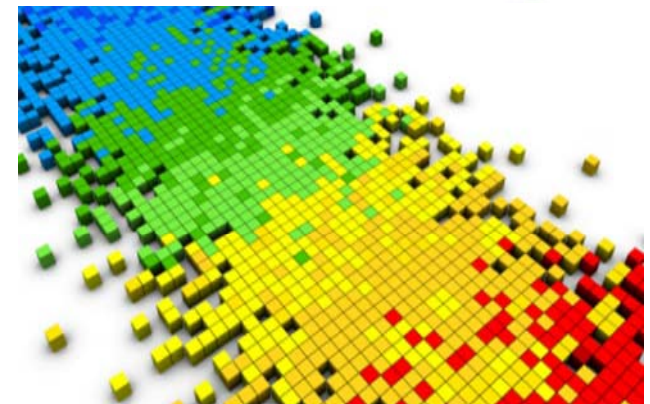
Image Quality

Image Quality



Proprietary high speed printing system
+
Patented pigmented inks
+
Instant dry papers
+
100+ years of Kodak Image Science

= Brilliant, crisp documents and photos in as little as 28 or 38 seconds that last a lifetime



Kodak

Kodak Image Science Technology



Image Capture to Print:

AiO Home Center Software combined with Kodak Perfect Touch Technology (image optimization software) & Kodak Pic Flick App support

- 1) GREAT IMAGE QUALITY OUTPUT WITH PERMANENT PRINTHEAD + 2 CARTRIDGE SYSTEM
- 2) NANO-PARTICULATE PIGMENTED INKS
- 3) FAST PRINT TIMES ON MICRO-POROUS MEDIA
- 4) PRINTS THAT LAST A LIFETIME



Image Quality

Kodak's premium pigmented inks produce beautiful documents and Kodak lab-quality photos*. Prints are instant dry, smudge and water resistant, and last a lifetime**



100 yrs unprotected

smudge resistant

brilliant color

fade resistant

water resistant

120+ CERTIFIED

OVER 120 YEARS WITH KODAK PIGMENT INKS






THE DISPLAY PERMANENCE STANDARD

* Using KODAK Ultra Premium and KODAK Premium Photo Papers. **Based on Torrey Pines Research (TPR), Wilhelm Imaging Research (WIR) and Kodak internal testing on KODAK Photo and Ultimate Plain Papers. Under all common consumer display and storage environments. Smudge resistance using Kodak Inkjet Photo papers.

Kodak

Print Permanence (Longevity) Performance Summary Image Quality (#10 and #30 Series Inks)

- KODAK All-in-One Printers, ink and paper achieved the highest level of overall print permanence of any consumer desktop inkjet printer system.*

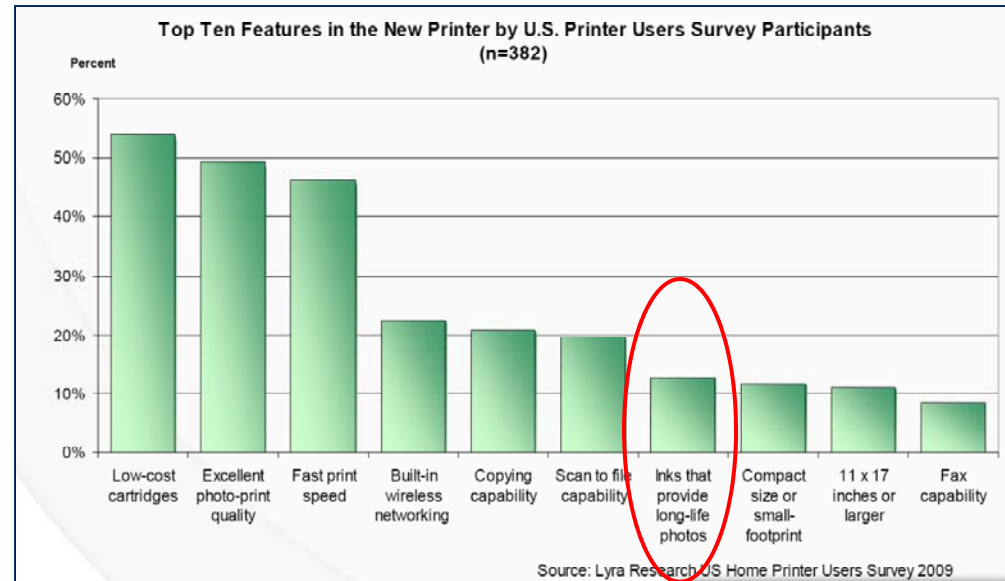
Kodak Photo & Document Print Permanence	
	Light Fastness
	Album / Dark Storage
	Unprotected Ozone Resistance
	Water Resistance
	Humidity Resistance



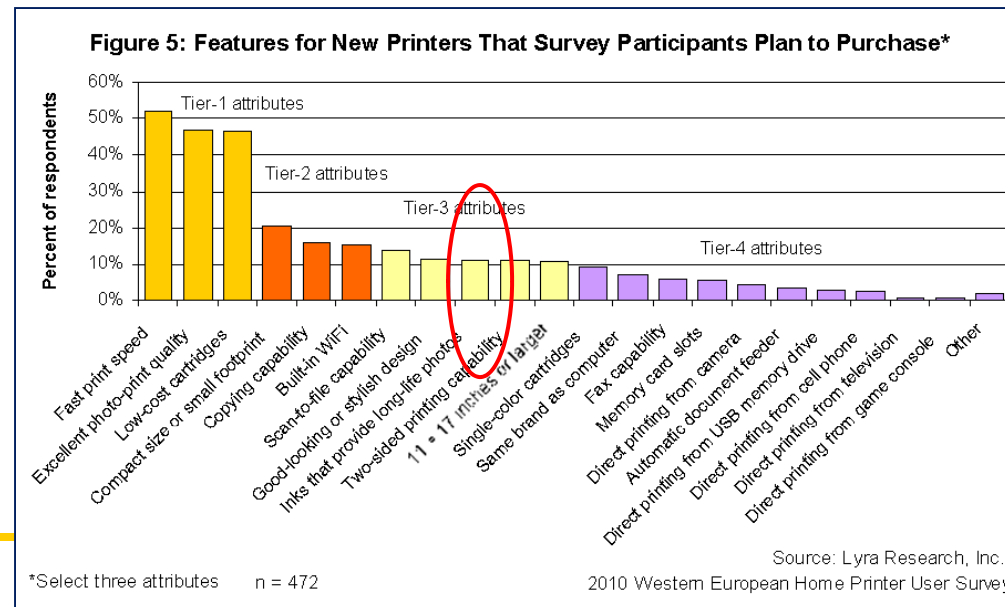
* Based on independent third party print permanence testing. Image fade resistance testing included the five major longevity testing factors: light, temperature, unprotected exposure to ambient ozone, high humidity and contact with water.

Image Quality

Customers want fade resistant photos



US&C (July 2009)



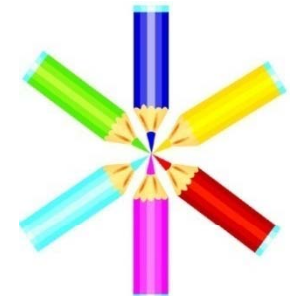
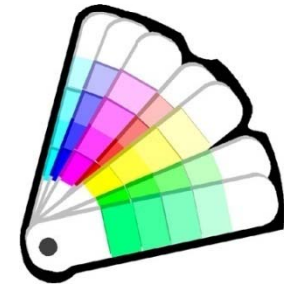
Europe (Jan 2010)

Kodak

Kodak 6-Ink (#10 Series) vs. 4-Ink (#30 Series)

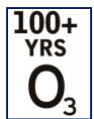
- Lab-quality photos last a lifetime
- Kodak's low-cost, high-quality pigment inks and porous photo papers dry instantly, smudge resistant and are water and fade resistant

	#10 Inks	#30 Inks
Colors	6 = B+CYM + Photo Black, P-ink	4 = B+CYM
Image quality (text, mixed text /graphics, and photos)	●	●
Vibrant, Brilliant Colors	●	●
Permanence and Fade Resistance	●	●
Water and Smudge Resistance	●	●
Instant Dry	●	●
Stain Resistance	●	●
Differential Gloss	●	●
Dark contrast photos	●	●



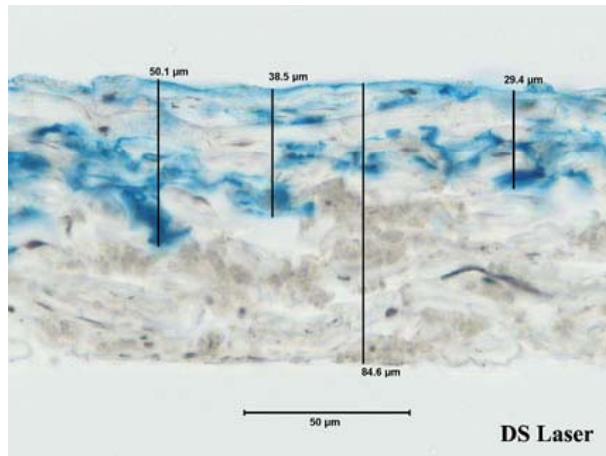
Best-In-Class Document and Photo Print Longevity*

- ✓ Dry instantly
- ✓ Won't smear or smudge
- ✓ Are Water-Resistant
- ✓ Offer the vibrancy of dye-based inks + the longevity of pigment-based inks
- ✓ #1 Photo Speeds (*@ highest quality*)
- ✓ Deliver lab-quality prints that last a lifetime*

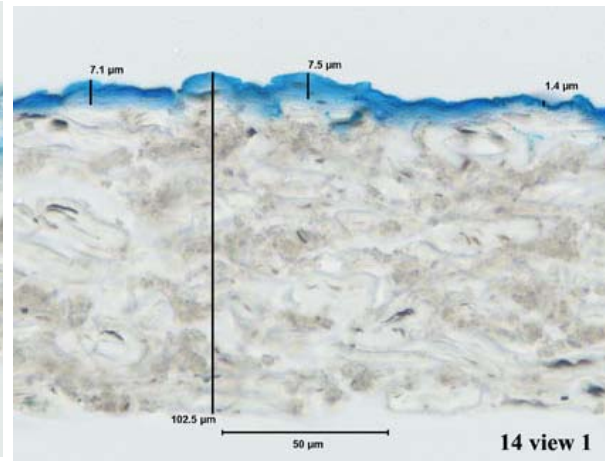


Kodak ColorLok™ Certified Plain Papers

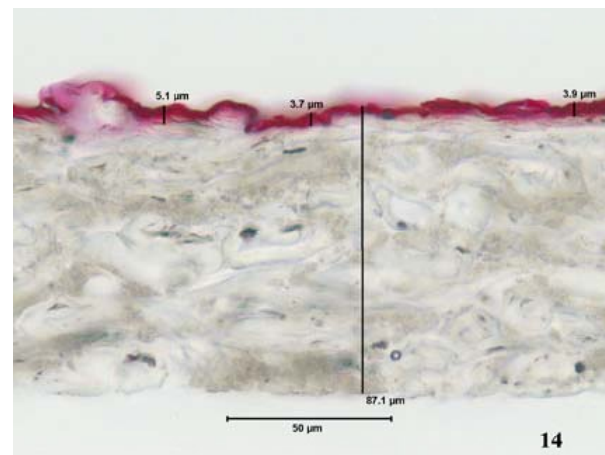
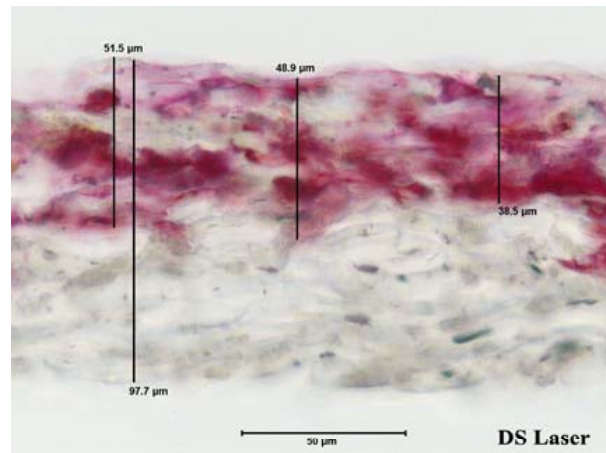
Conventional grade of paper



ColorLok™ Certified Paper



Typically boosts colour densities by 15 to 25%

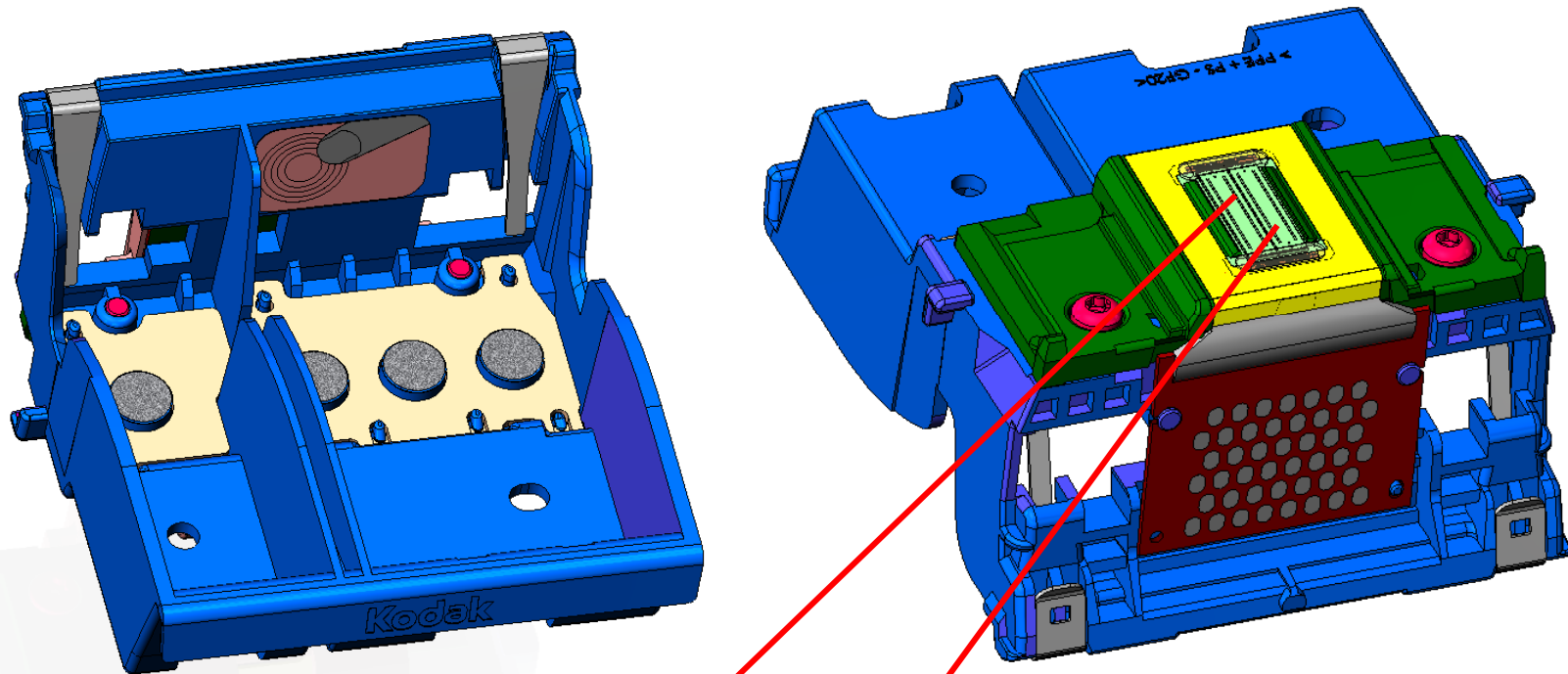


- ColorLok™ papers combined with Kodak pigmented inks boost color densities by 15 to 25% over conventional plain papers.
- Dramatically improves print quality by localizing colorant near surface.

Image Quality

Kodak #30 Ink Series Writing System*

Dual Drop Volumes ○ 6,5 pL
○ 2,7 pL



2560 nozzles total (640 nozzles x 4 inks); Dual Drop Volumes



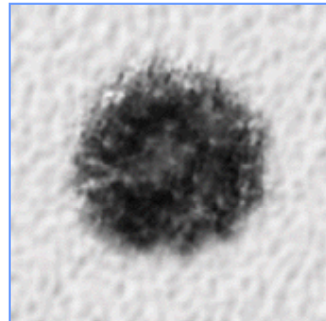
* ESP C110, ESP C310, ESP C315, ESP Office 2150/2170, ESP 1.2, 3.2, Hero 3.1 & 5.1, Hero 4.2

Kodak

General perception: “*Pigments do not have great color*”

Traditional Dye-based Ink

- **Soluble organic colorant**
Potentially better jetting reliability
Generally not water fast
- **Monomolecular chromophore**
Bright colours
Potential for high fade with light
and pollutant exposure



Traditional Pigmented Ink

- **Insoluble colorant**
Requires dispersion
Generally water fast
- **Group of Chromophores**
Potentially more light scattering =
decreased transparency
Stabilized chromophores = UV & Ozone
stability

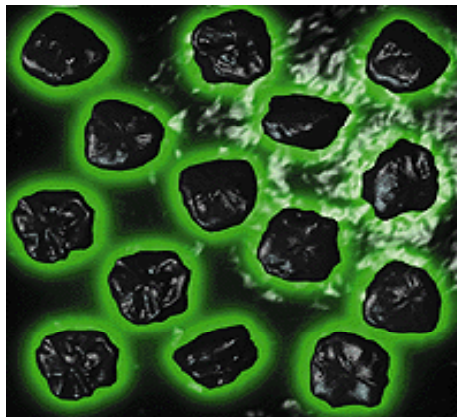


For many years those perceptions were correct!

Kodak Pigment Ink - Small-Particle Dispersion Technology

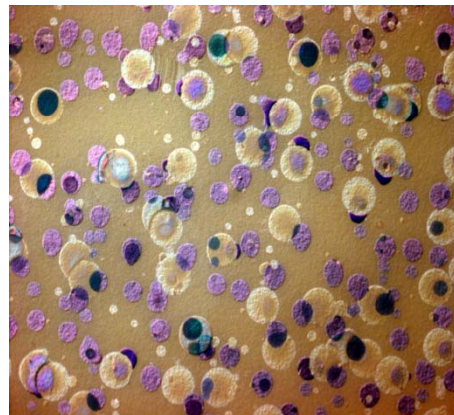
- Image stability advantage of pigments *with* the colour and reliability of dyes; Kodak has removed the need to compromise with nano-particulate pigmented inks!

OM Pigment

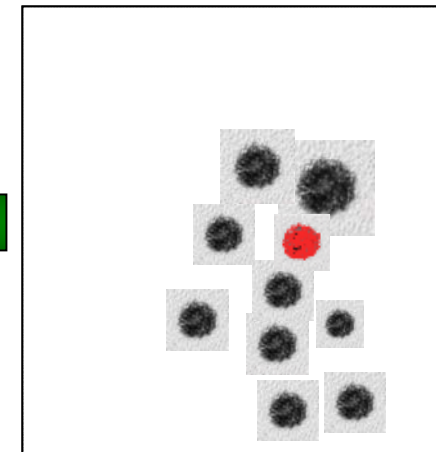


Light stability
Ozone stability

Kodak's Pigment

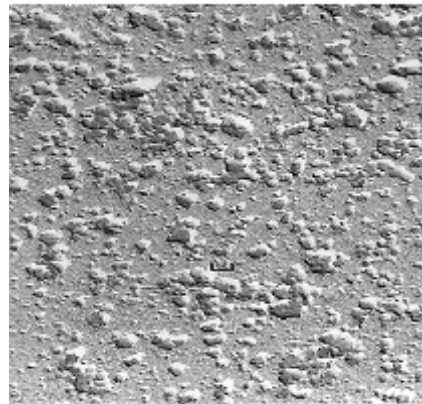
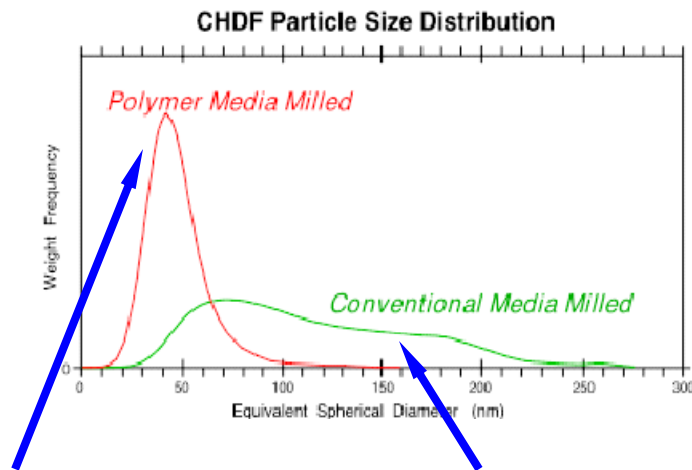


Dye

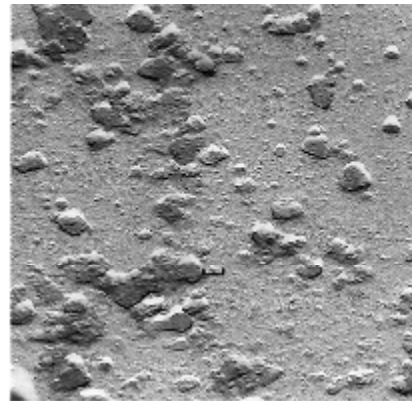


Colour
Nozzle reliability

Kodak Pigment Ink Milling Process vs. Conventional



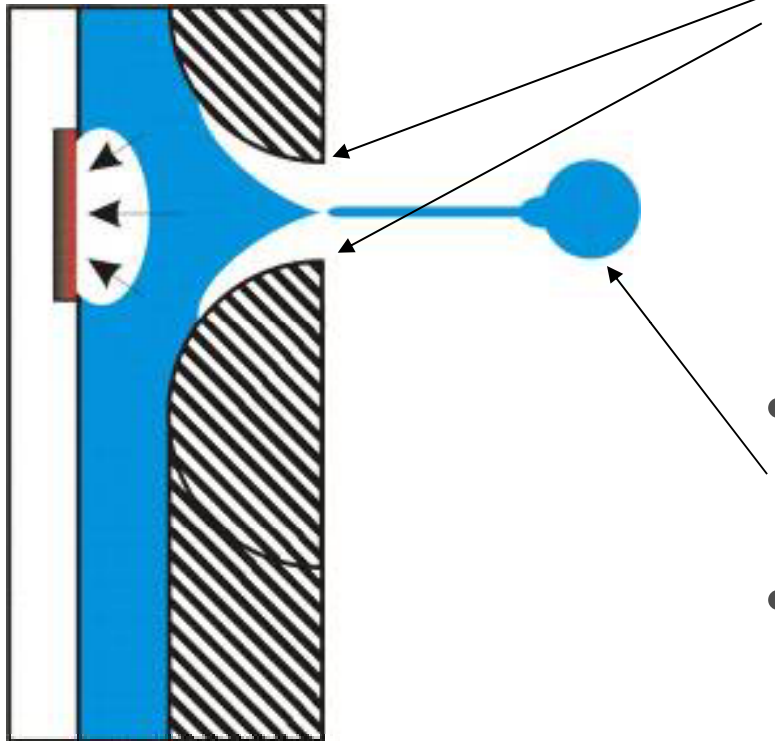
Kodak Process



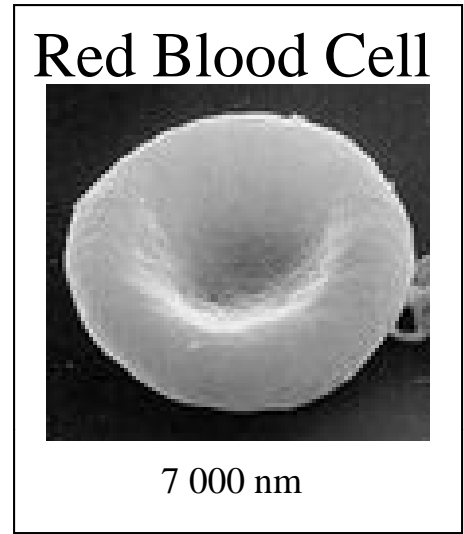
Conventional process

~ 25,000X magnification SEM

Kodak System Reliability



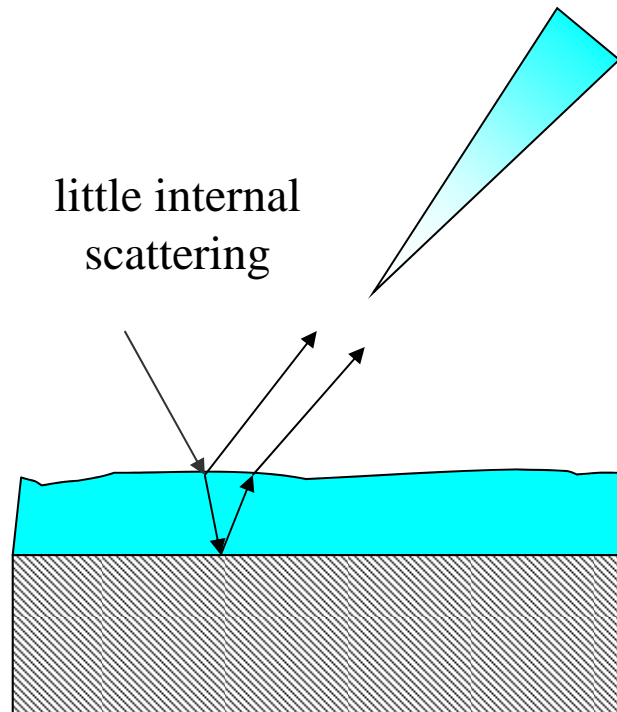
- **2000 nm**
– Nozzle Diameter
- **150 nm**
– Conventional Pigment Ink Drop
- **40 nm**
– Kodak Pigment Ink Drop



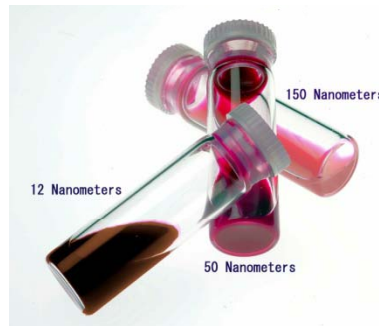
Kodak pigment inks are 3-4 times smaller over conventional pigment inks; affords better jetting longevity and printhead reliability.

Great Colour with Nano-Particulate Pigmented Inks

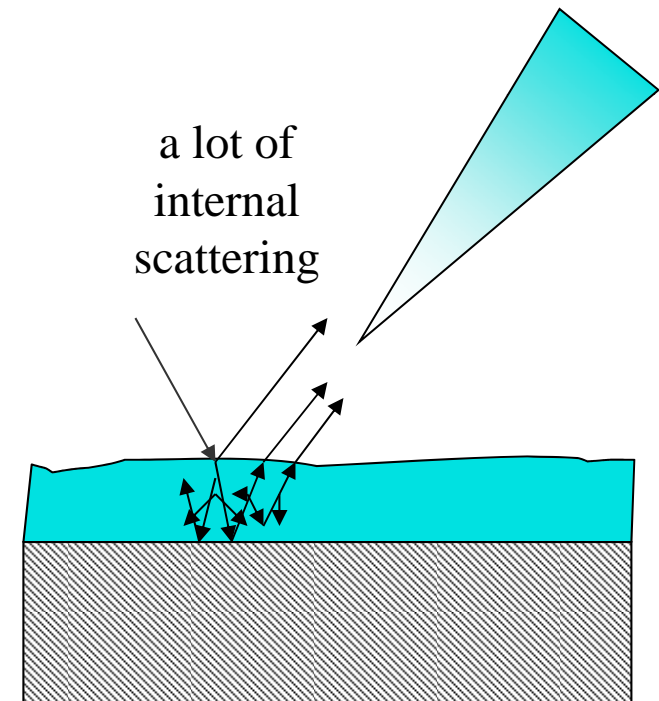
- Complex optics going on; primary factors:
 - Smoothness of 1st surface reflection
 - Internal scattering; small particles



Kodak AiO Pigment Ink



NOTE: as particle size decreases, light absorption and color strength increases!

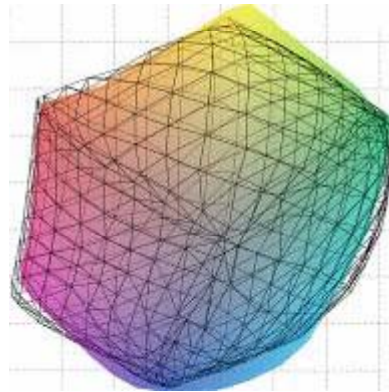


Conventional Pigment Inks

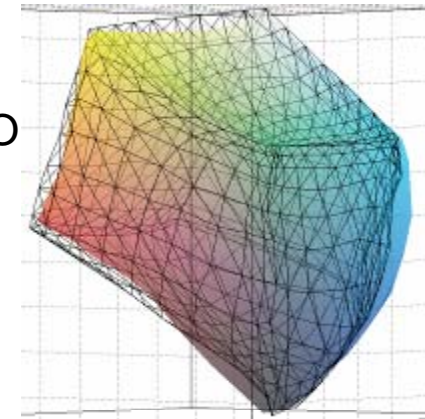
Apples-to-Apples Color Gamuts

- Kodak EasyShare AiO Printer gamut vs. a leading competitive dye-based gamut

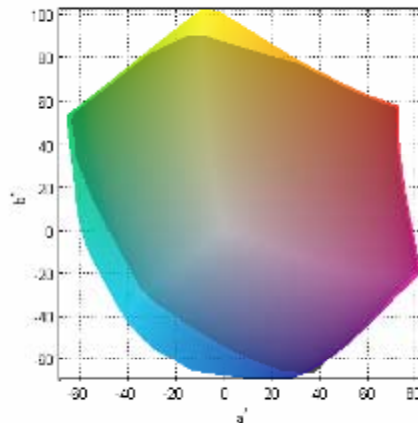
Kodak AiO



Leading Competitor AiO

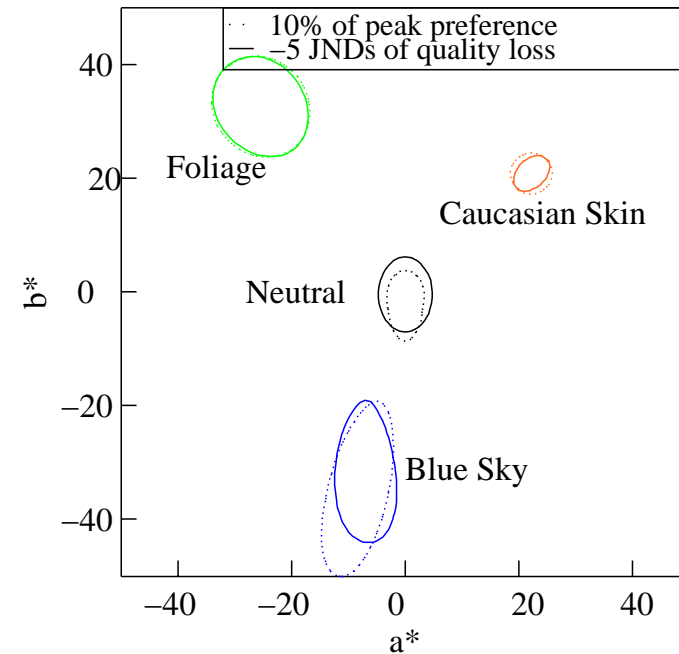
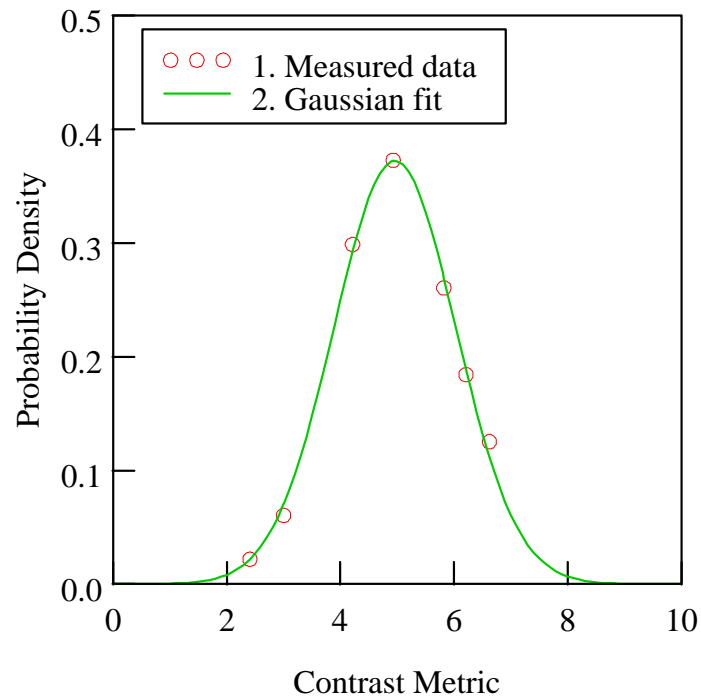


- Grey gamut is what you get with a classical (minimum ΔE strategy)
- Coloured gamut is what we get via UltraColor
- 13% increase in usable gamut volume!



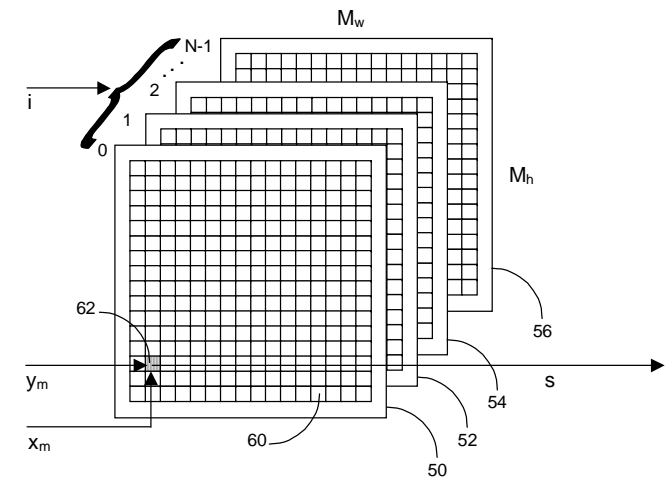
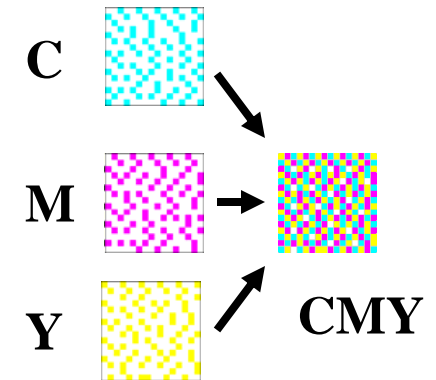
Setting the Requirements for Colour/Tone

- Very personal
- Kodak has a long history of understanding the consumer as well as leading-edge research to better define preferences
 - Blue skies, foliage greens, Caucasian skin tones and neutral colors



Print Layering Techniques

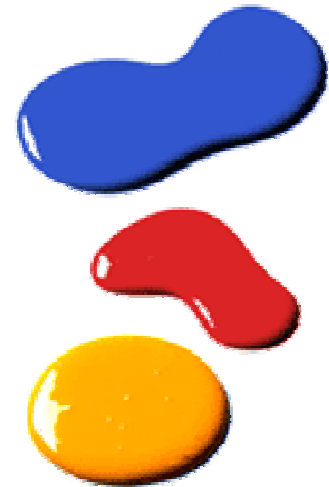
- Through Kodak's halftoning techniques & proprietary color error diffusion, the Kodak system minimizes dot overlap to reduce image noise level
- Kodak has implemented proprietary multi-level print masking to create smooth transitions and hide errors



Printmask architecture

Is there System Reliability with Pigment Inks?

- KODAK's key advancements:
 - ***Ink Formulation:*** humectants and solvents were carefully chosen to ensure proper dissolution on key components
 - ***Polymers:*** designed to stick where you want (on the media) and not elsewhere
 - ***Small Drop Size:*** another benefit of nano pigments; we have data that show the smaller the ratio of pigment size to nozzle bore, the better the reliability



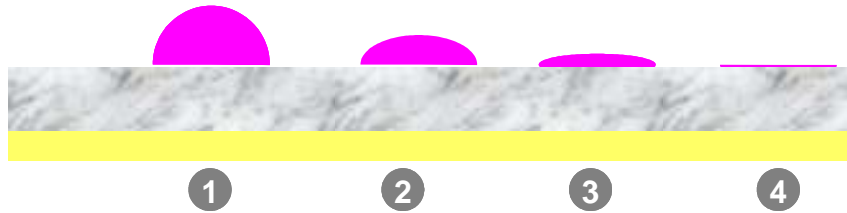
Media Absorption Rates

Swellable Media (i.e. HP Prem Plus)

Ink absorption takes 1200 msec

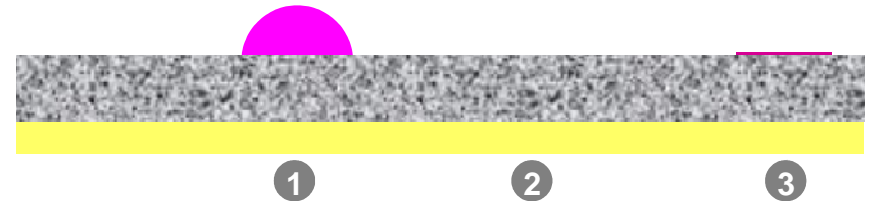


Inkjet Coating

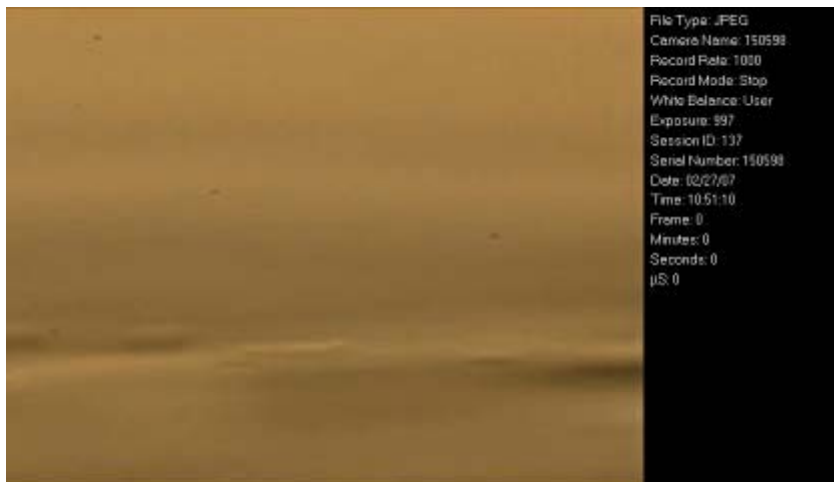


Porous Media

Ink absorption takes up to 15 msec



Kodak media absorbs ~80x faster!

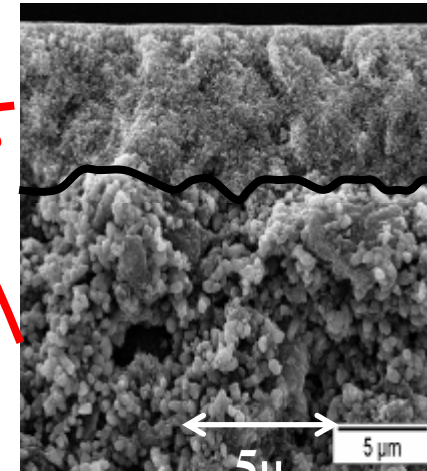
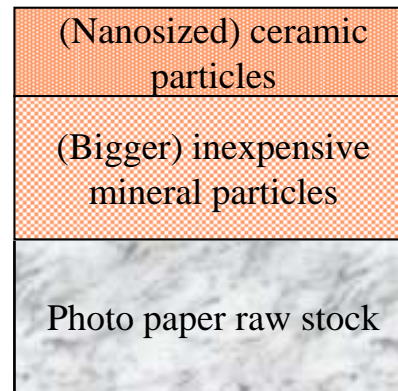


Drop absorption takes over 1 second in this case!

Kodak

Kodak Instant Dry Photos

- Fast print times demand micro-porous media
- Ink absorption is 8-10x times faster via **capillary action** than via diffusion (i.e. swellable media)

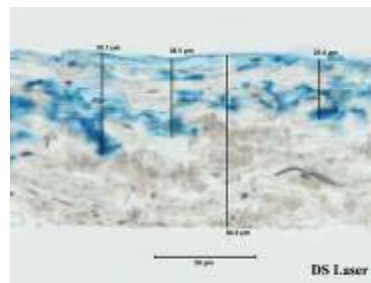


Structure of KODAK Inkjet Photo Paper

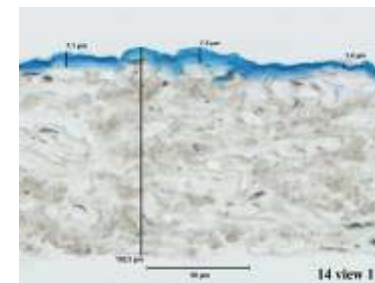
Kodak Plain Paper Performance

- Kodak plain paper demonstrates superior print quality performance by localizing colorant near surface

Conventional grade of paper



Calcium salt applied in surface treatment

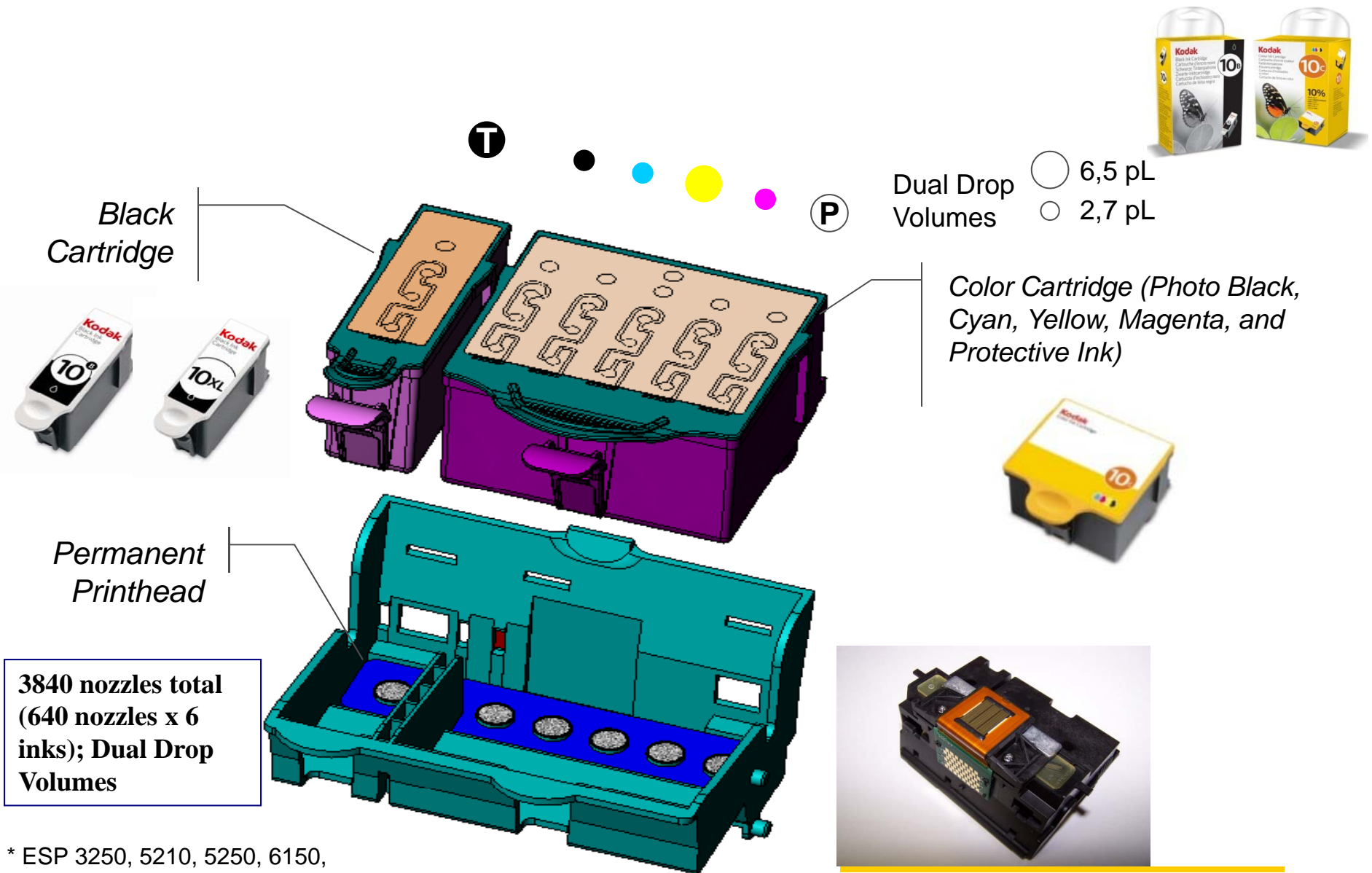


Typically boosts colour densities by 0.15 to 0.25



Image Quality

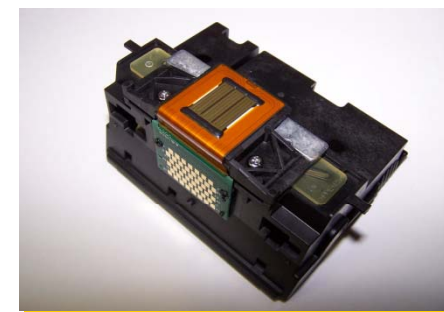
Kodak #10 Ink Series Writing System*



Dual Drop Volumes
○ 6,5 pL
○ 2,7 pL

Color Cartridge (Photo Black, Cyan, Yellow, Magenta, and Protective Ink)

**3840 nozzles total
(640 nozzles x 6 inks); Dual Drop Volumes**



* ESP 3250, 5210, 5250, 6150, 7250, 9250, Hero 7.1, 9.1 and Office Hero 6.1.

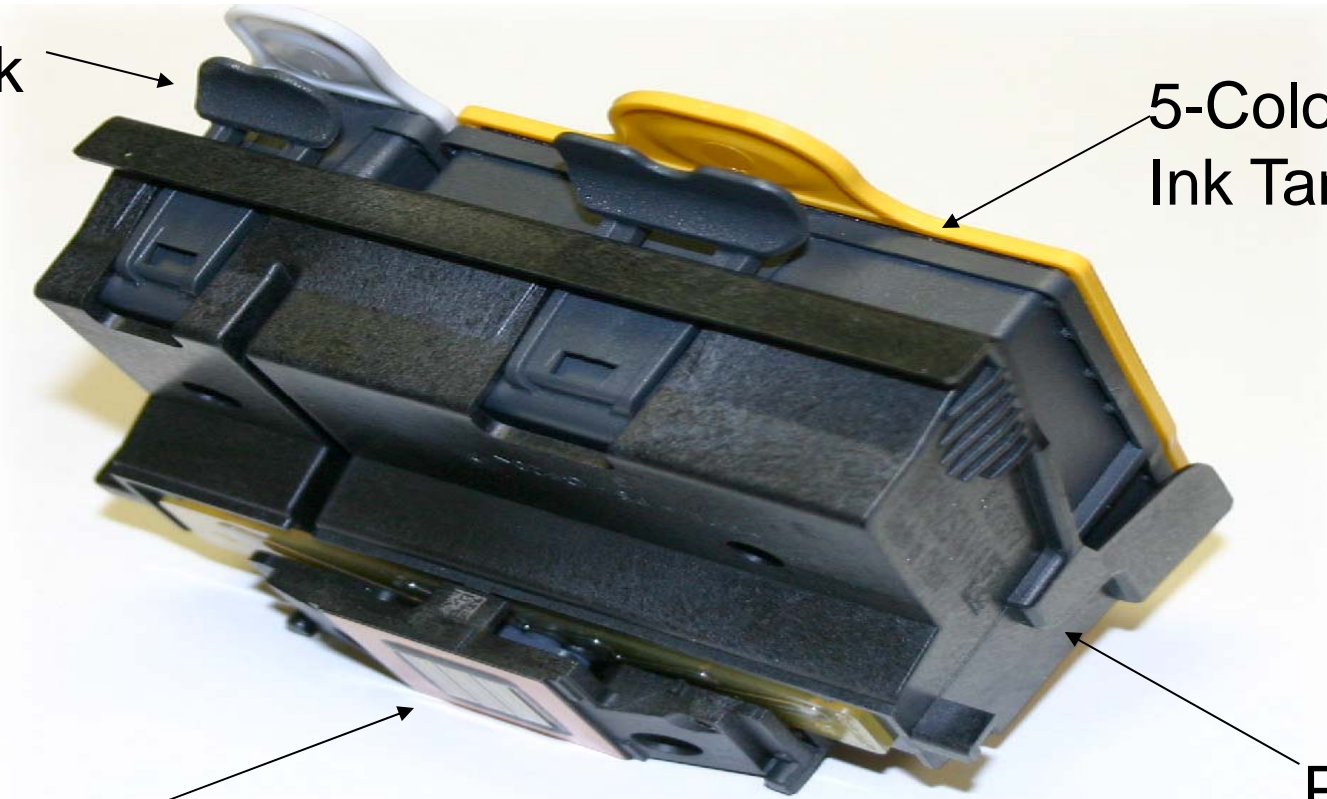
#10 Ink Series Printhead Details_1

Black
Ink Tank

5-Color
Ink Tank

Ejector

Print
Head



#10 Ink Series PrintHead Details_2

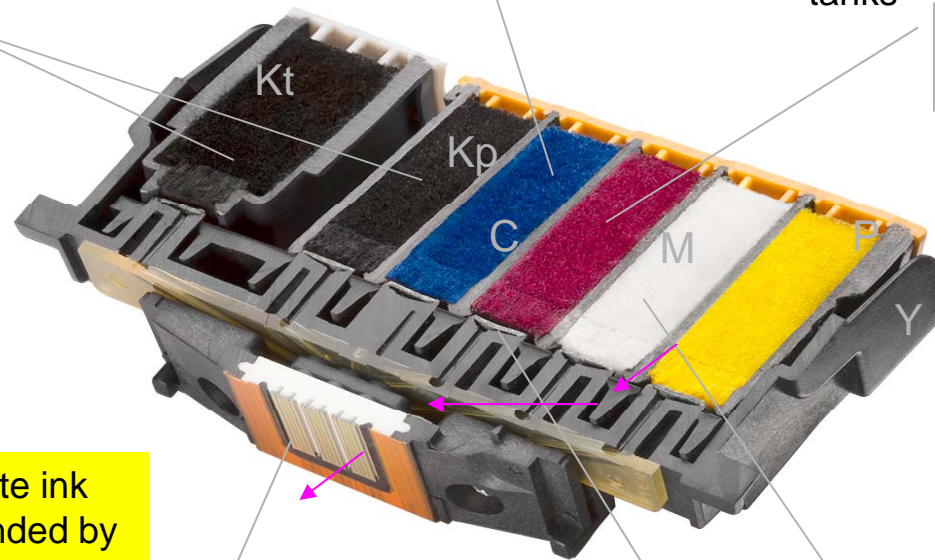
KODAK pigmented inks are stored in the ink tanks. With a proprietary milling technique, the pigment particle size is tightly controlled to deliver consistent nano-sized balls of colorant. The results are prints with great color and best-in-class permanence and longevity

All color printers require at least 3 colors, typically cyan (C), magenta (M) and yellow (Y) for a subtractive imaging process like printing. Kodak printers add two blacks for better density in shadows for photos (Kp) and text (Kt). Lastly, a protective clear ink (P) is provided to afford even better durability and image quality on glossy photos. The magenta arrows roughly show the path the ink takes on its journey from the ink tank to the paper

1. Ink starts in the ink tanks

Two black inks to maximize quality on photos and text documents. The first is optimized for bond paper and matte papers. The second black ink is optimized for glossy photo papers. You don't need to change cartridges because both are ready all the time

Highly engineered foam houses the ink and maintains the constant backpressure required by the ejectors



3. Ejectors create ink drops as commanded by the image processing

2. Ink travels through print head to ejectors

3840 ejectors expel drops as requested at up to 90 million drops per second. Each ejector has a tiny heater placed just above an equally tiny nozzle bore.

A clear protective ink provides photos more durability and improved image quality

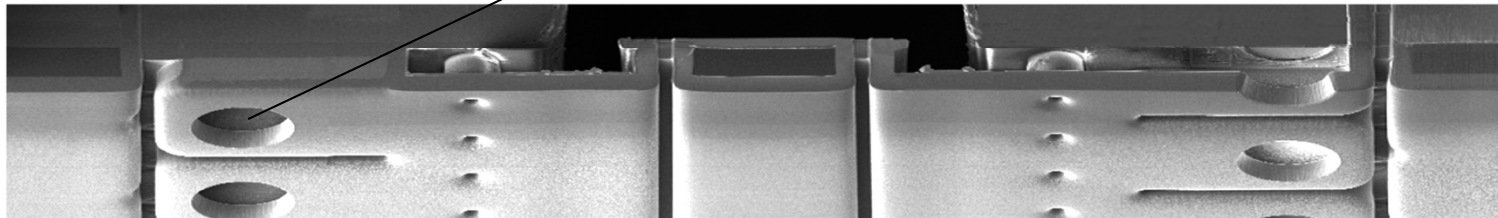
Stainless steel filters provide a final barrier to contaminants or particles.

Kodak

#10 Ink Series PrintHead Details_3

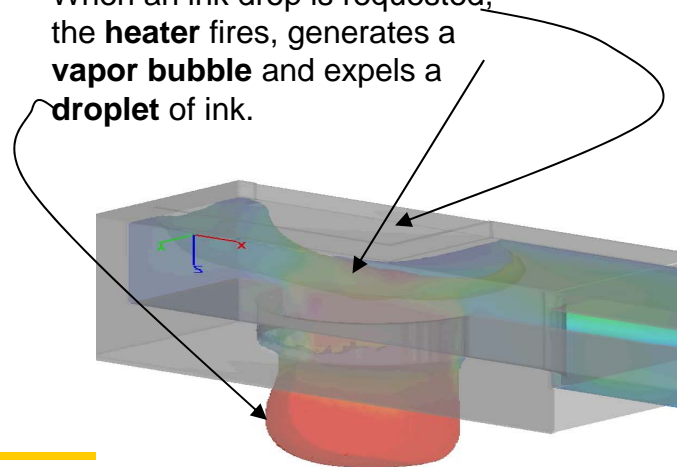
Ejector Inset Fodder

Ejectors consist of 3840 tiny heaters each sitting above a nozzle bore



red blood cell on a similar scale

When an ink drop is requested, the **heater** fires, generates a **vapor bubble** and expels a **droplet** of ink.



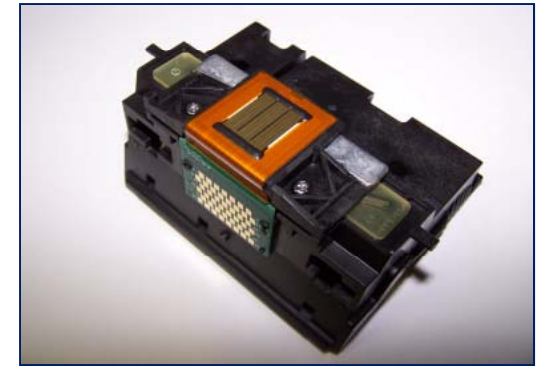
Over 90 million drops can be created every second

Kodak

#10 Ink Series PrintHead Details_4

Dual Drop Volumes

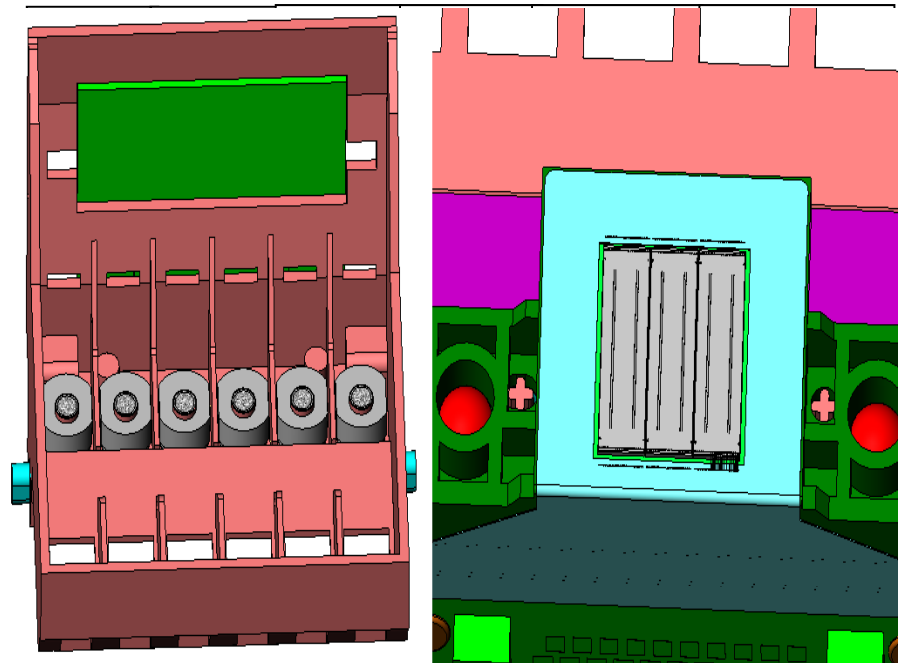
- Permanent Printhead – not disposable like other systems!
- Small drops (~ 2.7 pL) for cyan, magenta, and photo black for smooth grain-free transitions
- Large drops (~ 6.5pL) for other colours for crisp, dark text at high speeds
- Allows placement of physical structures with 0.5 μm precision!



Head View



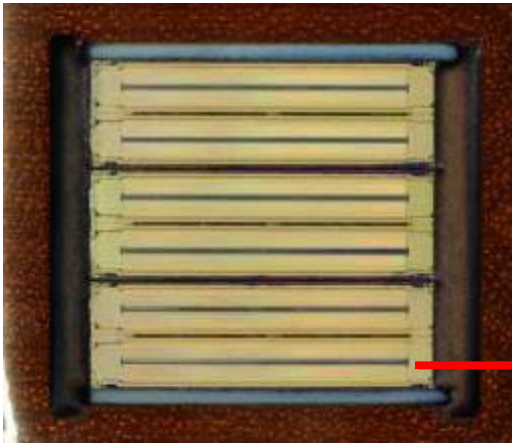
Accurate drop placement



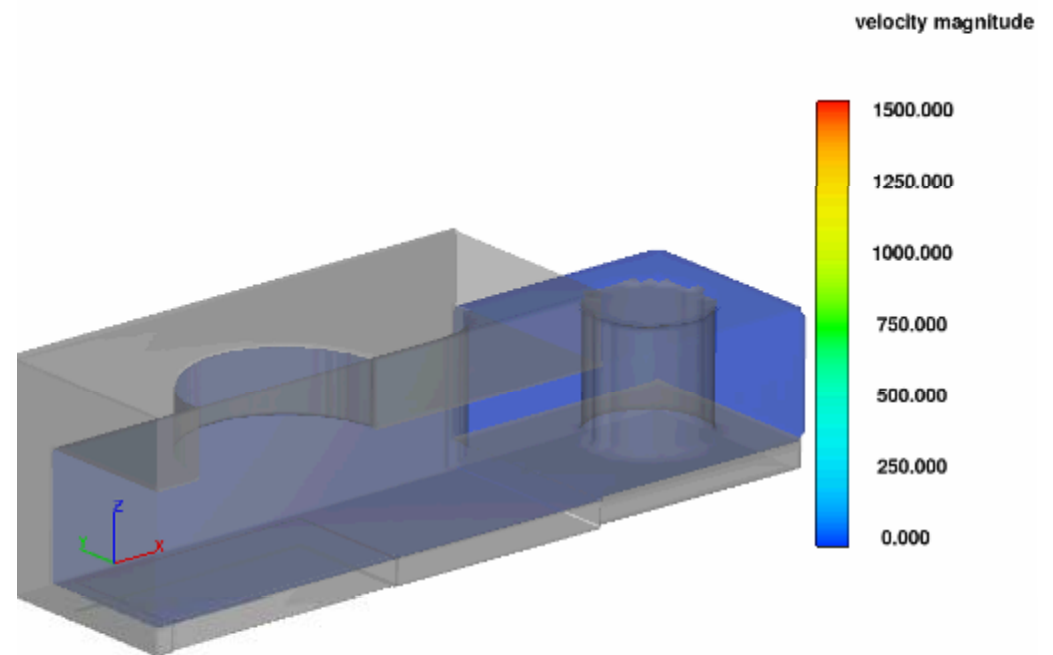
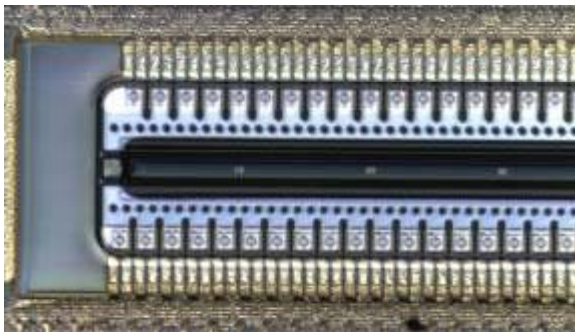
#10 Ink Series PrintHead Details_5

Printhead - Ejector Design

- 3840 nozzles total (640 nozzles × 6 inks)



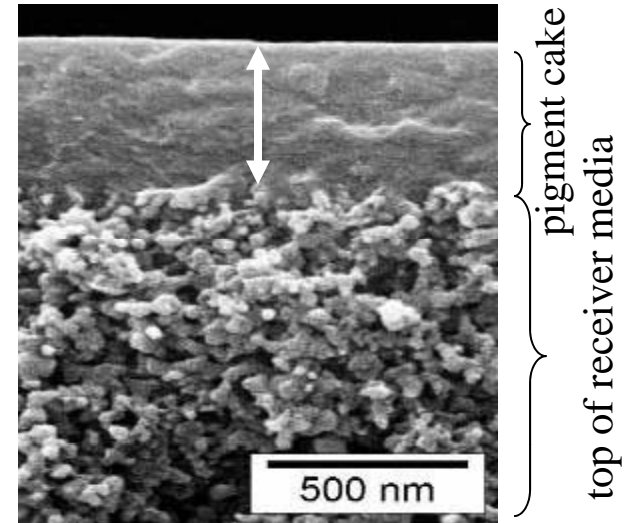
- Heater/Nozzle Layout



#10 Ink Series PrintHead Details_6

Protective Ink (P-Ink)

- Unlike dyes that absorb into the media, pigments sit on top of the paper
- Can impact and define gloss; purpose of P-ink is to reduce the appearance of differential gloss
- P-ink is applied to all Kodak 4-star & 5-star studio gloss and glossy photo media.
- P-ink is sprayed into the lighter zones of the image to balance out the varying ink surface heights (to effectively fill in the 'valleys')
- Provides additional stain resistance



OM Print
Coffee Stain



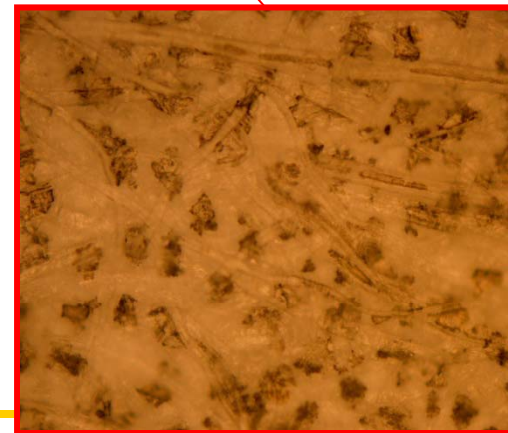
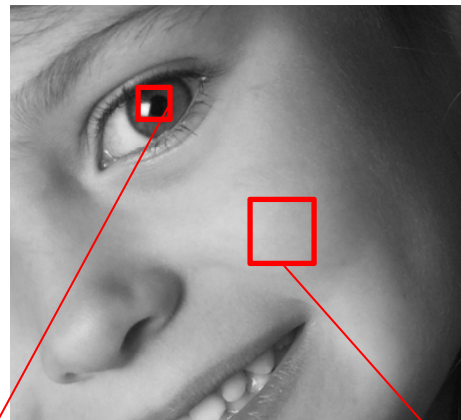
Kodak's
Print
Coffee
Stain

#10 Ink Series Printers: Grayscale printing

- Kt ink (6.5 pL drop size) used for 100% density areas; Kp (2.7 pL drop size) is also used for printing in lighter grayscale regions¹

Kodak Grayscale Printing

"The separate text black ink is used for plain paper and matte photo paper printing. It is a special carbon black dispersion - it is "self dispersed", meaning there is no need to add a separate dispersant or stabilizer. It is also much larger in particle size which helps raise the optical density on plain paper. Since it's black there is no loss on color saturation and the large particle size maintains acceptable image quality at the faster print speeds."

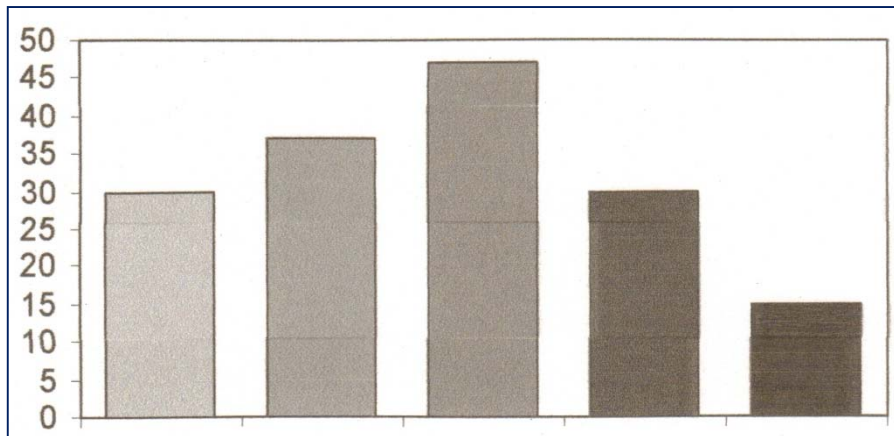


¹ Microphotos of printed grayscale test file. Kodak 10 series inks.

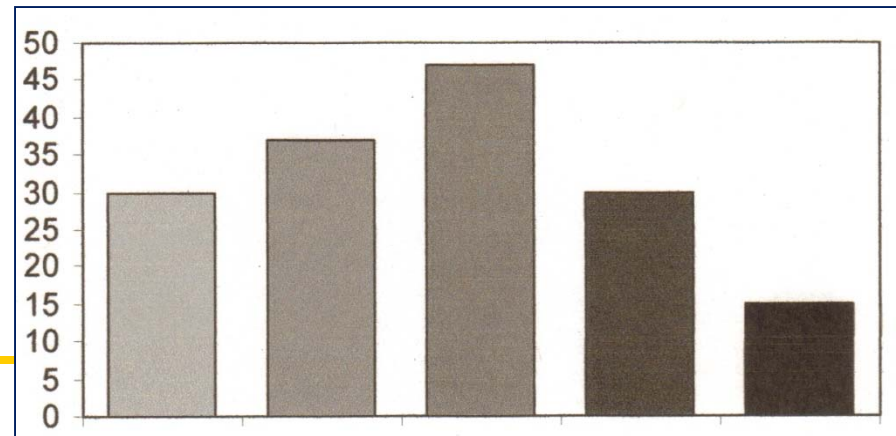
Great Black with Nano-Particulate Pigmented Inks_1

- The separate black (Kt – referred to as text black) is especially for plain paper printing as well as matte photo paper. It is a special carbon black dispersion -- it is "self dispersed", meaning we don't have to add a separate dispersant or stabilizer. It is also much larger in particle size -- that helps raise the optical density on plain paper. Since it's black, we don't have to worry about losing color saturation so we can get by with a large particle size for this ink. Only Kt ink is used when printing pure black text content (in B&W mode).
- The second black in the color cartridge, Kp or photo black, is primarily used for photo printing on glossy or semi-gloss papers, but is also used for document B&W printing. It has a smaller particle size to reduce haze on those glossy surfaces. We also take advantage of a smaller drop size (2.7pL for photo black, whereas the text black is ejected in 6.5pL drops) to help with photo grain.
- Kp is used to smooth grey tones in all grey-scale modes (not pure black text), this is especially evident during Normal/Best black and white printing (compare draft vs. normal modes below).

10 Ink Series B&W DRAFT Mode
(Text Black and Photo Black)



10 Ink Series B&W NORMAL Mode
(Text Black & Photo Black)



Great Black with Nano-Particulate Pigmented Inks_2

- Maintaining acceptable grayscale transitions/gradients is paramount for meeting acceptable image quality needs on Kodak's '10 ink series' printer models.
- During 'Black and White' printing, using either 'Draft, Normal or Best' mode, both Kt (black tank) and Kp ink (from color tank) are used to generate the monochrome/grayscale print. Technically both are black ink.



Test Print



10 Ink Series - B&W Normal Mode (Kt + Kp)

In draft mode Kp (photo black) is used in high density area's (near the 100% black point) but is not used here in the Normal or Best B&W modes.

Kt and Kp inks are used to generate the grayscale tones in the B&W (monochrome) output prints – this is essential for providing satisfactory image quality for the consumer (i.e. smooth tones & gradients help reduce visible microbanding).

Print Permanence (Longevity/Fade Resistance)

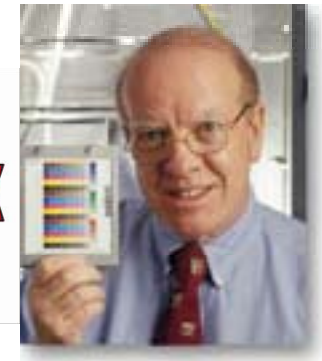
Wilhelm Imaging Research (WIR)

– ‘Prints Last a Lifetime’*

Print Permanence

“Kodak’s inkjet printers are best-in-class for print permanence among consumer desktop inkjet printers.”

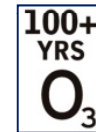
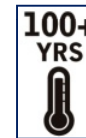
- >120 years light fade resistance under glass*
- >100 years unprotected resistance to ozone*
- >120 years temperature resistance (album and dark storage)*
- ‘Very High’ resistance to high humidity environments*
- ‘High’ resistance to water on resin-coated base photo papers; ‘Moderate’ resistance to water on plain papers and non resin-coated base photo papers



Henry Wilhelm



WIR ESP 7250 Test Results:



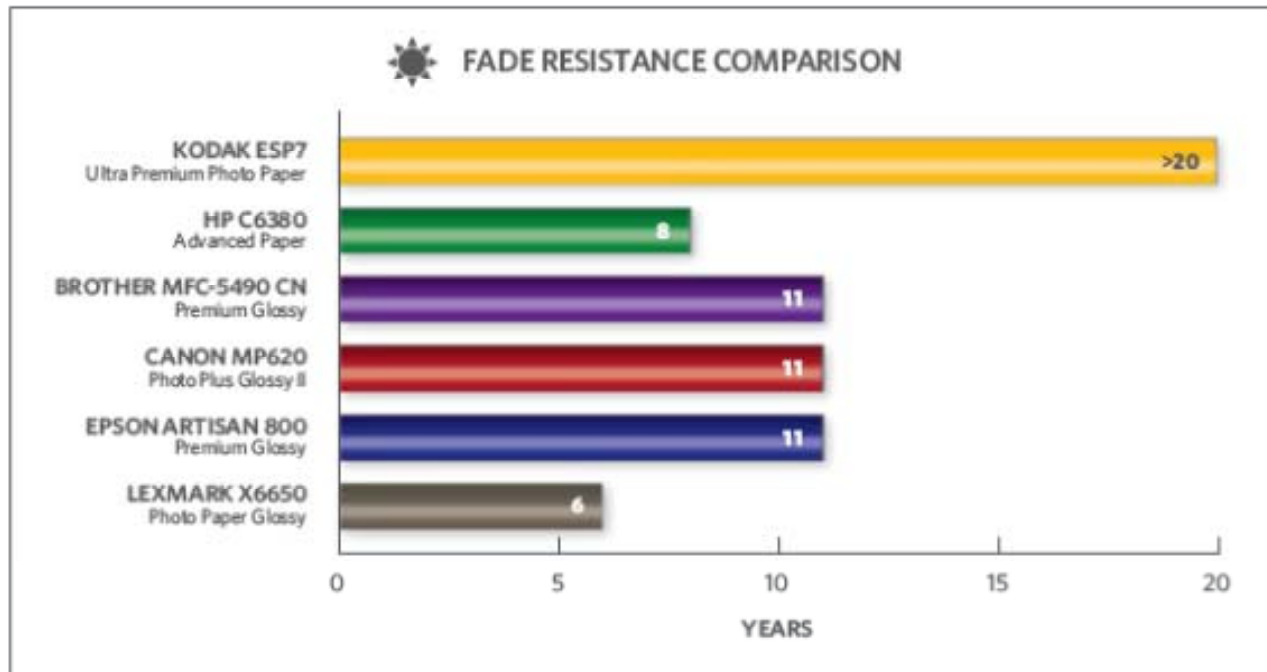
Paper Printed With Kodak No. 10 Pigmented Inks	Displayed Prints Framed Under Glass ⁽³⁾	Displayed Prints Framed With UV Filter ⁽⁴⁾	Displayed Prints Not Framed (Bare-Bulb) ⁽⁵⁾	Album/Dark Storage Rating at 73°F & 50% RH (Incl. Paper Yellowing) ⁽⁶⁾	Unprotected Resistance to Ozone ⁽⁷⁾	Resistance to High Humidity ⁽⁸⁾	Resistance to Water ⁽⁹⁾	Are UV Brighteners Present? ⁽¹⁰⁾
Kodak Ultra Premium Photo Paper, High Gloss	132 years	>300 years	43 years	>300 years	>100 years	very high	high	some
Kodak Ultra Premium Photo Paper, Studio Gloss	148 years	264 years	34 years	>300 years	>100 years	very high	high	some
Kodak Ultra Premium Photo Paper, Semi Gloss	259 years	>300 years	55 years	>300 years	>100 years	very high	high	some
Kodak Premium Photo Paper, Gloss	120 years	300 years	45 years	>300 years	>100 years	very high	high	some
Kodak Premium Photo Paper, Matte	234 years	>300 years	70 years	>300 years	>100 years	very high	moderate ⁽¹¹⁾	yes
Kodak Photo Paper, Gloss	163 years	243 years	60 years	>200 years	>100 years	very high	moderate ⁽¹¹⁾	some
Kodak Photo Paper, Matte	221 years	>300 years	67 years	>150 years	>100 years	very high	moderate ⁽¹¹⁾	yes
Kodak Ultimate Paper (*plain paper*)	290 years	>300 years	81 years	>300 years	>100 years	very high	moderate ⁽¹¹⁾	yes

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- Under all common consumer display and storage environments. Based on testing by Wilhelm Imaging Research (WIR).

Unbeatable Fade Resistance

- In independent studies which compared leading consumer inkjet printers, Kodak prints ranked highest in ozone/fade resistance*
- With other companies you are typically forced to make a choice between fade resistance or water resistance.

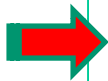


* Based on independent third party print permanence ozone testing on microporous photo papers – May 2009/Dec 2010.

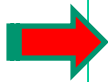
Print Permanence

- Tetris (30-Series & 10-Series) predicted print life estimates. [TPR, 2010-2012]

30-Ink Series
Data Testing*



10-Ink Series
Data Testing



Printer	Media	Estimated Life to First Endpoint (Years)				
		50 kLux HID	35 kLux HIF Glass	50 kLux HIF Poly	1ppm Ozone	5ppm Ozone
Kodak Supra VC 212109	Kodak Professional Endura	33	96	114.5	>92	>68
Kodak Enduratrans	2850-510	75	149	195	>92	>68
Fujitrans	F 11-025	110	254	308	>92	>68
New Lucky SA5 35266	Digital paper professional	7	11.1	4.9	>92	>68
Fuji Supra paper repeat	FujiColor Professional paper	34	107	150	>92	>68
HP Officejet Pro 8500	HP Advanced	31.2	71	160	79	>68
Epson 9900 or 7900	Epson Premium Photo Paper	>123	>258	>368	66	58
Epson 9900 or 7900	Kodak Professional IJ Paper	>123	>258	>368	>92	>68
EK Inkjet Tetris 1 WS 2.0	Kodak Ultra Premium Photo - HG	55.3	>258	>368	>92	>68
EK Inkjet R6.3	Kodak Paper	41.6	227.8	>368	>92	>68
EK Inkjet R6.3-CM	Kodak Paper	37.8	206.4	>368	>92	>68
EK Inkjet Tank 2	Kodak Paper	40.5	>258	>368	>92	>68
EK Inkjet Tank 10	Kodak Color Technology Paper	33.4	152.7	>368	>92	>68
Canon Pixma MP250	Canon Paper Plus Glossy	59	181	310	9	16
Canon MX7600	Canon	32.9	107.8	>368	>92	>68
Epson WorkForce 600	Epson	51.5	>258	>368	>92	>68
HP Photosmart C4780	Advanced HP Photo Paper SG	>123	234	321.6	14	16
Kodak ESP 5250	Kodak Premium paper	92.1	>258	>368	>92	>68
HP OfficeJet 6500	Advanced HP Photo Paper SG	83.8	193.7	254.8	13	17
Xerox iGen4	Glossy paper, no number	33	44.1	137	>92	>68
HP CLJ 9500hdn	Futura Laser # 403481	22	43.3	103.6	>92	>68
Xerox Phaser 7500 DX	Unknown	32.3	99.3	312.3	>92	>68
Kodak DL2100	Futura Laser Gloss #403481	31.2	45.6	91.5	>92	>68
Lexmark C782 n XL	Unknown	39.5	>258	>368	>92	>68
Konica Minolta 8650	Unknown	19	43.3	61.9	>92	>68

Note: Based on TPR Q2 2010 test data, all 30 ink series printers can support longevity claims above 92 years [lightfastness, temperature/thermal, and ozone exposure (environmental pollutants)], if testing was allowed to continue results would have exceeded 100 years.

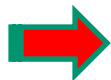
* HID uses Xe light not fluorescent and the fade rate is much faster. There are numerous products that are relatively insensitive to fluorescent light that fade much faster in Xe light (more UV). While the TPR report lists 55 years for Tetris in HID testing, this is considered flawed data since the HID test on Kahuna was better than 64 years, therefore in theory, the Tetris system would be much higher (closer to ESP 5250 results). Conversely, testing using fluorescent lighting (like WIR) with glass filtration and 450 lux per 12 hour day (like WIR assumptions) would likely result in ~120 YR rating for the 30-series inks.

Print Permanence

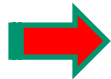
- Torrey Pines Research Testing Summary, 2010 thru 2012. Kodak 10-Series and 30-Series predicted print life using WIR (Wilhelm Imaging Research) end-point assumptions.



30-Ink Series Data Testing*



10-Ink Series Data Testing



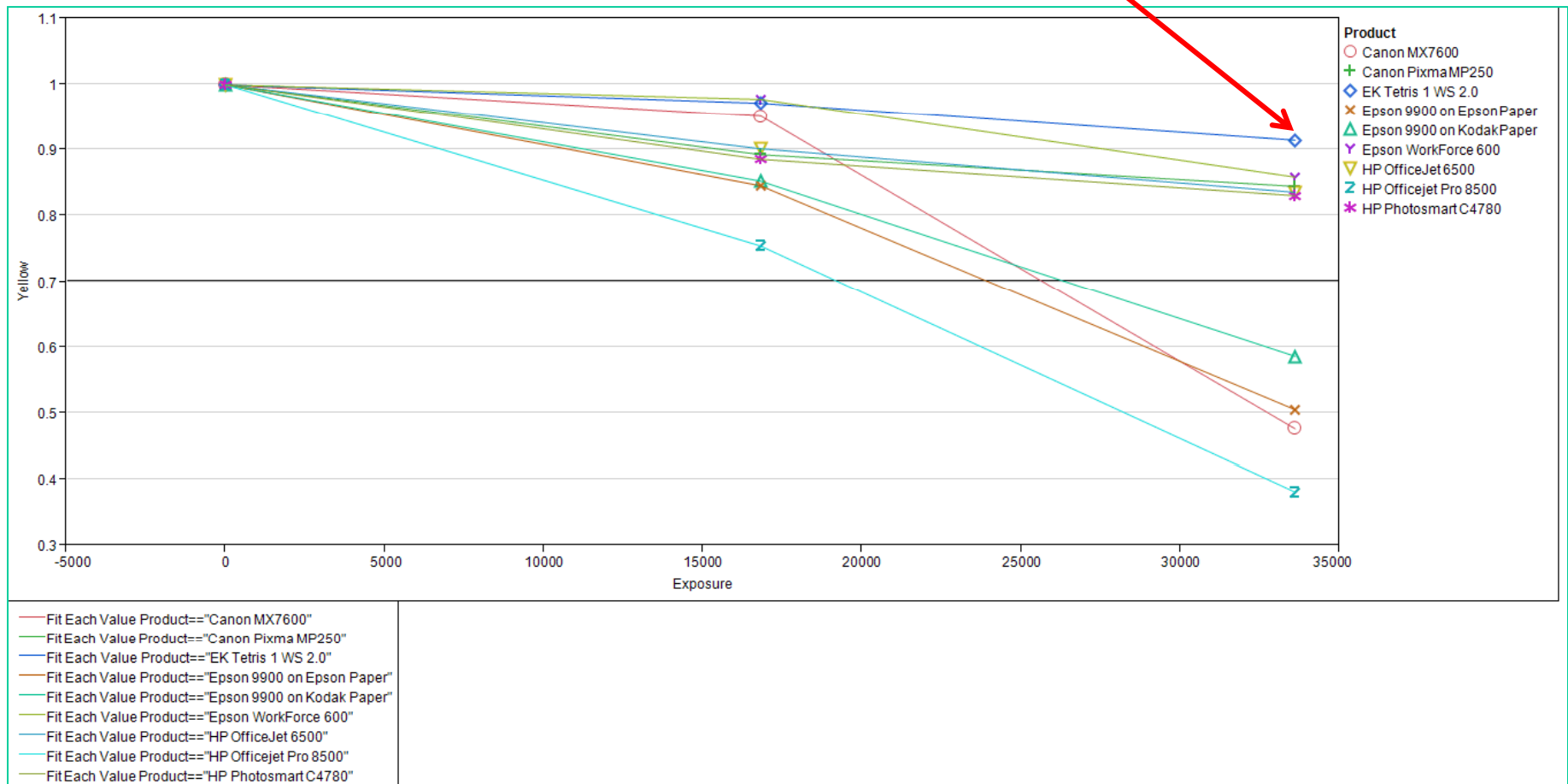
Printer	Media	Estimated Life to First Endpoint (Years)			
		35 kLux HIF Glass	50 kLux HIF Poly	1ppm Ozone	5ppm Ozone
EK Inkjet Tetris 1 WS 2.0	Kodak Ultra Premium Photo - HG	>72	>102	>92	>68
Kodak ESP 5250	Kodak Premium paper	>72	>102	>92	>68

Table 1 – Summary of Predicted Life in Years

Print Permanence

Kodak Yellow Ink Better Performance vs. **ALL** Competitors

- Comparison of 30 series vs. competitors; Kodak has **best yellow** ink performance*.



* Using "normal" 6 fade test target. HID testing uses Xenon light and not fluorescent - the fade rate is much faster. Some products that are relatively insensitive to fluorescent light will fade much faster in Xenon light (i.e. higher UV level).

20-Year Ozone Fade Comparisons

- TPR compared the #30 series inks vs. competitive dye-based printers systems (~85% of market); Kodak's pigment inks perform significantly better over the competitors*.



To view complete report click here:

http://store.kodak.com/store/ekconsus/en_US/Content/Theme/pbPage.groundbreaking_technology

* Simulated image fade. Based on independent third party print permanence and internal unprotected ozone resistance print permanence comparison studies, on select printer models, between dye-based ink and pigment-based inks applied to microporous media, not protected under glass. Printer models evaluated include the Kodak ESP 7, Kodak ESP 9250, Kodak ESP C310, HP Deskjet 3050, HP Officejet J4680, HP Officejet 6500, HP Photosmart C4780, HP Photosmart Plus B209A, HP Photosmart C6380, Canon MG5120, Canon Pixma MX330, Canon Pixma MP620, Epson Workforce 325, Epson Artisan 810, Epson Artisan 800, Lexmark Prevail Pro705, Lexmark x6650, Brother MFC 495CW and Brother MFC-5490CN, May 2009, December 2010, and June 2011. Actual results may vary.

Print Permanence

Epson T099/T080 inks have inferior print longevity compared to Kodak AiO*.

KODAK AiO

Printer: Kodak ESP 7 All-in-One Printer
Ink: Kodak Series 10 pigmented ink (6 inks: C, M, Y, K, photo K, clear)

Control Sample:



Tested Sample:



>20 Years Exposure

Exposed to ozone at 5ppm for 7.3 days (equivalent to 20 years @ 5ppb)

Epson Artisan 7xx/8xx

Printer: Epson Artisan 800 All-in-One Printer
Ink: Epson T098/T099 dye based ink (6 inks: C, M, Y, K, LC, LM)

Control Sample:



Tested Sample:



>20 Years Exposure

Exposed to ozone at 5ppm for 7.3 days (equivalent to 20 years @ 5ppb)

* Based on independent third party print permanence ozone testing on microporous photo papers – May 2009/Dec 2010.

Print Permanence

HP 564/364 inks have inferior print longevity compared to Kodak AiO*.

KODAK AiO

Photo Permanence Study

Printer: Kodak ESP 7 All-in-One Printer
Ink: Kodak Series 10 pigmented ink (6 inks: C, M, Y, K, photo K, clear)

Control Sample:



Tested Sample:



>20 Years Exposure

Exposed to ozone at 5ppm for 7.3 days (equivalent to 20 years @ 5ppb)

Torrey Pines Research
www.tpr.com

HP Photosmart C6380/Premium/Touchsmart

Photo Permanence Study

Printer: HP Photosmart C6380 All-in-One Printer
Ink: HP 564 dye-based ink (5 inks: C, M, Y, K, photo K)

Control Sample:



Tested Sample:



>20 Years Exposure

Exposed to ozone at 5ppm for 7.3 days (equivalent to 20 years @ 5ppb)

Torrey Pines Research
www.tpr.com

* Based on independent third party print permanence ozone testing on microporous photo papers – May 2009/Dec 2010.

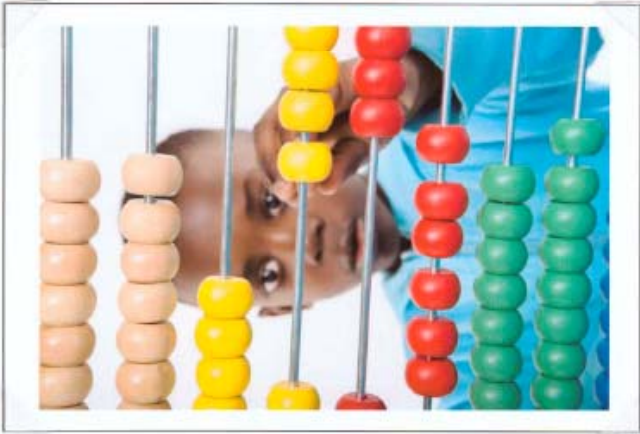
Print Permanence

Canon CL-221/511 inks have inferior print longevity compared to Kodak AiO*.


KODAK AiO

Printer: Kodak ESP 7 All-in-One Printer
Ink: Kodak Series 10 pigmented ink (6 inks: C, M, Y, K, photo K, clear)

Control Sample:



Tested Sample:



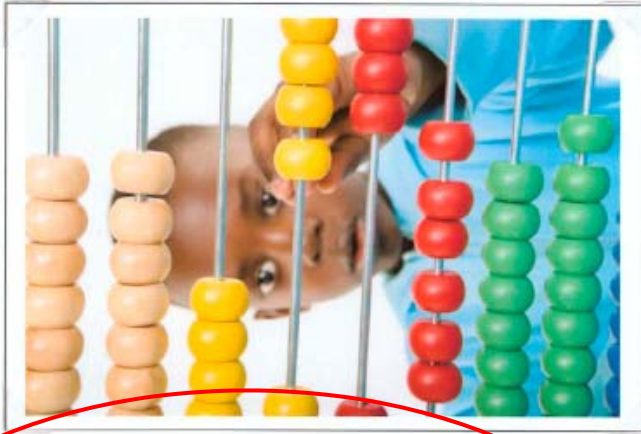
>20 Years Exposure

Exposed to ozone at 5ppm for 7.3 days (equivalent to 20 years @ 5ppb)

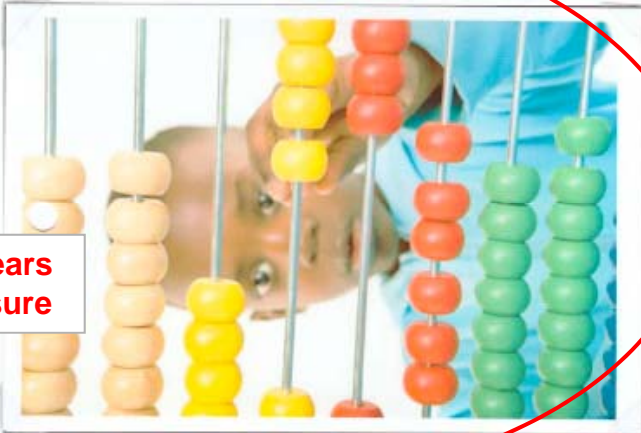
Canon Pixma MP620/560/640/980/990

Printer: Canon MP620 Photo All-in-One Printer
Ink: Canon CLI-221 dye based ink (C, M, Y, K), Canon PGI-220 pigmented ink (Black)

Control Sample:



Tested Sample:



>20 Years Exposure

Exposed to ozone at 5ppm for 7.3 days (equivalent to 20 years @ 5ppb)

* Based on independent third party print permanence ozone testing on microporous photo papers – May 2009/Dec 2010.

Print Permanence


Additional Competitive Ozone Fade Test Results*

**Lexmark Prevail Pro705 (4-ink system):
same inks are used in Impact S305**


Printer: Lexmark Prevail Pro 705
Media: Premium Glossy Photo Paper

Photo Permanence Study

Control Sample:



Tested Sample:



>20 Years Exposure

Exposed to ozone at 5ppm for 7.3 days (equivalent to 20 years @ 5ppb)

Torrey Pines Research
www.tpr.com

**HP Photosmart Plus B209A (4-ink system); same
inks used in P.S. Prem/C309/B109/B110 systems**

Printer: HP PhotoSmart Plus B209A
Media: Advanced Photo Paper

Photo Permanence Study

Control Sample:



Tested Sample:



>20 Years Exposure

Exposed to ozone at 5ppm for 7.3 days (equivalent to 20 years @ 5ppb)

Torrey Pines Research
www.tpr.com

* Based on independent third party print permanence ozone testing on microporous photo papers – May 2009/Dec 2010.

Print Permanence

Additional Competitive Ozone Fade Test Results*.


Canon Pixma MX330 (2-cartridge ink system): same inks are used in MX410

Epson Artisan 810 (6-ink system); same inks are used Artisan 700/710


Photo Permanence Study

Printer: Canon Pixma MX330
Media: Photo Paper Plus Glossy II

Control Sample:



Tested Sample:




>20 Years Exposure

Exposed to ozone at 5ppm for 7.3 days (equivalent to 20 years @ 5ppb)
Torrey Pines Research
www.tpr.com


Photo Permanence Study

Printer: Epson Artisan 810
Media: Ultra Premium Glossy

Control Sample:



Tested Sample:



>20 Years Exposure

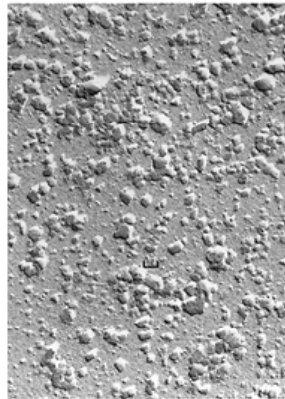
Exposed to ozone at 5ppm for 7.3 days (equivalent to 20 years @ 5ppb)
Torrey Pines Research
www.tpr.com

* Based on independent third party print permanence ozone testing on microporous photo papers – May 2009/Dec 2010.

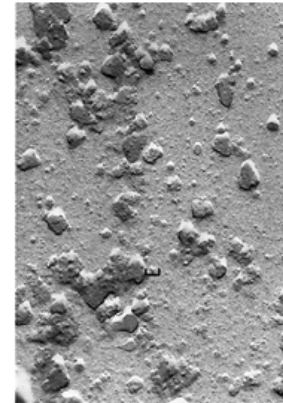
Print Permanence

Great Color & Black with Nano-Particulate Pigmented Inks

As particle size decreases,
light absorption
and color strength
increases!

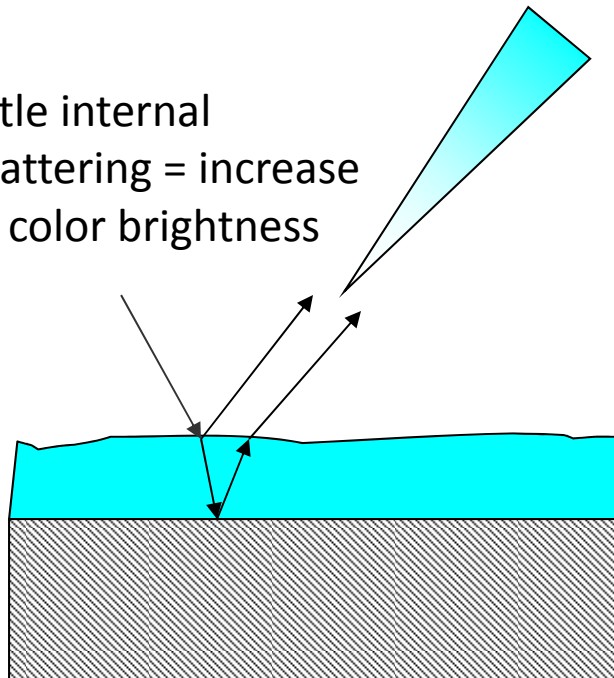


**KODAK AiO
Pigment Ink**

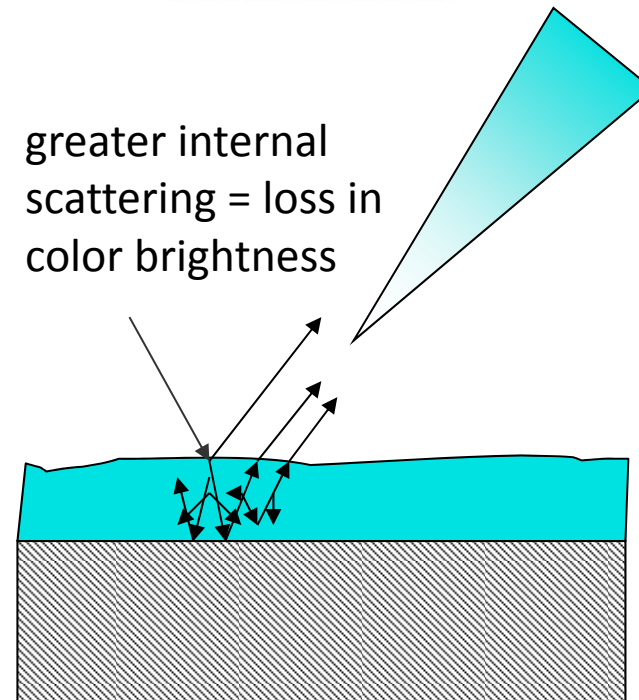


**Conventional
Pigment Inks**

little internal
scattering = increase
in color brightness



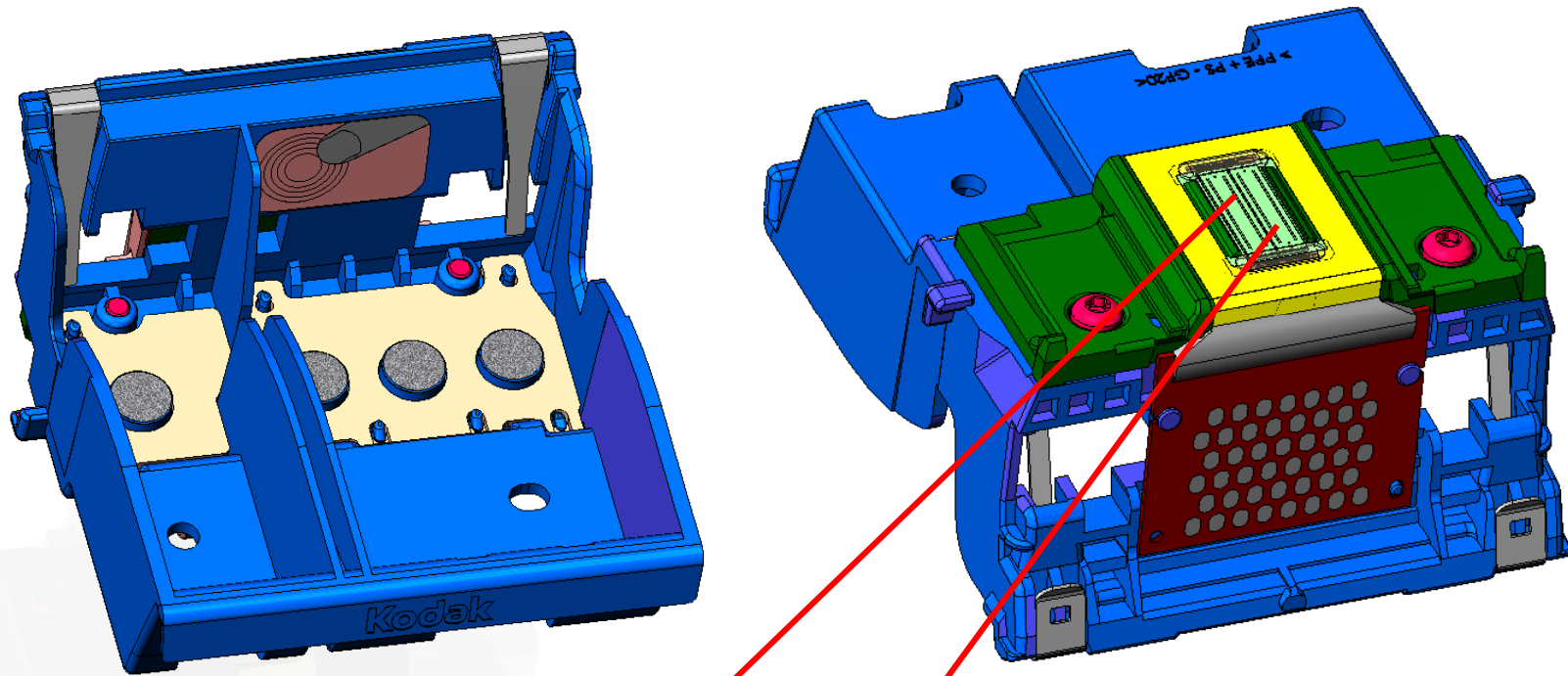
greater internal
scattering = loss in
color brightness



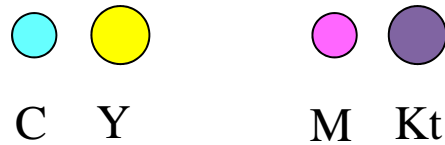
Kodak #30 Ink Series Writing System*



Dual Drop Volumes 6,5 pL
 2,7 pL



2560 nozzles total (640 nozzles x 4 inks); Dual Drop Volumes

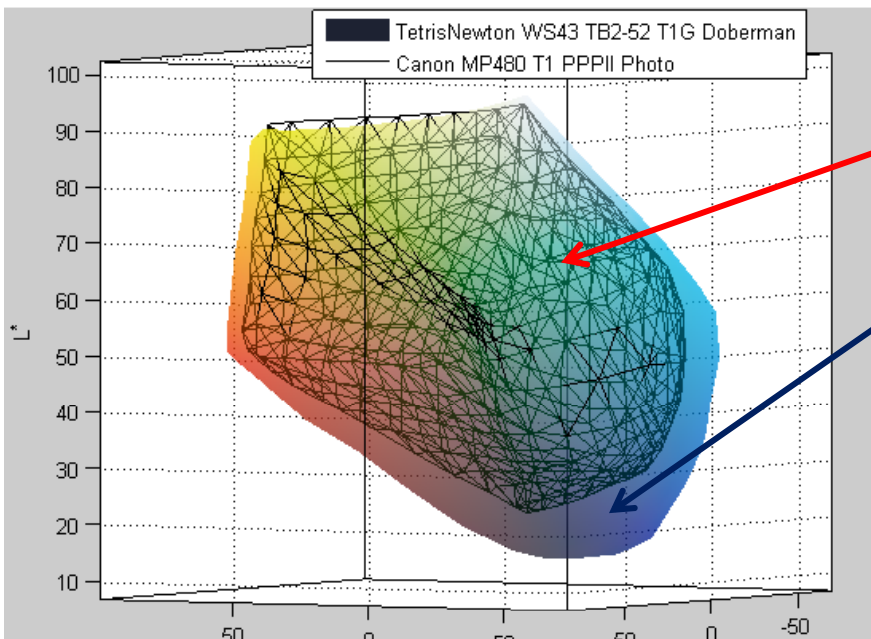


* ESP C110, ESP C310, ESP C315,
 ESP Office 2150/2170, ESP 1.2, 3.2,
 Hero 3.1 & 5.1, Hero 4.2

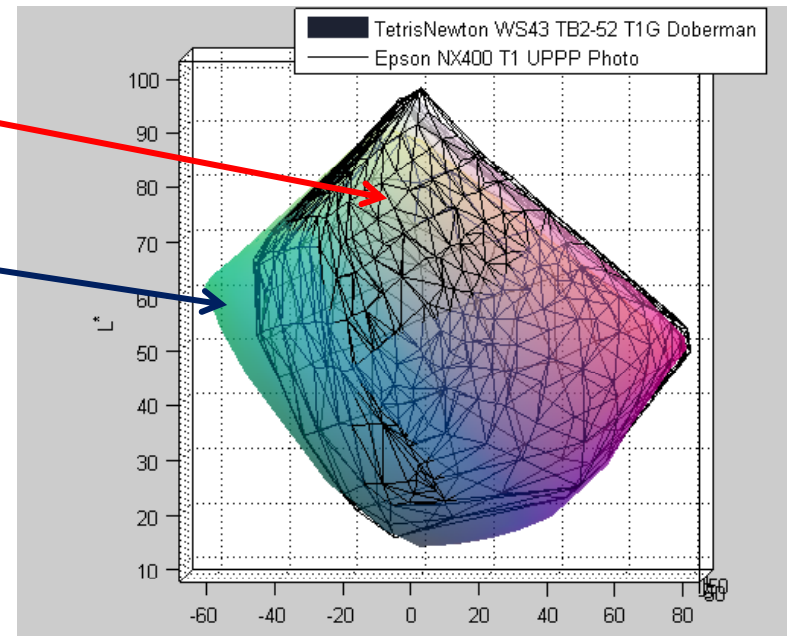
Wider Color Gamut vs Competitors

- Tetris (#30) 4-color Writing System has a **wider photo color gamut** vs. leading OEM ganged cartridge (CMY) printer models. Testing included the ESP C310, C110, ESP Office 2170 and Hero 3.1 printer models.
- Tier 1 (Kodak Ultra Premium Photo Glossy and Tier 3 (Kodak Photo Paper Glossy) Glossy Photo Papers
- Competitive OEM printer models evaluated (Native T1 and T3 Photo Media):
 - Canon MP480
 - Epson NX400
 - HP C4480

T1 Photo Glossy: Tetris vs Canon MP480



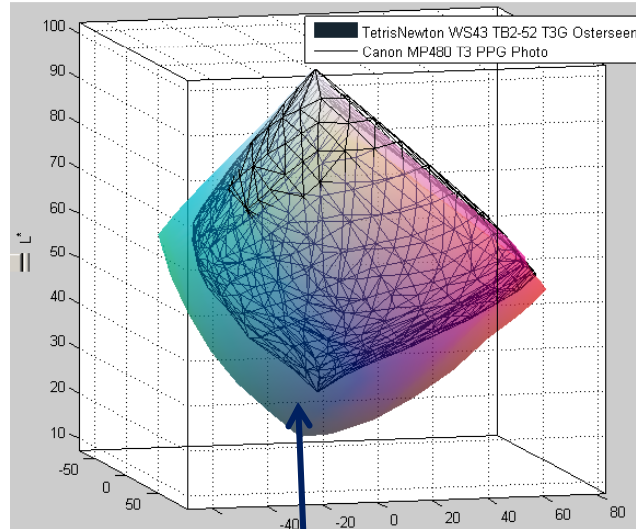
T1 Photo Glossy: Tetris vs Epson NX400



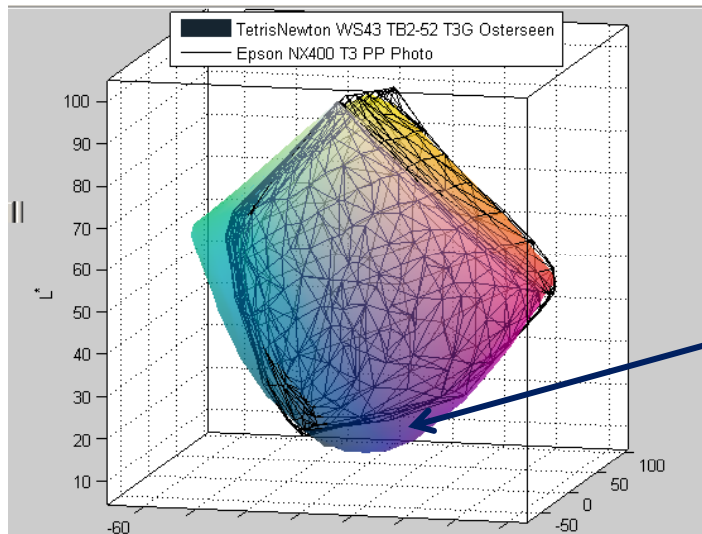
NOTE: for Assessing Color Gamut 3D Plots: Solid volume is Tetris and Wire volume is competitor.
Key comparison is black point (low L^*), especially on T3. Tricky to get great black with the three colors (CMY)

Wider Color Gamut vs Competitors_2

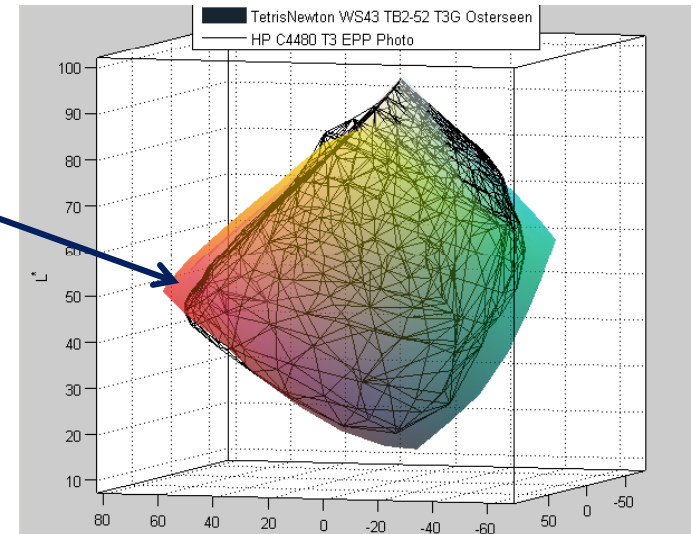
T3 Photo Glossy: Tetris vs Canon MP480



T3 Photo Glossy: Tetris vs Epson NX400



T3 Photo Glossy: Tetris vs HP C4480

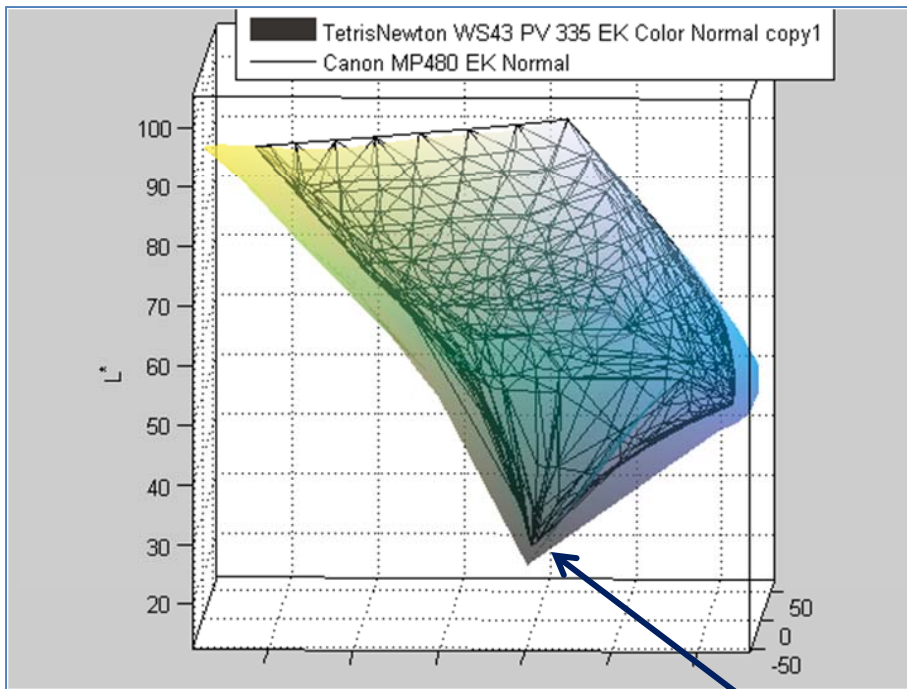


Kodak

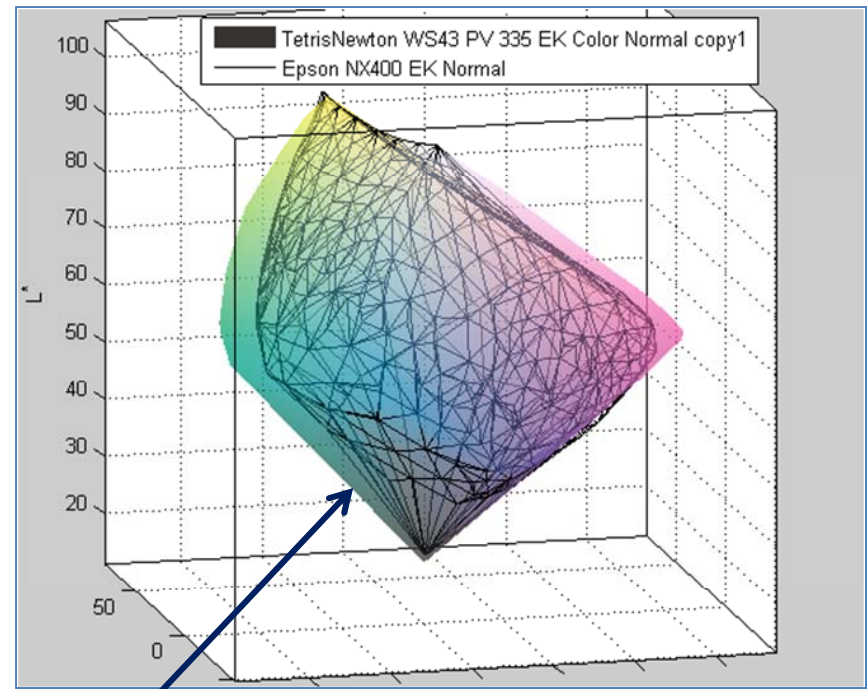
49 **NOTE:** for Assessing Color Gamut 3D Plots: Solid volume is Tetris and Wire volume is competitor. Key comparison is black point (low L*) esp T3. Tricky to get great black with the three colors (CMY)

Wider Color Gamut vs Competitors_3

Kodak Ultimate 24lb Plain Paper Color
Normal Print Mode: Tetris vs Canon MP480



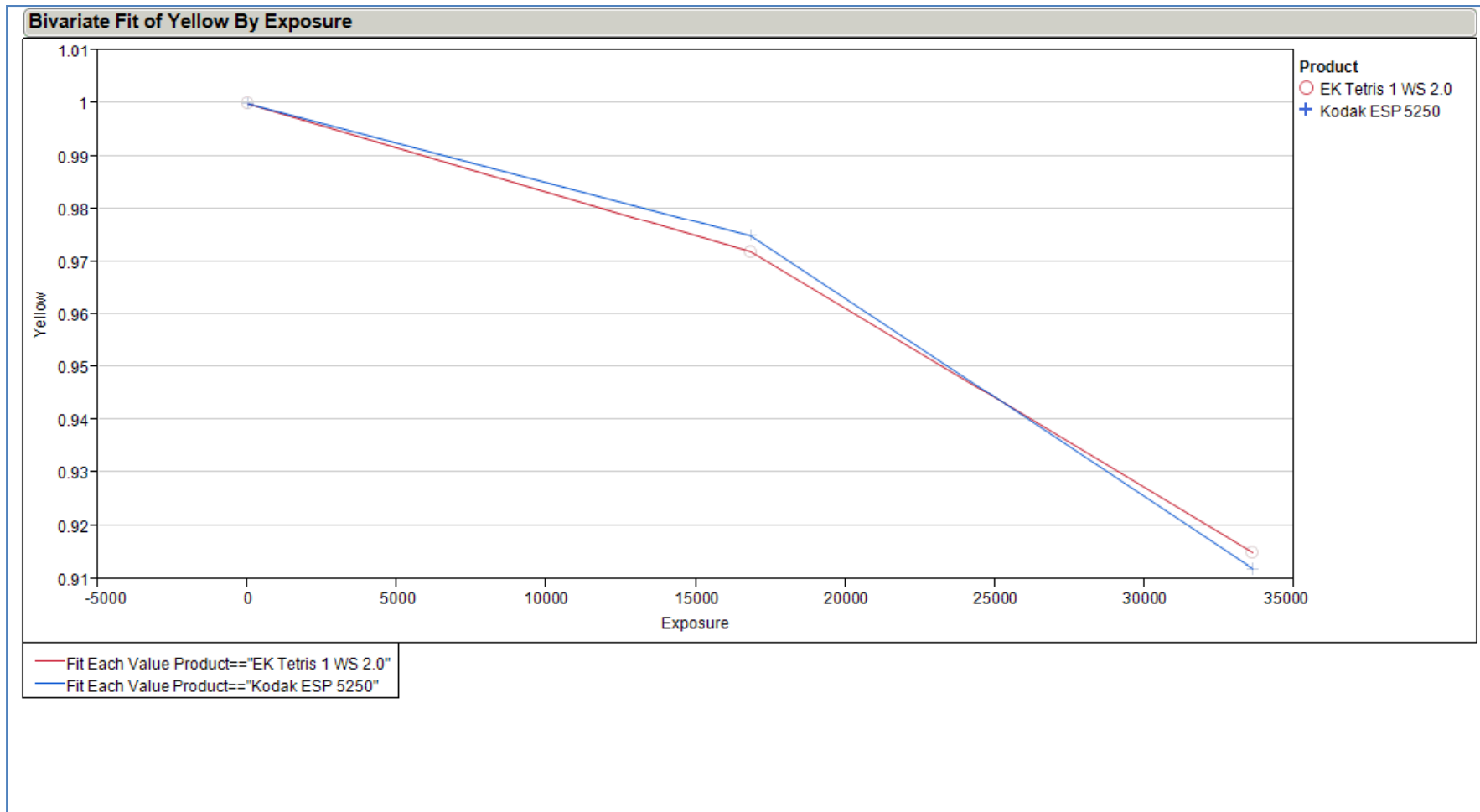
Kodak Ultimate 24lb Plain Paper Color
Normal Print Mode: Tetris vs Epson NX400



Kodak

Yellow Ink: 30 Series vs. 10 Series

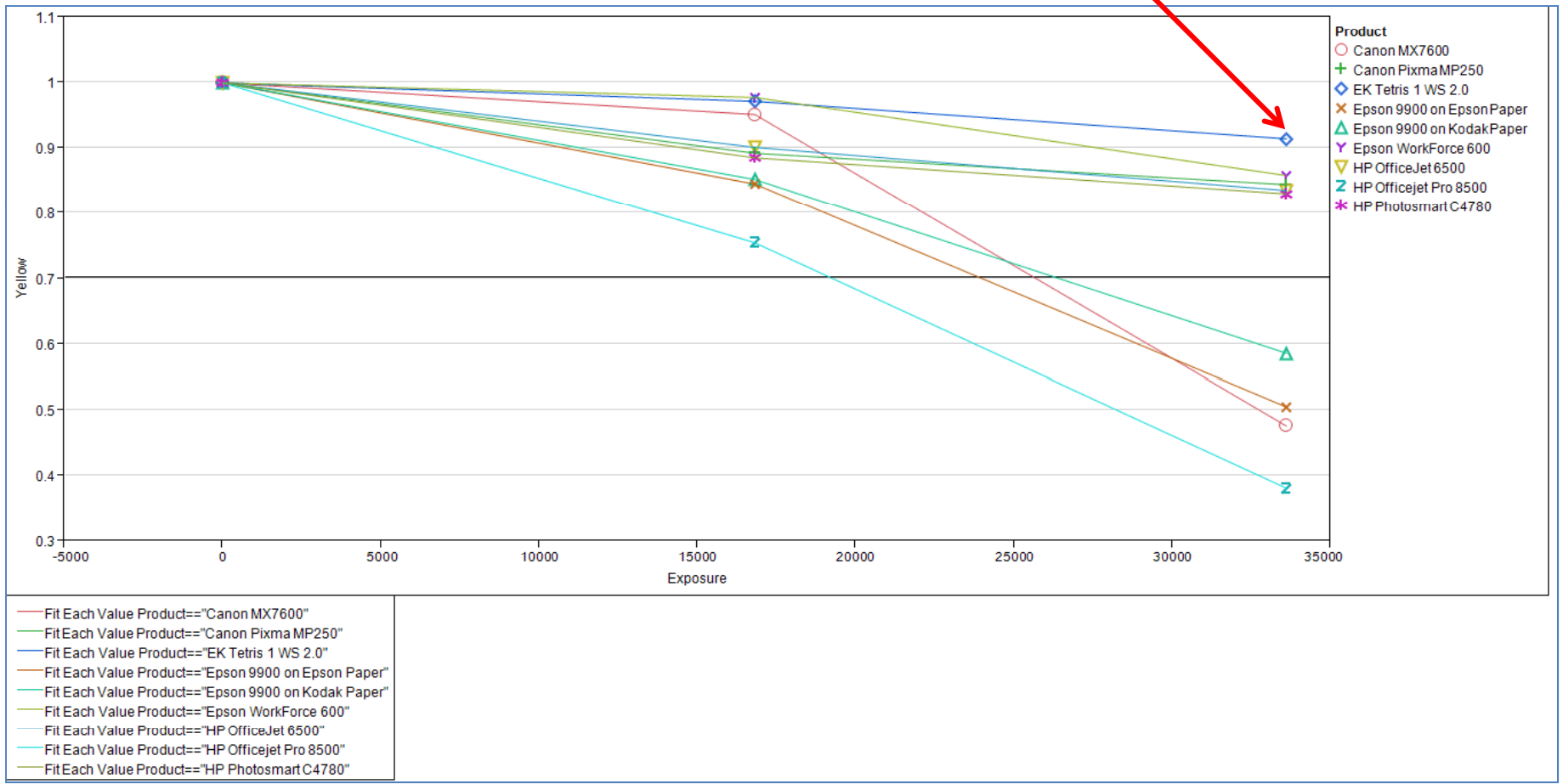
- Comparison of 30 series vs. 10 series (i.e. ESP 5250) yellow ink performance; both ink series platforms perform similarly.



* Using "normal" 6 fade test target. HID testing uses Xenon light and not fluorescent - the fade rate is much faster. Some products that are relatively insensitive to fluorescent light will fade much faster in Xenon light (i.e. higher UV level).

Yellow Ink – Better Performance vs. Competitors

- Comparison of 30 series vs. competitors; Kodak has best yellow ink performance*.



* Using "normal" 6 fade test target. HID testing uses Xenon light and not fluorescent - the fade rate is much faster. Some products that are relatively insensitive to fluorescent light will fade much faster in Xenon light (i.e. higher UV level).

Q & A